January 1998

How can we make our mathematics lessons meaningful and enjoyable?

Takbir Ali
Aga Khan University, takbir.ali@aku.edu

13 How can we make our mathematics lessons meaningful and enjoyable?

Takbir Ali

In our context there is a big diversity of opinions and perspectives about mathematics and the ways or approaches involved in the teaching and learning of mathematics. Teachers, students and other people who have ever been involved in the activity of teaching or learning mathematics express different kinds of opinion when asked about the issues of teaching and learning mathematics. Some people say that mathematics is a difficult subject. Some people regard it as a dry and boring subject. On further inquiry they argue that it is boring because it is a body of knowledge of the kind that consists of abstract ideas and bunches of axioms and sets of formulae developed by a specific elite of people (mathematicians). Some people are heard to say that mathematics is a nightmare for them. There are also people who are of the view that the range of applications of mathematical knowledge is limited. Even some mathematics teachers are not quite sure about the use of algebra in everyday life. There are also, however, some people who in this regard seem optimistic and quite confident to say that mathematics is 'the queen of knowledge'.

Different people have different perceptions of mathematics; but prevailing or diverse views and perspectives among people might be the result of some experience and some incidents observed by individuals. Such experiences and incidents are usually observed in the place (classroom) where the activity of formal teaching and learning of mathematical concepts is carried out. As far as the theory or belief of mathematics being a difficult, boring and abstract subject is concerned, I do not, at the moment, tend to discard this belief because when I reflect on my own experiences, observations and memories, I find that I myself as a learner (in my studentship period) and my students have been experiencing or observing unpleasant events which included a high ratio of student failure and poor performance in examinations in mathematics and physical abuse etc. in the mathematics classroom. Does this kind of situation still exist to any degree today?

If so, then we need to find the reasons why mathematics is boring and a nightmare for our students rather than being fun and a magic toy. There might be a lot of answers to this question. But one possible answer that occurs to me is that those students who do not love mathematics might not because they are not exposed to the sort of environment where they can use their logical thinking in exploring and investigating new mathematical concepts and ideas.

The authority of the teacher and old fashioned textbooks (stating known mathematical rules, formulae and closed end questions) lead students to slavish learning. This in turn may cause demotivation and failure in terms of development of logical thinking by the students. Perhaps there are a variety of approaches and techniques with which we can help our students to develop their mathematical understanding and talent and ultimately create a love of mathematics instead of hate and frustration. During the M.Ed programme's mathematics module, I became aware of a few such teaching strategies which in my view have great potential to make our mathematics lessons more effective, meaningful and enjoyable. Let us see what those strategies are and how they work.

Games

Many mathematical concepts such as numbers and geometrical shapes can be taught through games. Games are useful in a sense that they arouse the interest of the children and also help to sustain curiosity and motivation, which are essential elements to get the learner's mind involved in the process of interaction between learner and materials/concepts. Greenland *et al.* (1989) count the following as important when using games in learning mathematics:

- Games are enjoyable and generally non-threatening. The pupil may be unaware of the learning element. They increase 'on task' activity.
- Games provide for the introduction and the reinforcement of skills and knowledge and for the diagnosis of strengths and weaknesses.
- Games can free the teacher to observe an individual or the class more readily. They support and encourage active and independent learning.
- They can permit creativity and the employment of imagination in children and create a need for mental working.
- They develop social skills, such as co-operation, sharing and taking turns. They develop language in a group setting. They promote pupil-pupil discussion. They encourage children to teach each other.

During the mathematics module we were exposed to some games activities and then we were provided with an opportunity to try them out with students. My colleagues and I practised some games activities (dice throwing, tessellation and mental subtraction) with children of the age range 9-11 years. To a great extent, I found the importance of games described above to be true. Perhaps we can experiment with the following kinds of mathematical games with our pupils to test the validity of the above mentioned statements pertaining to the importance or advantages of games in learning mathematics.

Activity 1: Dice throwing game

What we need: Two dice per group; sheet of 6 x 6 grids.
How we do it: Number 1-6 across the bottom of the 6 x 6 grid. The children take it in turns to throw the dice. An X is marked in the grid above the number thrown. The first one to get six crosses above one of the numbers wins a point. This activity can be extended to 6 x 12 and so on.

6						
5						
4						
3						
2						
1						
0	1	2	3	4	5	6

Activity 2: Shapes constructing game

Requirements: Sheets of dotted paper, in 3 by 3 dot grids; pencil
How to play: This game can be played in a paired situation or in a group, ideally 4/5. Children can be given the rules first and then the task.
Rules: You may only join from dot to dot.

Task: Taking turns, you are to draw a quadrilateral but it must be different from any previous one. You will be eliminated if you draw a similar shape or if you cannot draw one at all. The winner is the child who draws the last shape. This game can be modified, e.g. triangle.
Expected achievement: Awareness of shape, quadrilateral, triangle, social skills and maybe a small leap towards a promotion of mathematical thinking.

Besides the games, during the maths module I experimented with some other strategies and found them quite useful and beneficial. These included:

Posing a challenge to the students in the form of exploratory and investigational work

Somehow open ended questions, problems related to recognising patterns, thinking alternatives, etc. may lead to a corresponding increase in children's efforts to achieve the target.

When children are provided with an opportunity to work on open ended questions or challenging tasks, but not higher than the children's level of skill and thinking, they become involved in the activity with full concentration and use their abilities to discover the mathematical logic involved in the problem. If they are successful, the children enjoy the achievements of their efforts and consequently the learning of mathematics becomes fun for them.

During the maths module we became involved in a small scale research activity. During the research in one of the lessons we attempted to examine the theme that in the learning of mathematics, exploratory and investigation work leads children to relational understanding. We presented rather a challenging investigational task to students of the age level 13-15 years. We wanted students to find out the values of sine and cosine ratios for angles 0° to 360° and then plot a graph between angles (0° to 360°) and their respective values to obtain the sine curve. Students wrote the values and then plotted for 0° to 90° without any difficulty because the values of some standard angles (30°, 45°, 60° and 90°) were given in the table. But they were stuck when they wanted to find and plot for angles beyond 90°. At this stage students were provided with a little help. They were asked to find the value of 100° with a calculator. They obtained sin100°= 0.9848 and plotted this value on the graph. they were asked to observe the graph. The students observed the graph with keen interest and found that sin100° = sin 80°. They were probed about what logic existed there. They repeated the same procedure for another angle and after 2-3 minutes discussion they made the following conjecture:

'If we move 10° ahead after 90°, then the value of sin goes 10° back from 90°.'

Applying this conjecture, they predicted values for angles >90° (91°-360°), plotted and obtained a complete sine curve and also located positive and negative sine values in the respective quadrant of the Cartesian plane.

From the students' exploratory work and achievement we concluded that exploratory and investigational tasks led to meaningful learning.

Can we work on the following example in order to check how investigational and exploratory work helps students to build their mathematical knowledge and nurture their logical thinking?

Investigation Task

The formula for the area of a triangle is 'half the base times its height'. Can you find a similar formula for the area of a parallelogram? Show that your formula works.
This activity may help students to discover a formula for finding the area of a parallelogram. Students should desirably use their prior knowledge and mathematical thinking.

What would be the Teacher's Role? The teacher may provide the students with dotted paper and can also help them by showing them how a parallelogram can be divided up into two triangles.

Conclusion

In summary, this paper emphasises the importance of designing learning activities so that student may find them enjoyable and appropriately challenging.

References

Greenland, P. *et al.* (1989) *Using Mathematical Games* (West Sussex County Council) pp. 4, 11, 20.