

# Teaching-Learning Mathematics in the Constructivist Classroom

## A Field Experience

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### Abstract

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*Teaching mathematics to those students who do not have a strong base in mathematics is challenging. Same is the case for learning mathematics as far as the students are concerned. The present paper explains probable reasons for this issue supported with empirical evidences which are collected through multitude of sources during a three-month field visit at Central School for Tibetans, Bylakkube, Karnataka. Past performance in mathematics of tenth standard students and the opinion of teacher concerned about student's performance in mathematics were taken as a background for undertaking a small action research. The study combined both quantitative and qualitative research techniques for collecting and interpreting data. Triangulation methodology was incorporated for drawing appropriate conclusions. Findings reveal that poor performance in maths can be explained by correlates like students' mathematical base, attitude towards mathematics, study habits and parental involvement.*

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### Introduction

Mathematics is generally considered one of the most important subjects at school level all over the world. All the major commissions and committee reports on education since Independence rightly

emphasised the importance of mathematical knowledge and its utilitarian values. In spite of all these reports and recommendations, many students struggle with mathematics and become disaffected as they constantly bump into obstacles to

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engagement. It is a fact that, amongst the subjects taught in schools, mathematics is considered one of the toughest subjects. But reason for this might be different in different situations. Many studies have been conducted in this area and researchers have come up with their recommendations as well. Still the problem of low performance in mathematics appears to plague all levels of school education. This of course is a serious issue to be tackled, possibly by teachers.

Recently the author had an experience of teaching in Central School for Tibetans (CST) Bylakuppe, Karnataka, for three months the subject of mathematics as a part of our field work. There the author got an opportunity to teach continuously two sections of tenth standard students. The very first experience the author received from the Principal and teacher concerned in Mathematics was quite challenging. They told the author that the performance of these students in mathematics was lower than their performance in other subjects but while comparing their mathematics performance with performance of students from other classes (VI, VII, VIII, and IX) they are far better. The interaction with the students during the first week of the field visit also gave the author a chance to verify those remarks made by the Principal and Mathematics teacher. Then the

author thought of finding out the various reasons for their low performance in mathematics and some strategies for improving their performance accordingly.

### **Research Questions**

Many studies and reports have come up with various reasons for low performance in mathematics. One of the important factors is teacher-related such as method of teaching, personality of teacher etc. As a classroom practitioner the author is very confident of using appropriate strategies of teaching in order to create interest among the students. Review of literature related to this problem highlights many student-related and other factors, which contribute to the academic achievement of students. From the discussion with principal, teachers and students and exposure gained through classroom observation during the first week helped the author to concentrate on some factors like attitude towards mathematics, basic knowledge in mathematics, study habits and parental involvement. But the author needed to know which factor among these significantly influences mathematics achievement. Accordingly the author decided to find answers to some of the questions like:

Which factor can best predict the mathematics achievement of these students?

What are their relative contributions for predicting mathematics achievement?

How can the author help these students to improve their mathematics achievement?

### **Review of the Literature**

Many researchers found that, the attitude of students towards study of mathematics had the highest correlation with mathematics achievement. The study conducted by Patel (1997), came up with the finding that study habits and academic achievement are positively correlated. This supports the findings of the study conducted by Panchalingappa (1993), Chauhan (2003) and Zadoo and Rana (2008). The influence of home support on Mathematics achievement was done by Pal and Nagarajan (1997) through their study on gender and mathematical mystique and found that home support along with teacher support and response to teaching influenced the perceptions and attitudes related to mathematics and all these factors interactively influenced the mathematics achievement for boys and girls. Casanova et al. (2005) concluded that variables of family environment (parental acceptance, control, involvement in ward's education and expectation of success) plays an important role in predicting academic

achievement. This supports the findings of the studies conducted by Hill & Craft (2003); Marcon (1999); Stevenson & Baker (1987).

Hadi and Al-Ommar (2009) while studying different factors contributing academic achievement, found that student level variables (prior achievement and self concept) were more important than school level factors (gender, number of students in school, and teachers' satisfaction).

In sum, research has shown that the factors like attitude towards mathematics, study habits, mathematical base and parental involvement all contribute positively to the academic achievement of students. Certain factors are more important than others in predicting academic achievement. This relative importance differs from one situation to another. How far these factors are responsible in the given context of Tibetan School with a majority of students from Tibetan refugees' families was a concern for me as a researcher and as a teacher. Hence a detailed study of their relative importance will help me to frame suitable strategies for teaching in order to help the students to improve their performance in mathematics.

