

**STUDY ON MATHEMATICAL ACHIEVEMENT USING THE CLIMBING LEARNING  
METHOD IN KENYAN SECONDARY SCHOOL**

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**Introduction**

Many African countries envision being industrialized by the year 2020 and Kenya is no exception. However, looking at the performance of mathematics and science subjects at secondary education level in Kenya, the vision to be industrialised is in doubt because the performance by the students in these subjects has been very poor. Improving the performance of Mathematics and Science education is a great societal need in Kenya not only for industrialization of the country but also for producing scientifically empowered citizens.

Research by one the key stakeholders in secondary education in Kenya, the **Strengthening of Mathematics and Science in Secondary Education (SMASSE)** project in 1998 has shown that consistent failure and negative attitude by students, towards Mathematics, continues to characterize the classroom. Based on this same research, teachers have been found to present lessons that are too much teacher-centred with the teacher as the main actor and sometimes the only actor in the classroom as students remain passive recipients. Mathematics Lessons have been found to be difficult, boring and lacking in effective teaching/learning materials. This is the practice also widely employed in Africa. The challenge thus has been how to make Mathematics more “alive”, more “real” and more “accessible. It is, therefore, strongly felt that students’ involvement during lessons must be enhanced to increase motivation, effective teaching/learning materials used and lessons should be made more interesting.

The author therefore realised that a student-centred lesson should be enhanced from two complimentary elements; (i) placing more responsibility in the hands of students, and (ii) requiring the teacher to serve as a mentor and facilitator in presenting knowledge especially to students and fellow teachers in the teaching /learning process.

The author has been a national INSET trainer in mathematics since 2000 and proceeded for further study in Japan in 2002. The paper presented here is based on the study the author undertook while in Japan but focusing on the Kenyan classroom. During her study in Japan, the author learned “Climbing Learning Method” which could be applicable and more effective in the Kenyan classroom. This brings about a pedagogic paradigm shift from teacher-centred teaching/learning practice to student-centred teaching/learning practice. The shift also aims at shifting from theoretical approach to activity focused approach.

Here, “Climbing Learning Method” is a method based on the information creation learning model which places emphasis on developing abilities while regarding the mathematics learning process as an information creation and transmission process. Knowledge must be organized

structurally and functionally. If on creating knowledge, knowledge is tightly organized structurally and functionally, one can then utilize and apply the stored knowledge in the brain. Climbing learning method therefore propagates the use a functional network by means of the structurally and functionally organizing knowledge in the students' brains. The learning elements in the teacher's brain are firmly tied structurally and functionally to each other. But learning elements within the student's brain may not be firmly tied structurally and functionally to each other and may be existing as separate entities to each other.

Climbing approach utilizes a learning structural chart referred to as concept map where the students are supposed to fill in the spaces provided, the explanation of the learning elements, the formula, the examples and self made problems and answers. In the process the students understand the content and meaning of each learning element tightly thereby extending the existing knowledge and reconstructing it. The filling in, of the concept map is assigned as homework. The other teaching learning tool is *The Table of the reason for arrow lines*. The students write the reason for the arrows, in the concept map. This activity is to enhance the students' understanding of interrelation of learning elements. The 3<sup>rd</sup> tool is *the research card* where the students write any questionable issues. These are *how*, *why* and *what* issues. By doing all these the students become more responsible in the learning process. The challenge of making mathematics more "alive" and more "real the author used Activity focused Teaching/Learning to try and overcome this. Activities here refer to minds-on and hands-on activities. This is with the understanding that increased use of senses enhances understanding and promotes retention by learners. With the use of activities, mathematics is made more real, and this arouses students' interest and curiosity as they relate mathematics to their real life experiences. The use of hands-on and minds-on activities during the teaching/learning process as applied in the research is yet another paradigm shift from theoretical , chalk and talk, talk and talk and Knowledge/ Content Based approach to Activity focused Teaching/Learning. The Kenyan Traditional Method of Teaching Mathematics implies instruction, practice and evaluation as the simple pattern of activities in the classroom.

### **Purpose**

The purpose of this study was to investigate the applicability and effectiveness of Climbing Learning Method in the Kenyan classrooms. The author compared the students' mathematics cognition and attitude before and after being exposed to the following methods of teaching and learning mathematics;

- i) 'Traditional' Method of Teaching and Learning Mathematics in Kenya
- ii) The Climbing Learning Method

### **Method**

#### **Grouping and Data collection**

At the beginning of the research, the students in the 4 classes were given a Pre-Achievement Test which was based on the previously covered topic, Logarithm and Indices. The results of the test were used to group the students with the best two classes being Group A and the other

two classes were Group B as shown in Table 1

**Table 1 the Study Sample**

	No. of Classes	No. of Students	Sex
Group A/Traditional method	2	98	Male
Group B/Climbing Learning method	2	98	Male

Concurrently, a Pre-Attitude Test questionnaire was given to all the classes to measure the students' entry behaviour in as far as their attitude towards mathematics is concerned.

