

RESEARCH ARTICLE

Effect of abacus training on maths anxiety

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ABSTRACT


Background: Mathematics anxiety is a feeling of tension and anxiety that interferes with the “manipulation of mathematical problems” in varied situations of our daily life. Beyond a certain degree, anxiety hinders performance, particularly in the case of higher mental activities and conceptual process. Studies suggest that maths anxiety affects math abilities and some aspects of memory and abacus trained experts performed significantly better on tests of calculation speed and accuracy. **Aims and Objectives:** To study the effect of abacus training on maths anxiety. **Materials and Methods:** Data were collected from 60 primary school students (30 abacus trained and 30 untrained) using maths anxiety rating scale-India. **Results:** The mean values of maths anxiety scores among abacus-trained students were 107.06 and those without abacus training were 116.21 which are statistically significant. **Conclusion:** Since maths anxiety is known to affect maths performance, there is a need to recognize the positive effects of abacus training on school mathematics learning as well as broader aspects of children’s development.

KEY WORDS: Maths Anxiety; Abacus; Maths Anxiety Rating Scale-India; Primary School Students

INTRODUCTION

Mathematics anxiety is a feeling of tension and anxiety that interferes with the “manipulation of mathematical problems” in varied situations of our daily life. Often, students who are anxious and fearful toward maths or who do not comprehend the importance of maths in professional and personal life are likely to avoid the study of mathematics.^[1] Individuals with high maths anxiety demonstrated smaller working memory spans, especially when assessed with a computation-based span task.^[2] Although moderate amount of anxiety may

actually facilitate performance, beyond a certain degree, however, anxiety hinders performance, particularly in the case of higher mental activities and conceptual process.^[3] Today’s job market increasingly relies on a technically trained workforce with almost 75% of the jobs in the future requiring computer use which demands mathematical competence. If the student lacks the necessary mathematical background to pursue these technical careers, their career choices will be limited in the future.^[4] When relationship between maths anxiety levels and mathematics achievements among students were tested, students who were high achievers had lower levels of anxiety, while low achieving math students had high levels of anxiety. Probable reason could be a strong understanding of mathematics and more confidence among high achievers. Although several studies suggest the effect of maths anxiety on maths performance researchers confirm the bidirectional relationship between maths anxiety and mathematics performance (the Reciprocal Theory), in which maths anxiety and mathematics performance can influence one another in a vicious cycle.^[5]

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Abacus is a unique traditional arithmetic tool that has been used in Asian countries such as Korea, Japan, China, and India since 1200 AD. Arithmetic calculations are performed by altering the configurations of beads that represent numbers.^[6] Around the world, abacus has been used in preschools and elementary schools as an aid in teaching the numeral system and arithmetic. Mental abacus (MA) is a system for performing rapid and precise arithmetic by manipulating a mental representation of an abacus, a physical calculation device.^[7] Initially, children learn to calculate on a real abacus, with both hands simultaneously. Later, when they are getting familiar with the operation, they are instructed to simulate the abacus-calculation process in their minds with actual finger movements in the air. Finally, they can calculate through the imaginary abacus without moving fingers, as if manipulating a “MA.”^[8] Abacus training can induce significant changes in brain functioning and behavioral performance. One consequence of training is changing the pattern of brain activation. Abacus training is of interest because abacus experts gain the ability to handle digits with unusual speed and accuracy.^[9] Several studies have reported improvements in the arithmetic ability of subjects trained to use an abacus. For instance, Hatano and Osawa reported that abacus trained experts performed significantly better on tests of calculation speed and accuracy and had longer digit span compared with those who were not so trained.^[10] In terms of cognitive functions, the findings of Chen demonstrated that MA training may improve basic cognitive capacities and possess utility for learning and education.^[11] Furthermore, studies have shown that math abilities play an important role in one’s academic success, career aspirations judgment, and decision-making. Thus, individual difference in early math abilities is especially important because of its effect on later math development. Therefore, a majority of studies have been dedicated to investigating the potential factors accounting for children’s math abilities. Since studies suggest that maths anxiety negatively affects math abilities and some aspects of memory^[1,12] and abacus training is known to improve math abilities and skills, the present study is an attempt to know the effect of abacus training on maths anxiety.