### **Methodology**

Descriptive Survey Method was employed for the study.

### **Tools used**

The following tools were used for collecting relevant information.

**Study Habit Scale (SHS)**—It is a self-made tool which consists of 50 items in the form of a 5-point Likert scale. These 50 items were classified into seven components namely Concentration, Remembering, Organising time, Study technique, Taking notes, Examination, and Motivation.

**Parental Involvement Scale (PIS)**—This scale consists of 18 statements with three alternative responses namely ‘always’, ‘sometimes’ and ‘never’. This test contains items to be responded to by the students, about the assistance and support rendered by their parents for their study at home as well as school.

**Mathematics Base Test (MBT)**—This test was developed to assess the ability of students in basic mathematical ideas of number operations and number sense up to the sixth standard. This consists of 25 multiple choice items with a maximum time of 20 minutes.

**Scale of Attitude towards Mathematics (SAM)**—To assess the attitude of students towards Mathematics a scale developed by Santhamma Raju and Ancel Maria was used. It consists of 32 statements

related to mathematics with five alternative responses.

**Achievement in Mathematics**—In the present study it was considered on two different occasions. In the initial stage of the study academic achievement score was the marks scored by the students in the first formative test. The second time, the marks scored in the second Formative test were considered.

### **Site and Participants**

Central School for Tibetans (CST) Bylakuppe, Karnataka, is one of the main Senior Secondary Schools under Central Tibetan Schools Administration (CTSA), New Delhi, an autonomous organisation under the Ministry of Education, Government of India, with the primary objective of providing education to Tibetan children living in India. Like all schools in India they have a tri-lingual system of instruction—the local language, English and Hindi. Tibetan is the main language from the first Standard to fifth Standard with some English. From sixth Standard up, English is the language of instruction. Students continue to study Tibetan in secondary school and Hindi is added to their curriculum. The primary sections (Class I to V) are scattered at various areas of Bylakuppe and the main school consists of classes VI to XII.

The participants of this study were two sections of tenth Standard students with a total number of 40 students — 23 boys and 17 girls. Out of these 23 boys 3 were Indian and remaining Tibetan. All girl students were Tibetan.

### **The Plan of the Study**

The first three classes during the first week of the field visit were used for creating a rapport with the students through personal discussion and motivational talk. Their personal likes and dislikes were shared during these conversations. Attitude scale and Study Habit scale were administered subsequently. The Parental Involvement scale and Mathematics Base Test were administered at the end of the first week. The data collected through these tools was then analysed with the help of appropriate statistical techniques.

### **Statistical Techniques Used for Analysis**

The quantitative data was analysed through suitable statistical techniques, namely, Product Moment Correlation, Multiple Regression Analysis and t-test. Qualitative data was also used for cross-checking the information gathered through quantitative analysis with the help of triangulation methodology.

### **Analysis and Discussion**

To find out the influence of the selected factors on achievement in mathematics the correlation between these factors and academic achievement was calculated and is presented in Table 1.

From the above table it can be seen that all the selected variables are positively correlated with achievement in mathematics. Moreover the variables Attitude towards Mathematics and mathematics Base are statistically correlated with academic achievement at 0.01 level of significance. The correlation is statistically significant for Study Habits at 0.05 levels of significance. In the case of Parental Involvement even though the correlation is found to be positive it is not statistically significant. The above correlation matrix also shows that the relations between these predictor variables are also statistically significant except in the cases of correlation between Parental Involvement and Attitude towards Mathematics, and Parental Involvement and Mathematical Base. The positive correlation between all these variables is an indicative of the effect of all these factors on the achievement in mathematics.

Table 1  
**Correlations Matrix for 4 Predictor Variables and Achievement  
 in Mathematics**

Pearson Correlation		Achievement in Maths	Attitude toward Maths	Mathematics Base	Study Habits	Parental Involvement
	Achievement in Maths	1.000				
	Attitude toward Maths	0.543*	1.000			
	Mathematics Base	0.437*	0.414*	1.000		
	Study Habits	0.312**	0.378**	0.332**	1.000	
	Parental Involvement	0.227	0.190	0.069	0.462*	1.000

(\*) correlation is significant at the 0.01 level

(\*\*) correlation is significant at the 0.05 level

During the open discussion with students at the beginning of the field visit, they were asked how they felt about learning mathematics. Some of the opinions are hereunder:

"I am not able to understand all the formula And in class when ~~tell~~ I understand very well. But when I come home that time I ~~am~~ not able to understand where to start and I get confuse.

