Enhancing Students' English Language Proficiency and Mathematical Conceptual Understanding through *Talking Mathematics*

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Introduction

The recent change of medium of instruction in the teaching of mathematics poses great challenges to both mathematics teachers and students. Mathematics by itself is a language that made up of symbols and numbers. It has its own structure and abstraction that could cause problems in understanding. Unlike most people think, mathematics may use few words to write, but it needs a lot of explanation to make students understand the concepts. For the majority of Malaysian students, English language is not their first language. Thus, this poses double hurdles: English language proficiency and mathematics understanding.

Nevertheless, the rationale behind this new policy is appropriate in view of the significant role of mathematics and English in this information and technology age. Therefore, the more urgent and pertinent needs are to find various ways and solution to meet up with this challenge. How can we help the mathematics teachers and students to improve their English language as well as to enhance their conceptual understanding of mathematics?

This paper aims to introduce an activity called "Talking mathematics" which I adapted from Baroody (1993). This activity can also be modified to become a game, to be played by two persons, or played in groups or by the whole class. Before I introduce this activity, let us discuss the relationship between language and mathematics learning, and the importance of language in mathematics teaching and learning.

Language and mathematics learning

Language is not only a tool of communication, but also as a tool for reflection and thinking. According to Vygotsky (1978), we use private speech to puzzle through ideas. It is also a way of constructing new understandings. For example, when we see a new thing, we will ask ourselves, "What is this?" We then try to figure out what is the new thing either searching through our memory or relate to our previous experience. If we still cannot recognise or explain it, we will ask for help. This 'help' can come from somebody else such as teachers, parents, peers or mass media such as books, journals, newspaper or internet.

Similarly, when a student first meets with a new mathematical concept, for example, 'cube'. He may not know what this word means. Even if he is given a model of cube to see, he may still not be able to relate it to the concept of cube. Unless the teacher explains the concept using a language that is simple enough to him and relating to his/her previous experience, by giving various examples to support the explanation, or else the student will not be able to master the concept. Most important, there must be a two-way communication between the teacher and the student. For the teacher uses the language to explain, the student uses the language to reflect and construct his/her knowledge. This means the student must be encouraged to ask questions, as well as to express his/her ideas in his/her own words. In other words, a two-way communication means having a discussion between two parties. It is not just a mere explanation by the teacher or reflection by the student. This is because through discussion, we make our inner thoughts or private speech public (Vygotsky, 1978). It is through making our inner thoughts public that we get to realize the gap or misconception of our understanding.

As concur by Britton et. al. (1975) that we use language to think and to learn, to communicate our thoughts besides using it as a tool for reflection as well as a tool for expression. In fact, whether alone or with others, we use oral language to think about and to make sense of what we are doing (Connollly. 1989). Thus, Baroody (1993) suggests that by encouraging children to *talk* about their ideas is an excellent way for them to discover gaps, inconsistencies,

or lack of clarity in their thinking. Indeed, it is well documented that *communicating mathematics* promotes a deeper and more lasting understanding of the subject.

Thus, to improve English language and understanding of mathematical concepts, we need to promote communicating mathematics. This means we need to encourage students to 'speak out and talk about mathematics'. Students must be given the opportunity to discuss, to share and to explain mathematical ideas or concepts that they are learning. Students must be able to reflect on what they have learnt. They must be asked to present and to display their understanding in various forms, such as in written works as well as orally to the whole class. In fact, by presenting their ideas or explaining to their peers, the students will not only understand the mathematical concepts better but this activity also helps to boost up the students' confidence in mathematics. To motivate students to discuss and to share ideas, it is best if they can learn through their own experience or related to their daily life activities.

Talking Mathematics as an activity

Talking mathematics is a simple class activity that can be carried out to encourage students to use language especially correct mathematical language as well as to enhance their understanding of terminology. This activity can be carried out at any time of a lesson, but it may be best to carry out as a warm-up activity at the beginning of a lesson or as a formative assessment at the end of the lesson.

To begin, a teacher shows a mathematical term or concept, such as 'polygon' to the class. The teacher then asks each student to write a complete sentence using the term given. Each student then read out his/her sentence to the class. The class is asked to check and discuss if the sentences given are logical and mathematical accurate. The following are some examples of sentences given by students:

a) 'A polygon is a two dimensional shape.'

b) 'Pentagon is a polygon with 5 sides.'

c) ‘A polygon is a flat surface enclosed by straight sides.’

As we notice, sentence (a) is short and simple but it is mathematical correct as it describes one of the significant characteristics of polygon (i.e. two dimensional shape). Sentence (b) is also simple and correct as it gives an example of polygon. However, what do you think about sentence (c)? Do you think it is mathematical correct too? Does it sound ‘right but not very right’? At his point, we may encourage the student who gave this sentence to explain further. We can also encourage the class to discuss what is missing here? What is the ambiguity? How to modify the sentence to make it mathematically correct? Perhaps, changing the ‘flat surface’ to ‘two-dimensional shape’ may be better? Similarly, is it more accurate to use ‘straight lines’ rather than ‘straight sides’? Do we need to specify the minimum number of sides? Certainly, this is going to stir up a lot of discussions among the students and the teacher. Consequently, this will clearly promote a lot of use of language as the students need to argue and to clarify themselves. As a result, they will gain better understanding of the concept learnt. This activity will also help to clarify any misconception that the students may have.