MATERIALS AND METHODS

The study was conducted on 60 primary school students (30 abacus trained and 30 non-abacus) of mean age group 8–9 years enrolled at Delhi Public School (DPS), East campus, Bangalore. The study was conducted after obtaining permission from the principal of the concerned school. Students with a history of mental illness, emotional disturbances, internalizing/externalizing disorders, and specific learning disabilities were excluded from the study. Data were collected with the help of maths anxiety rating scale-India (MARS-I). This questionnaire was developed by Karimi (2008); which contains 31 items of situations which causes mathematics anxiety. It has two subscales - math test

anxiety containing 15 items and numerical tasks containing 16 items. Each item of this scale is rated on a five-point scale ranging from very much anxious (5 points) to not at all anxious (1 point). Psychometric properties of this scale were computed by researchers. The correlation between scores on MARS-I and MARS (Richardson and Suinn 1972) was 0.87. 2-week test-retest reliability of the scale was 0.85 and internal consistency alpha-coefficient was computed 0.88.^[13]

Statistical Analysis

Descriptive statistics were used to find the distribution of the sample and were expressed as percentage. Unpaired Student’s *t*-test was used to compare the means of the two groups.

RESULTS

The observations of the present study were recorded in Table 1 and Figure 1.

DISCUSSION

Good academic performance is very important not only to students and their parents but also to institutions. The quality of student’s academic performance is influenced by wide range of environmental factors and psychological factors within the learners such as motivation and the self. The test anxiety and mathematics anxiety are increasingly being seen as factors underpinning levels of motivation for academic performance.^[14] The human brain has an enormous capacity to adapt to a broad

Table 1: Maths anxiety scores among abacus and non-abacus students

Parameter	Mean±SD		P value
	Abacus	Non-abacus	
Maths anxiety scores	107.06±24.90	116.21±13.98	0.04*

*Significant

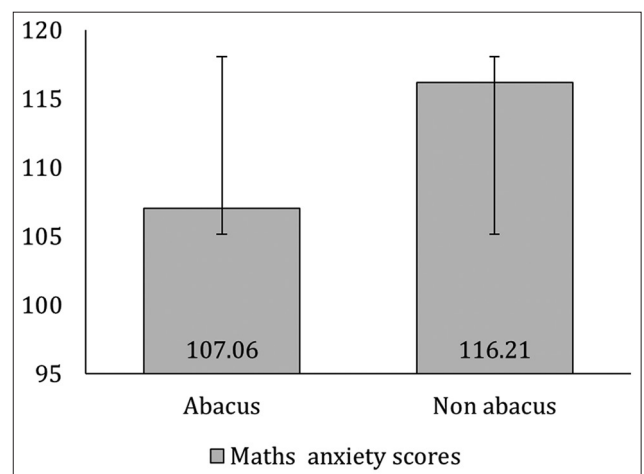


Figure 1: Maths anxiety scores among abacus and non-abacus students

variety of environmental demands. The brain is the source of behavior but is in turn modified by the behaviors it produces such as when acquiring and practicing particular skills.^[15]

The results of the study revealed significant relationship between mathematics anxiety and abacus training. It is observed that trained abacus students had lesser mathematics anxiety compared to students who were not trained. These results are consistent with the finding of Wang *et al.* which reported that abacus-trained children performed better than their peers on math abilities in arithmetical and visual-spatial domain.^[16] Abacus-trained individuals exhibited decreased levels of anxiety as they demonstrated extraordinary ability in mental calculation and performed better in mathematics. Earlier studies suggested that abacus group showed higher average fractional anisotropy (FA) in whole-brain fiber tracts, and the regions with increased FA were found in corpus callosum, left occipitotemporal junction, and right premotor projection, suggesting enhanced integrity in white matter tracts related to motor and visuospatial processes and a visuospatial representation for digit memory.^[17,18] Maths anxiety seriously constrains performance in mathematical tasks and reduction in anxiety is consistently associated with improvement in performance. It often leads to avoidance of situations involving mathematics by those who experience it and mastery and performance approach through abacus training negatively influence math anxiety, directly and indirectly. Since mathematics anxiety is a good predictor of mathematics performance and it also seems to affect some forms of memory, reducing this kind anxiety through abacus training may lead to improvement in mathematics scores and academic performance.

Strength and Limitations of the Study

The findings of the present study are interesting enough to know the how abacus training lowers maths anxiety. However, our study included a small sample of students studying at DPS. Further studies involving a larger group may be required for detailed information regarding the advantages of abacus training.

Implications

Clinical implication of the present study is yet to be explored further. Future study should examine the relationship between duration of training and maths anxiety scores. Further studies should focus on effect of abacus training on variables such as memory quotient (using Wechsler Memory Scale), attention span, and other aspects of cognition.

CONCLUSION

The results of the present study showed that trained abacus students had significantly lesser mathematics anxiety scores

compared to students who were not trained. Since maths anxiety is known to affect maths performance, there is a need to recognize the positive effects of abacus training on school mathematics learning, and on broader aspects of children's development. Further, parents need to be educated regarding the benefits of abacus training so that their children are motivated to learn abacus as after class supplemental mathematics education.

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