When we learn all the formula we face confuse of the formula. Does not want to by heart the theorem and example we face lot of confuse for doing different problems. Formula and identities is very difficult to by heart. When we learn more in maths the chapter I learn is not coming and also I am very to learn maths.

unit

Because maths is more confusing & we have to think a lot. While doing maths test, we of kind a feel like almost ~~questions are forgetting~~ all we had learnt. While doing maths, due to pressure we ~~are~~ are unable to use our thinking skill & what we had learnt. There should be ~~are~~ many formulae.

because can't think that much as it is so tough In class teaching time we understand and can write but in exam it is very tough & couldn't do it. That is the problem learn all formulae but don't know ~~how~~ when to use specially in trigonometry & quadratic polynomial.

In the class the teacher teach us and sometimes I understood but when I get home and try to do some problem the solution didn't come at all. ~~By time~~ The teacher teach very fast at last minute & I couldn't understand at all. Teaching us again & again, like if ~~I~~ I ~~get~~ understood & other students didn't & teacher teach us another method & it makes me all confuse & can't understand at all.

These remarks made by the students themselves shows how they approach mathematics. Almost 90% of the students opined in a similar fashion. This shows their attitude towards mathematics, their study habits and the problems they face due to lack of strong base in mathematics. This also supports the findings we just arrived at on the basis of the correlation analysis. The opinion of the Principal, Teachers and the marks obtained by the

students in the first formative test also supports this finding. Regarding the mathematics base, majority of students faced difficulty even in simple mathematical operations. A girl who was good in all subjects including mathematics has done a mathematical operation as part of a problem like the following —

$$113-64/113-49 = -64/-49 = 64/49 \text{ (By cancelling 113 from numerator and denominator)}$$

Another student when asked to measure the three internal angles of a triangle using protractor measured the angles like this:

$$\angle A = 68^\circ, \angle B = 139^\circ \text{ and } \angle C = 111^\circ$$

Students were able to solve math problems using four fundamental operations but they took more time in completing the computation. Therefore, these incidences draw special significance of a strong mathematical base for developing and motivating students in enhancing their mathematical knowledge. The problem faced by these students in this area, as the author observed through classroom interaction, also supports the findings of the above quantitative analysis.

Furthermore, to find the answer to the second question, the author decided to analyse the quantitative data using multiple regression analysis. The details of the regression model and the summary of the regression analysis are given below.

Since there were four predictor variables and one dependent variable, the regression model can be explained as follows:

$$Y = f(X1, X2, X3, X4)$$

Where Y: Achievement in Mathematics

X1: Attitude towards Mathematics

X2: Mathematics Base

X3: Study Habits

X4: Parental Involvement

The summary of the full regression results are given in the Table 2.

Table 2  
**Summary of the Multiple Regression Analysis**

Predictor Variables	B value	Standard Error	t value
Constant	14.387	2.034	7.07*
Attitude towards Mathematics	3.923	1.021	3.842*
Mathematics Base	1.321	0.531	2.488**
Study Habits	0.236	0.126	1.873
Parental Involvement	0.027	0.078	0.346

(\*) significant at the 0.01 level

(\*\*) significant at the 0.05 level

Regression Equation is

$$Y = 14.387 + 3.923X1 + 1.321X2 + 0.236X3 + 0.027X4$$

Regression model obtained clearly indicates that all the predictor variables has positive influence on the dependent variable, i.e., achievement in mathematics. It gives the relative influence of the variables also. The greater B value (3.923) obtained for the variable Attitude Towards Mathematics shows that out of these four predictor variables, the contribution of Attitude Towards Mathematics is relatively more. In other words, positive attitude towards mathematics will influence achievement in mathematics. The corresponding t value of 3.842 is



statistically significant at 0.01 level of significance. Hence it can be concluded that attitude toward mathematics has a significantly higher influence on achievement in mathematics. The next higher B value is for Mathematics Base (1.321), which indicates that for this particular group of students the second most influential factor for achievement is Mathematics Base. The corresponding t-value is also statistically significant at 0.05 level of significance. The next influencing factor is Study Habit and the least influential is Parental Involvement.

