Southeast Asian Mathematics Education Journal
2011, Vol. 1 No.1, 85 - 89

Curriculum Review in Singapore

The following commentary on the direction and substance of the curriculum review process currently happening in Singapore was included because of its interest to readers from other countries. However, the views expressed here are those of the author, a respected and experienced Asian mathematics educator, and do not necessarily reflect those of the editors or the international advisory panel.

What Might Happen to School Mathematics in 2013?

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The Year 2007

What was new in the O level mathematics syllabus 2007? Perhaps the change was mainly in the teaching approach and not so much in the content knowledge. Among the changes, we put more emphasis on the process and we made an attempt to put mathematics in context.

In fact, there is nothing new about the process and the context. The Chinese did it over 2000 years ago. Look at the classics "Nine Chapters of Arithmetic" and many other classics in mathematics from ancient China. These books normally contained a collection of problems. The problems in these books were always presented in context. The problems were always solved by means of a process. Naturally, there was no formula. If the process itself produced an answer, there was no need for a formula. We have re-discover the approach in modern times. In fact, there is nothing new about it.

There is also nothing new about the process and the context as far as Singapore is concerned. Years ago, more precisely 50 years ago, Euclidean geometry and Newton's mechanics were part of school mathematics at the time. In Euclidean geometry, we prove theorems. To prove a theorem, we have to go through the process. In mechanics, we construct models. To construct a model, we have to put it in context. So there is nothing new about it.

We lost Euclidean geometry gradually over the years starting from the days of the Math Reforms in the 60s in the west and in the 70s in Singapore. As a consequence of the Math Reforms, mathematics became pure mathematics. Gradually, mechanics was replaced by statistics. Henceforth we lost two rich, indeed very rich, areas for learning mathematics and for setting exam questions. We do not know what we have until we have lost it. Now we are trying very hard to recover what we have lost. In other words, we want to teach mathematics with emphasis on the process and

pose mathematical problems in real-life or pseudo real-life contexts. In fact, we had it all along in Euclidean geometry and mechanics and then we lost it

In education, there are very few new ideas. People simply re-cycle old ideas and give them new names.

What How When and Why

Let us discuss the what, how, when and why of this so-called new approach to mathematics teaching. In more words, we ask the following questions:

What is it?

How do we do it?

When and where do we do it?

Why do we want to do it?

We shall elaborate in what follows.

What is it?

We want to teach knowledge and we also want to teach the use of knowledge. We want our students to be able to answer the problems in TIMSS and also the problems in PISA. It is said that TIMSS tests the content of mathematics, whereas PISA is more on applications. In other words, we want our students to learn mathematics and also to learn how to apply mathematics.

Put it in practice, we want to set open problems and expect our students to be able to answer them. The key word here is open. To solve such problems, students have to think differently and not rely only on recall.

How do we do it?

We do it by asking open questions. If modelling provides a good way to pose open problems, then use it. Though called by different names such as performance tasks etc, they serve the same purpose as modelling. Note that problems in modelling are always posed in context.

We often use rubrics to mark performance tasks. There should be a distinction between rubrics used for research and rubrics used for classroom assessment. We may not want to go for the full rubrics. An abridged version is more than enough.

When and where do we do it?

The usual comment is that we have no time. We are not expected to do modelling tasks every day. Maybe have it at least once a year or at most once a term,

assuming one year has four terms. Asking questions is a way of life, a habit, and an art. Suppose we say the area of a quadrilateral of sides a, b , c, d is $\left(\frac{a+c}{2}\right)\left(\frac{b+d}{2}\right)$. Ask not whether the formula is good or bad. Ask how good it is.

Why do we want to do it?

We teach mathematics and we should also teach mathematics for understanding. For understanding, we must look at the process. As I believe, this is known. However we still need formulas and algebra. It is often through formulas that we make mathematics simple and make it easy to apply. Do not condemn formulas. We need both processes and formulas.

The Year 2013

What is new in the O level mathematics syllabus 2013? There is at least one new element in the syllabus that is learning experiences. It is called knowledge requirements in the Swedish mathematics syllabus (2011). Roughly speaking, we make explicit what we want our students to experience during the learning process. For example, when we teach quadratic equations, we want our students to see that the graph of a quadratic function is nothing but a projectile. We can call it an experience and we make it explicit. Further, we can use quadratic functions to find the maximum or minimum point. This is an application. It is another experience, and we make it explicit. In a way, this is a natural consequence of putting emphasis on the process. Now we move one step further to spell out the specific experiences to be emphasized in the learning process.

We are not the only nation introducing this idea in the syllabus. Sweden is doing it. So are the United States in Common Core State Standards (CCSS 2010) and Chile, South America, in Content and Pedagogical Standards for Secondary School Teacher Education in Mathematics (Draft 2011). There is no national mathematics syllabus in the United States. CCSS is the nearest to it. Both the United States and Chile did not call it by a name. But they made it explicit in their syllabuses (standards). However there is one difference. In the 70s, we imported the Math Reforms from the west. This time we did it independently. So were other countries, at least three of them, other than Singapore. As I said above, this is a natural consequence.

You will find all the details of the syllabus 2013 on the website when announced officially. It is a more extensive document than the syllabus 2007. We want to change, but we cannot change overnight. This is only the beginning. We must do it in steps. Probably, this is the only way that we may succeed. This is not fire-

fighting, and it should not be fire-fighting. We are training our students in schools for the work place different from our own. Hence we must do it differently.

In The Classroom

A reform, if it is a true reform, can move only as fast as teachers can move. Suppose we, as teachers, believe in the proposed change. Suppose we want to move forward. What are we supposed to do in the classroom? I have no doubt that there will be training programmes. Indeed, it has already started. What I am saying here is something which I think might happen in 2013. Let me quote an email that I sent to my students. Here is the content of the email.

Why is the answer important?

Suppose you build a house. When completed, the house collapsed. Do you still pay the contractor because the process was correct?

Why is the process important?

You may do the wrong thing and still get the right result. I am not sure you will be lucky again next time. If you did it correctly in the process then I have reason to believe that you do not have to depend on luck.

Why is the presentation important?

If you can say it well, you can get through one door. I mean what you say will reach the person behind the door. If you can write well, you can get through at least three doors. I mean what you write will reach the boss of the boss of your boss. Only good presentation travels.

End of the email: In summary, we may wish to do the following in the classroom.

- Make sure mathematics we teach is correct.
- Make explicit the experiences in our learning process.
- Pay more attention to presentation of mathematics.

By all means, teach for the examination. There is nothing wrong to teach for the examination, but not for the examination alone. The examination will not change in the short term. In times to come, it will change. It will be too late for students to catch up if we do not start changing our teaching now. We must accept the fact that though we may give the same amount to all students, students may not receive the same amount at their end. Since we apply differentiated syllabuses, differentiated teaching, therefore we must also accept differentiated learning.

As I said it elsewhere, we keep changing and changing, we reach a point that we have nowhere to copy from and we have to find our own solution to our unique problem. We, I mean curriculum designers, teacher trainers, and teachers, have to do it together to find a way of moving forward, a way that works for us. For example, we may have to build up jointly the resources to be used in the classroom.

In conclusion, we must teach mathematics differently. We want our students to be able to solve problems beyond the textbooks. Perhaps teaching from the syllabus will no longer be an exception. However we may not want to do that all the time. One important thing to remember is that students must learn how to follow rules first before learning how to break them.

References

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[Note: Some of the materials above have been given in a talk to Singapore teachers on 08 September 2011]