After grouping, the teaching of the topic Angle Properties of a Circle in Grade 2 in secondary school followed. Group A was taught using the 'traditional' method of teaching and Group B was taught using the Climbing Learning method. At the end of the topic, a Post-Achievement Test and a Post-Attitude Test questionnaire were administered. The Post-Achievement Test had questions in three categories namely;

(i) Computational skills (ii) Procedure (iii) Relation or Knowledge application questions. Comparison between the two groups was measured using Pre- and Post Achievement Tests and Pre- and Post-Attitude Tests.

## **Results and Discussion**

### **Discussion and Analysis of Achievement Tests**

The results of the Pre and Post Achievement Test are as shown below;

**Table 2 Comparison of the Pre- and Post-Achievement Test**

	Post-Achievement Test	Pre-Achievement Test	Difference
Group A	52.8	51.2	1.6
Group B	78.2	37.0	41.2

The performance for Group B improved a lot after learning using Climbing Learning Method (41.2% increase) even though it had the poor classes. That of Group A whose students learnt using Traditional Method which mainly emphasis on the computational skills, did not improve much. Therefore the Climbing Learning Method is highly effective for raising Cognitive ability than 'Traditional' Method of teaching and learning mathematics in Kenya.

The differences in performance for the two groups in different categories of questions are very diverse. In computational skills (maximum score 35), Group A has an average of 25.0 and Group B has 28.2 with a difference of 3.2. In procedure (maximum score 30) Group A has an average of 14.7 and Group B has 22.9 thus a difference of 8.2. In Relation (maximum score 35) Group A got 13.1 while Group B got 26.9 a difference of 13.8. Therefore the Climbing Learning Method which was used by Group B can be said to be much more effective on Procedure and Relation than the method used by Group A. With a proper understanding in these two categories improves the computational skills as reflected in the results.

From the results it is quite clear that students in Group B were able to relate questions to

concepts more than in Group A .This is very useful as they do their studies, revision etc. Therefore Climbing Learning Method proved to be more effective in developing this ability than the ‘Traditional’ method of learning in Kenya and especially for the Low Ability students.

**Discussion and Analysis of Attitude Tests**

A comparison of the Groups’ Pre and Post-Attitude Test Results are as shown below;

**Table 3 The results of Attitude test for Groups A and B**

	Pre-Attitude Test	Post-Attitude Test	Difference
Group A	3.66	3.58	-0.08
Group B	3.81	3.98	+0.17

From the results, the attitude of Group B increased positively while that of Group A increased negatively when Pre and Post Attitude Test Results are compared.

7 items out of 25 had a positive increment in Group A, while 23 out of 25 test items increased positively in Group B.

**Paired-Sample t Test**

This was used to compare the means of Pre and Post tests for both Groups A and B and see if the average difference is significantly different from zero.

**Group A;** There was a statistically significant decrease in attitude in mathematics from a Pre-test (M=3.66, SD =0.63) to Post Test (M=3.58, SD = 0.55)  $t = 2.36$   $df =24$  significance value (alpha) = 0.026.The Eta squared statistic (0.19) indicated a large negative effect size.

**Group B;** There was a statistically significant increase in attitude towards mathematics from Pre test ( M=3.81, SD = 0.56 ) Post test ( M=3.98, SD = 0.55 )  $t = -9.23$

$df =24$  significance value (alpha ) = 0. The Eta squared statistic (0.78) indicated a large positive effect size.

**Correlation**

The relationship between Achievement Test scores and Attitude Test scores was investigated using the Pearson product moment correlation coefficient. Results of the value of Pearson correlation (r) are as follows;

Group B’s relationship improved positively though still weak with Pre Tests ( $r=0.222$ ) and Post Tests(  $r=0.332$ ). For Group A, the strength was rather reduced with Pre Tests ( $r= 0.314$ ) and Post Tests( $r=0.294$ ).

**Use of mathematical language**

From the results of the test given, the students in Group B used mathematical language more effectively than students in Group A did in answering the questions. There were fewer misconceptions and misuse of mathematical language. Therefore, Climbing Learning Method can be useful for effective mathematical communication, use of mathematical language and elimination and remedy of misconceptions.

**Conclusion and recommendations**

The author concludes that the Climbing Learning Method can be applicable in Kenyan

classrooms and recommends the followings;

- 1) Since the results of this study show a great improvement in students' Cognition and Attitude towards mathematics with the Climbing Learning Method author recommends that Kenyan teachers implement this method in the classroom as an alternative teaching method that will assist learners in;
  - a) Achieving higher cognition
  - b) Instilling the right attitudes to students thus having an increased student interest confidence and enthusiasm towards learning mathematics.
- 2) In the study, a topic in Geometry was used. It is suggested that further research is conducted in the other branches of mathematics as offered in Kenya.
- 3) To expose Kenyan mathematics teachers to this method during In-Service Training courses
- 4) Diversify future study on difficulties experienced by teachers and learners in teaching and learning mathematics using Climbing Learning Method
- 5) Diversify the future study on the relationship between Creativity and Climbing Learning Method in the Kenyan classrooms.

The author now believes that a pedagogic paradigm shift from traditional method to Climbing Learning Method in the classrooms will enhance students' capacity in cognition, application, logical thinking and positive attitude resulting to effective classroom practices in Kenya.

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