### **Actions Taken**

From the correlation matrix given above in Table 1, we found that Attitude towards Mathematics is significantly correlated with Mathematical Base and Study Habits. This shows that their combined effect on Mathematics achievement will be very significant. This indicates that if the teacher can employ some strategies to improve their mathematical base for helping them to solve different problems confidently, then automatically their attitude towards mathematics also will change positively. Similarly a strategy for developing a positive attitude towards mathematics in turn will influence their study habits also.

Based on these observations the author decided to use different

strategies that could be helpful for developing positive attitude towards mathematics, improving their mathematical foundations and forming suitable study habits. Some of the activities the author incorporated during the three-month field visits are briefed below.

### **Shortcut methods in Mathematics**

A shortcut method of solving mathematical problems using Vedic mathematics was practised for one period every week. This activity not only helped them to improve their base in fundamental operations but also helped to develop a positive attitude towards mathematics.

### **Co-operative group work**

This was used invariably on many occasions during the classroom teaching process. This helped me to create interest among the students, which in turns helped to develop positive attitude as well as a good study habit. The following example illustrates how this strategy has been used in the classroom while teaching the concept *basic proportionality theorem*.

A brief introduction was given. Students were divided into four groups and one among each group was selected as leader. Each group was asked to cut different types of triangles from chart paper (at least five different types) and told them to

give names like ABC, PQR etc. They were asked to draw a line (with suitable name) parallel to any one side of the triangle by touching its other two sides.

In the next stage they were asked to measure the length of the intercept made by the line with the other two sides and they were asked to prepare a chart which is given below:

<i>Triangle</i>	<i>Length of Intercept made at 1st side</i>	<i>Length of Intercept made at 2nd side</i>	<i>Ratio of Intercept made at 1st side</i>	<i>Ratio of Intercept made at 2nd side</i>	<i>Relationship between the ratios</i>
$\Delta$ ABC					
$\Delta$ PQR					

In the next step all leaders were asked to sit together and discuss their findings. They were able to generalise the conclusion.

After this discussion they were again asked to sit in the original group and leaders were asked to convey the conclusion they derived to the other group members.

### **Involvement of Students in Assessment**

Peer Assessment and Self Assessment as a mechanism for improving learning has been used in the classroom. This strategy helped them to assess themselves as well as their peers. The continuous feedback

they received encouraged them to learn more.

In order to know how far the author was successful in his attempt to improve the performance of these students in mathematics, a comparative analysis was done by using the marks of second formative test, which was conducted in the second week of September with that

of first formative test. The detail of the analysis is given below:

Table 3  
**Mean, SD and t-value of Mathematics achievement score in FA1 and FA2**

<i>Test</i>	<i>Number</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>t-value</i>
FA 1	40	23.26	6.12	3.17*
FA 2	40	27.35	5.33	

\* Significant at 0.01 level

The above table shows the mean marks obtained in two tests namely FA 1 and FA 2. The mean difference of 4.09 is indicative of improvement in the performance in mathematics. The significant t-value also shows

that this difference in performance is statistically significant. But this result alone cannot be considered as a claim for the success of my strategies. The opinion the author received from the students about the classroom transaction and their attitudinal change towards mathematics also indicates that the strategies incorporated in the classroom were successful.

### **Conclusion**

The study attempted to find out some of the major predictor variables for achievement in mathematics for a sample which mainly consisted of Tibetan students. It is evident from the finding that the better the student's attitude towards Mathematics, greater is the Mathematics achievement score. Similarly higher level in mathematical base gives better result in

achievement. It was also found that attitude towards mathematics is positively and significantly correlated with mathematics base. Even though it is an action type research which comprises only 40 students of one school, the findings have wide implications. If the teacher can use an appropriate strategy to develop a positive attitude towards mathematics, students will automatically start studying maths. Another crucial dimension to be addressed is regarding the foundation in maths. If the teacher can help to develop this attitude from the primary classes onwards, this problem will never arise. Otherwise, the mathematics teacher should spend at least one class per week (or free time) for improving their basic mathematics skills using various shortcut methods as well as puzzles.

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