

Motivating Lower Ability Students To Think: Some Classroom Activities

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Abstract

The importance of getting students to think cannot be overemphasized. This article identifies some features of classroom activities that seem to be able to motivate students to engage in higher order thinking. Several classroom activities are described. These activities had been used to motivate, in particular, weak mathematics students not only to learn mathematics, but also to engage in mathematical thinking normally associated with students who are mathematically inclined. Such activities often perceived by students as non-threatening, allow students to choose and make decisions, and are usually varied.

Background

Educational systems all over the world are placing greater emphasis on encouraging students to think creatively and critically. In particular, mathematics educators generally agree that students should develop problem solving skills. The current mathematics curriculum in Singapore, first implemented in 1992, is no exception (Ministry of Education, 1990).

In classrooms everywhere low ability students exist. These students do not perform well in mathematics for a variety of reasons. Some are specifically weak in mathematics while others are generally weak academically.

This article attempts to suggest examples of classroom tasks that could motivate weak mathematics students, not only to learn mathematics, but also to engage in mathematical thinking normally associated with good mathematics students. The first part of the article attempts to identify some features of classroom activities that seem to be able to motivate students to engage in higher order thinking. The second part includes activities that have been tried out in several mathematics classes.

Motivating Students To Acquire Higher Order Skills

Although students are generally aware of the importance and usefulness of mathematics, such awareness does not motivate students to learn the subject (Dossey, Mullis, Lindquist & Chambers, 1988). Findings from various researches have indicated that students' conception of motivation tends to be organized into three categories - interest (Hidi, 1990), arousal (Malone, 1981) and control (Lepper, 1988). These findings are congruent with the model of intrinsic motivation (Middleton, Littlefield & Lehrer, 1992). According to this model, whether students would engage in an activity depends on whether the activity matches students' idea of an interesting activity. If the activity is not previously encountered, then the degree of arousal, i.e. how well the activity can provide cognitive stimulation, and the degree of control, i.e. how much choice students have in the activity or the level of difficulty of the activity, determine students' motivation to engage themselves in the activity. Similarly, Malone and Lepper (1987) identified four characteristics of activities that motivate students. According to them, activities should appeal to the sense of curiosity, encourage students to be involved in a world of fantasy, be challenging and provide students with a sense of control. In a qualitative study, Oldfather (1991) found that students were motivated by tasks based on real life situations, relevant tasks, challenging tasks and tasks that provided students with some autonomy. A small-scale survey study among a group of Singapore teachers also indicated that relevance of learning task is an important motivating factor while a lack of variety of learning tasks, a lack of student involvement and punishments are cited as strong demotivating factors (Wong, 1994).

Mathematics activities should thus be:

- non-threatening. The use of familiar content and context suitable to students' ability is useful. Humour can also make mathematics less threatening.
- able to provide for autonomy in learning. Students should be given some opportunities to make decisions and choices and to exercise creativity.
- varied. A range of activities, including outdoor ones, that provides for individual learning styles should be experienced by students.

Some Classroom Activities**Activity 1: One Five Four****One Five Four**

Topic: Mensuration (Area)

Level: Upper Primary to Secondary

Draw shapes that have an area of 154 cm^2 .

In one Secondary One (Express) class, students were required to work in pairs for several minutes before the teacher facilitated a whole class discussion to elicit students' responses. During the initial discussion most pairs offered rectangles as possible solutions.

(S represents student, T represents teacher.)

S1: We have a set of rectangles. 1 by 154. 2 by 77. 7 by 22. 11 by 14.

T: Can your partner explain how the answers were obtained?

S2: We try one by one. We take 154 divided by 1, 2, 3, 4, 5 and so on. And we got four possible answers.

T: It is good that both of you worked in a systematic way.

S3: Could we use decimals?

T: What do the rest of the class think? [Some murmurs.] Is it possible?

S3: Yes. Like 4 times 38.5.

T: Okay. So afterwards you may want to try and get shapes with sides that are not in whole numbers. How about shapes other than rectangles? Anyone?

S4: Yes. Triangle.

T: Draw it on the board. [S4 drew a right-angled triangle with a height of 4 cm and base of 77 cm.] Does anyone else want to give one more possible triangle? No? Okay. Now continue to get more possible shapes. Take note of three things. First, do not limit yourselves to just one particular shape. Second, do not limit yourselves to just whole numbers. Third, work systematically, not randomly. Go on.

During the initial and subsequent discussions, some pairs set new directions for the other students to pursue. The teacher sometimes suggested possible direction that students might pursue. The teacher also pointed out desirable qualities demonstrated by some pairs.

This activity allows the teacher to draw upon previous knowledge of students to introduce new concepts. For example, the formula to compute the area of a particular shape was introduced only when the class as a whole was ready for the introduction.

When the discussion continued the next day, the teacher tried to find out whether the class was ready to learn the computation of area of a circle.

T: Last lesson, we had rectangles and triangles. Anyone got new shapes?

S5: Yes.

T: Draw it on the board. [S5 drew a shape on the board.] Good. This shape is made up of rectangles and a triangle. Does anyone have a shape that is not made up of rectangles and triangles? [S6 raised his hand.] Yes, Ian. Draw the shape on the board. [S6 drew a circle on the board.] How many of you have this? [Five pairs put up their hands.] Okay, now all of you try to find the radius of this circle. [About five minutes later ...] Now how many of you have answers? [Sixteen pairs put up their hands.]