Talking mathematics as a game

“Talking Mathematics” can also be played as a game to promote communication in mathematics. The rules are simple. The players are made up of a host (could be the teacher) and two team members (one gives clues and another guesses the answer). To play the game, first of all, the host will hold up a mathematics word (e.g. a circle) and shows to the whole class. The guesser must have her back to the host. The clue-giver then gives clues and the guesser guesses. If the guesser got stuck, the clue giver could decide to ‘pass’. The following conversation illustrates this activity:

The host (H) shows a word ‘a circle’ to the clue giver and the class.

The Clue Giver (C): “a round shape”

The Guesser (G): “a circle”

H: “Good!” and shows another word ‘odd number’

C: “1, 3, 5, 7, 9.”

G: “odd number”

H: “very good!”. H shows the next word, ‘bar chart’

C: “a kind of table, one column by one column.”

G: “histogram”

C: “no, almost like a histogram, but it can also be row by row”

G: “bar graph?”

C: “nearly right, try again!”

G: “bar chart?”

H: “yes, you got it!” H shows another word, ‘axis’.

C: “x and y”

G: “unknown?”

C: “no, a line of x or a line of y.”

G: “equation?”

C: “pass!”

H shows the fifth word, ‘frequency’

C: “the number of time something occur”

G: “frequency?”

H: “Yes, very good, you got 4 out 5 words correct!”

To make the game more exciting, we can limit the time to say, 1 minute to try out 5 mathematical words. To encourage the students to use more precise description or clue, we can limit the number of clue sentence given. Thus the rules can be flexible and modified according to our objectives.

Talking mathematics as a class game

I have tried out the above, ‘talking mathematics as a game of two players” with three groups of mathematics teachers during a mathematics workshop.

They found the game fun and interesting and they enjoyed it. However, some of them commented that as the game only involves two players, the other students in the class might feel bored because they are only act as observers. Therefore, how to modify this game so as to involve all the students in a class?

One suggestion given by some teachers was that the teacher still play the host, but elects a student to be the clue giver while the whole class guesses. This suggestion was then tried out in the workshop. I observed that every student (or participants in the workshop) was very keen to guess the answer. For this activity, the role of the clue-giver becomes very significant. If the clue-giver master the content well and has a good command of the language, then he or she can give clear and precise clues. This will allow the students to guess the word easily. Conversely, the students will be confused by the clue given and could not guess it right. The following example illuminates the latter situation.

For example, to guess the word, 'frequency', the clue giver gave the following:

C: "Something that is up and down."

One student (G1) put up his hand and guessed as "wave?"

C: "No."

G2: "Graph?"

C: "No, it is also a word that you study in Physics."

G3: "Rotation?"

At this junction, some students started to feel restless and they asked if they could ask questions to the clue giver. In fact, this is what we like to encourage. By asking questions, the students are trying to express their understanding. Moreover, through asking questions, students might clarify what they have misunderstood. The following interaction illustrates this point.

G4: "Which mathematics topic does the word belong to?"

C: "Statistics."

G5: “Is it ‘line graph’?”

C: “No.”

G4: “Is it dealing with data?”

C: “Yes, it shows how often a data occurs.”

G4: “Frequency?”

H: “Good! You got it!!”

Although this activity might take time especially when both the clue-giver and the students did not master the concept well. Nevertheless, the main objectives of “talking mathematics” are to encourage students to speak out, to discuss, to express their understanding and to communicate mathematically. Indirectly, this activity will promote the students to use language more often and more precisely. Hence, if they are encouraged to use English to ask questions and to express their ideas, then their English proficiency will then be enhanced or improved.

What do you think about ‘Talking mathematics’?

When the above question was asked to the participating mathematics teachers in the workshop, their comments were:

“It is rather fun and interesting”

“I think it encourages student to talk and to discuss.”

“We can use it to encourage students to speak English.”

“I would like to try it with my students and see what happen?”

“May be it can promote the proper use of mathematical words.”

However, there were also some mathematics teachers who voiced the following worries:

“It is fun and good, but then in the exam, students are not going to be tested for the meaning of the mathematics terminology.”

“I think it is too time consuming.”

Conclusion

Even though I have not tried out this "talking mathematics" activity with the school students, most mathematics teachers participated in my workshop have agreed that they would like to try out this activity in their mathematics classes. Similar to any other kind of activity, there are always both advantages and disadvantages when it is carrying out. If our objectives are to promote mathematical communication and to enhance language proficiency, then I believe that "talking mathematics" is an activity that encourages students to ask questions, to describe and to explain mathematical concepts that they have learnt. Indirectly, this activity will encourage students to use precise and accurate mathematical words, and hence promote better understanding of mathematical terminology. If this activity is modified into game, the element of competition will make it more exciting and fun for the students. In fact, as pointed out by Baroody (1993) that "Helping children acquire mathematical terms and their related concepts is important for fostering shared meanings, which can facilitate communication" (pp. 2 – 117). Thus, I hope the readers, especially those who are mathematics teachers may like to try out this idea (Talking Mathematics) in their classes and give me the feedback.

References

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