

# Teaching Methodologies to Implement Effective Student-Centered Learning in Mathematics

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**Abstract** - There are many debates going on regarding the current education system and the standardized testing method. I agree that the current Standardized Testing system only judges a fish by its ability to climb the tree. Most of the time the learner is being pushed to study; they are not being pulled into learning by the education system. Education systems in the past have generally focused their attention on creating employees not entrepreneurs. We, as educators, dig inside students and expect them to perform well in the subjects offered by the school curriculum but seldom do we try to identify or discover the special talent buried deep inside each one of them and help nurture them to develop and grow in their own specialization. Student Centered Learning is not just about the teacher being in the class and delivering the subject. It is about deploying various teaching methods to make the learners understand the concept and evaluate them based on their unique outcomes. In order to enhance the learners' interest to learn and make them self-reliant in the learning process, it is important to include real-time examples for them to understand the concepts and solve problems based on their understanding. [1]

**Keywords** – Learning Time, Teaching Methodologies.

## I. PROBLEM STATEMENT

Sir Ken Robinson quips: “Do schools kill creativity?” [2] while Sugata Mitra states: “Students can teach themselves” [3]. In my view they both are right because learners are bored inside a classroom but they are active in non-academic activities and most often they share information and teach others what they know. 0; the second goal is employment. The present education system is designed in a way that people spend about 20 years their time for acquiring knowledge and skills that they use at work for rest of their lives in order to generate an income. [4] So, they are forcibly kept inside four walls and fed with theories on all subjects – starting from ‘falling of an apple’ to rising of Apple Inc. This methodology does not induce the learners' thinking capability rather only it enables the memorizing capability of the learners. In today's world it is understood that mathematics is a difficult subject to understand [5] and there are no real-time examples that can make the learner to relate to and understand the concept so it is inevitable to memorize the formulas and apply the variables to generate the expected result. So, the existing method of teaching mathematics fails to make the learner understand how the formula is being derived and what variables are to be applied in the formula. Due to this, students are able to find solutions for only a few ‘standard’ problems applying the formula and they find difficult when there is variance in the formula or variable. [6]

## II. SCENARIO I: LEARNING TIME, SPEED AND DISTANCE

Time, speed and distance are the topics under calculus which is part of daily human life. These metrics are measured when something travels from one place to another. Calculus is the mathematical study of continuous change [7].

### A. Formula Variance

1. If time and distance is given, then speed needs to be found
2. If time and speed is given, then distance needs to be found
3. If distance and speed is given, then time needs to be found

### B. Teaching Methodology: Field Trip

Learners are expected to go through real life situations to observe the concept, collect relevant data and apply the data to appropriate formula to drive the result [8].

### C. Pre-knowledge

Conversion of minutes to hours and vice versa

Conversion of meters to kilometers and vice versa



**D. Implementation Steps**

- Arrange a day for fieldtrip by bus
- Install speedometer app in all learners’ mobiles
- Explain the concept of calculus
- Give to the learners the table shown below and ask them to fill the data obtained during their journey.

**Table 2.1: Time, Distance and Speed**

Interval	Time	Distance	Speed = ?
1			
2			
3			
4			
5			

Note: Every learner will be asked to fill the data with different time and distance

- Ask the learners to find the speed of the bus using the formula

$$speed = \frac{Distance}{time}$$

**E. Sample Questions**

1. Find the speed of the bus
2. Find the difference in speed for interval 2 and 4 from above table
3. If the bus is traveling at the speed of interval 3 for 4 hours find out the distance travelled by the bus
4. If the bus is traveling at the speed of interval 5 then how many hours will it take to reach 570km

**F. Sample output**

**Table 2.2: Sample Time, Distance and Speed**

Interval	Time min	Distance Kilometer	Speed =D/T kmph
1	5	7	84
2	8	10	75
3	12	14	70
4	15	25	100
5	18	30	100

$$\begin{aligned} \text{Average Speed} &= \frac{30}{18} \times 60 \\ &= 100 \text{ kmph} \end{aligned}$$

**III. SCENARIO II: LEARNING STATISTICS**

Statistics deals with collection of data and the process of analyzing the data, organizing the data and presenting the data [9]. Statistical results are always considered to be an approximate value. In statistic, data collection is done using survey method, observational studies and experimental outcomes. Most often, in statistical class, there is no data collection done involving the students using the interactive method. Data are given in a table or taken from textbook so the learners get minimal or no experience in data collection and organizing.