The teacher then went on to find out from several pairs what their answers were. He then posed several what-if questions to the class using the answers he elicited from the class.

T: Alright. We have several answers on the board. Let's organise them in ascending order ... from the smallest to the largest. [He wrote 3.5, 7, 14, 24.5 and 49 on the board.] What if the radius is 3.5, could the area be

154? [Pause.] What if the radius is 7, could the area be 154? And so on. Now everyone work out the area if the radius could be these values. [Ten minutes later ...] Remember the area has to be 154. How many of you think that the radius is this? ... How many got this as the radius? ... How many got this? ...

This discussion provided clear signals to the teacher how ready the class was to learn the computation of area of circles as well as the part that seems difficult to many students.



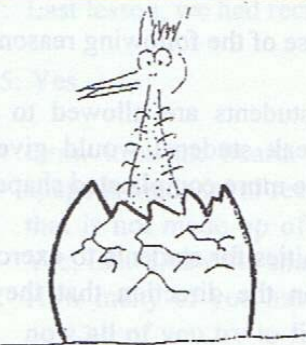
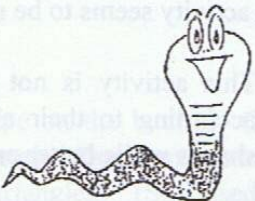
This activity provides opportunities for:

- creative problem solving.
- problem posing.
- drill-and-practice.
- the teacher to introduce the computation of a particular shape only when the students are ready.

This activity seems to be motivating because of the following reasons:

- This activity is not threatening as students are allowed to respond according to their ability level. Weak students would give simple shapes while better ones would provide more complicated shapes.
- This activity provides ample opportunities for students to exercise their autonomy. Students could decide on the direction that they would pursue in generating solutions.
- This activity allows students to progress from familiar grounds to unfamiliar ones in a gradual manner.

Activity 2: Lim Ah Ter

Lim Ah Ter	
<p>Topic: Numbers / Algebra Level: Primary to Secondary</p>	
 <p>Lim Ah Ter is a pig Farmer in Choa Chu Kang.</p>	<p>There are pigs ...</p> 
 <p>... and chickens on the farm.</p>	 <p>But there are also a few snakes disturbing the animals.</p> <p>All these animals have 46 legs and 18 heads together.</p> <p>How many snakes are there on the farm?</p>

In a Secondary One (Normal - Technical) class, this activity was given to students at the start of the year. In a Secondary Three (Normal - Academic) class, this activity was given to students after the class was taught how to solve simultaneous equations. In both cases, the students were shown the comic illustrations using an overhead projector. They were then instructed to solve the

problem in pairs in 20 minutes. The teacher then conducted a whole class discussion to share students' answers.

In the Secondary One class, students used draw-a-picture, guess-and-check and make-a-table methods. The teacher, after getting every pair to tell the class what the pair did, solved the problem while thinking aloud to demonstrate metacognitive thinking in solving non-routine problems. The class saw the teacher think of possible methods, abandon seemingly hopeless solution paths and pursue apparently hopeful ones.

In the Secondary Three class, most students used similar methods. In addition, a few pairs attempted, unsuccessfully, to use an algebraic method. The teacher conducted a similar whole-class discussion as before. In the next lesson, the teacher demonstrated the use of algebra to solve the problem.

This activity provides opportunities for:

- problem solving.
- making connections. The use of different methods to solve a problem is a good way for students to make connections.
- the teacher to build upon the knowledge that students bring into the class. After the teacher has found out what heuristics the students used, he could help them improve on the use of heuristics that the students already would use prior to formal instruction. This approach could be more meaningful than one where the teacher lists several heuristics and subsequently proceeds to show the use of these heuristics.

This activity seems to be motivating because of the following reasons:

- The activity has a humorous context. The funny context puts many students at ease. The weaker students, in particular, are less anxious and consequently could focus on the task with a clearer mind.
- The activity has a local and, hence, familiar context. This made the activity more appealing than one in a foreign context.
- The activity is in a pictorial form. Words are kept to a minimum. This is helpful to students who have reading difficulties.

- The activity allow almost everyone to start on the problem. Weaker students often begin using more primitive methods while good students usually introduce more sophisticated techniques.

Activity 3: Swimming Pool

Swimming Pool

Topic: Mensuration (Surface Area)

Level: Upper Primary to Secondary

Go to the swimming pool. Find the surface area of the pool that is touching water. Present your solution on a piece of art paper. You and your partner are provided with a measuring tape.

This activity provides opportunities for:

- making connections. This activity allows students to use mathematics in a real-life situation.
- developing abstract three dimensional visualization.

This activity seems to be motivating because of the following reasons:

- This activity involves hands-on measurements. Students seemed very enthusiastic about being actively involved in the lesson.
- This activity is concrete in nature. Students do not need to rely on their ability to visualize, something many of them would rather not do.
- This activity is novel. Few previous mathematics activities were held outdoors.

Conclusion

“The most important single attribute of the information age economy is that it represents a profound switch from energy to brain power as its driving force, and from concrete products to abstractions as its primary products. Instead of training all but a few citizens so that they will be able to function smoothly in the

mechanical systems of factories, adults must be able to think" (Zarinnia & Romberg, 1987, p.23-24). Hence in preparing our students for the workforce of the 21st century, each and every student, including the weakest ones, must develop higher order skills. This article shares some mathematics classroom activities that promote such development.

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