**A. Teaching Methodology: Cooperative Learning**

In cooperative learning, the learners are divided in to small groups, each learner with different a level of ability. Since we have groups of people, it is easy to deploy the survey method, observational studies or experiments to collect data [10].

**B. Implementation Steps**

- Make groups of 5 learners, each with different levels of learning ability
- Explain the concept of statistics
- Give examples for sample data collection
- Ask the learners to prepare the appropriate table to collect data
- Give each group with different topics to collect data

**Table 3.1: List of Hobbies with frequency**

No.of Observation	Hobbies	Tally Mark	Frequency
1	Singing		
2	Dancing		
3	Cooking		
4	Reading Novels		
5	Playing		
<b>Total</b>			

- Ask the learners to find mean using the formula
- 

$$Mean = \frac{Sum\ of\ observations}{Number\ of\ observations}$$

**C. Sample output**

Find average number of students having same hobbies from below table

**Table 3.2: Sample list of hobbies with frequency**

No. of observations	Hobbies	Tally Mark	No. of Students
1	Singing		4
2	Dancing		2
3	Cooking		1
4	Reading Novels		3
5	Playing		4
<b>Total</b>			14

$$Mean = \frac{14}{5}$$

≈ 3 students have same hobbies

**IV. SCENARIO III: LEARNING PROBABILITY**

Probability is the occurrence of possible outcomes which relates to random experiments [11]. When teaching the concept of probability, it is assumed that the learners are already aware of the outcome of an experiment so the learners are not made to undergo the experience in the learning environment. Often, only the theory part is explained with few samples.

**A. Teaching Methodology: Experiment**

Learners are expected to carry out several experiments with the given components and write down their output and make decisions based on the experiment [12].

**B. Implementation Steps**

- Ask the learners to bring coins of different denominations or a six sided dice
- Explain the concept of probability and possible outcomes when a coin is tossed
- Explain the possible outcomes of when a card is picked from a pack after shuffling.
- Explain the possible outcomes of throwing a dice
- Give a demo to the learners about the possible outcomes when a coin is tossed
- Ask the learners to fill their findings/outcomes in the table given below:

**Table 4.1: Probability of coin and dice**

Items	Outcomes	Frequency
2 Coins	Head, Head	
	Head, Tail	
	Tail, Head	
	Tail, Tail	
<b>Total Frequency</b>		
Dice	1	
	2	
	3	
	4	
	5	
	6	
<b>Total Frequency</b>		

- Ask the learner to find the probability of getting (Head, Head), (Head, Tail or Tail, Head) or (Tail, Tail) using formula

$$Probability = \frac{Number\ of\ Possible\ Outcomes}{Total\ number\ of\ Frequency}$$

**C. Sample Questions**

1. Find the probability of getting at least one head from above table
2. Find the probability of getting at least one tail from above table
3. When a dice is rolled, find the probability of getting 4 from above table

**D. Sample Output**

**Table 4.2: Probability of 2 coins**

Items	Outcomes	Frequency
2 Coins	Head, Head	4
	Head, Tail	7
	Tail, Head	
	Tail, Tail	9
<b>Total Frequency</b>		20

Probability of getting at least one head

$$= \frac{Number\ of\ getting\ at\ least\ one\ head}{Total\ number\ of\ frequency}$$

= 11/20  
= 0.55

### V. RESULTS

Learners find it fun to learn with the experimental method and they quickly get the concept since it makes them do the experiment and write the outcome based on the experiment they carried out. Cooperative learning helps different types of learners to be in a group so the learners are able to help each other among themselves in understanding the concept and it makes everyone to actively participate. The slow learners are more open to ask and learn from their peers.

### VI. COMMENTS

It is understood that Student Centered Learning has some prerequisites such as bigger learning environment, budget for extra activities, teacher-learner cooperation, availability of technology, knowledge about available technology and sufficient time to complete the activities. It is also expressed by many educators that learners are not willing or cooperative enough to implement SCL.

Here is a table which enumerates few teaching methodologies which can be mapped with mathematics:

**Table 6.1: Teaching methodologies for mathematics**

Teaching Methodology	Mathematics Topics
Field Trip	Calculus
Cooperative Learning	Statistics
Experimental Learning or Trial and Error method	Probability
Group Discussion	Integration
Project Work	Geometry, Graph
Problem Solving	Algebra
Demonstration	Volume of Objects
Case Study	Statistics
Group Project	Statistics

### VII. CONCLUSION

Student Centered Learning is all about engaging the learner with activities of his/her interest to provide the skill and knowledge they require to learn the subject. By using various types of teaching methodologies facilitators can engage the learner to actively participate and learn the concept to apply in real world scenario.

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