The Role of Text-books and ICT in Designing and Implementing Effective Lessons: Examining Curriculum Recommendations and Teachers' Practices

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Teachers in Brunei Darussalam generally use recommended textbooks and books supplied by the Ministry of Education in order to teach their students. Many of them only rely on those books while there are others who would look at other books or surf the internet in order to get ideas on how best to teach a mathematics topic. Some would follow the recommendations entirely, but many would change the recommended lessons to adapt to their classrooms. This paper would examine the recommendations of the new SPN 21 (New Education System of the 21st Century) mathematics curriculum and the normal practice by the teachers in this country in order to design and implement effective lessons.

INTRODUCTION

The changes in curriculum usually come hand-in-hand with changes in textbooks. Textbooks are rewritten in order to accommodate the changes in curriculum because they act as a bridge between the intended and the implemented curriculum which can also be termed as potentially implemented curriculum (Valverde, Bianchi, Wolfe, Schmidt, & Houang, 2002). It is thus understandable why the awareness of textbooks and how they are used are crucial for understanding the process of teaching and learning mathematics. If one considers the reform of the mathematics curriculum it is therefore important to understand the role of textbooks. Figure 1 shows the connection between intended, implemented and attained curriculum as depicted by Valverde et al. (2002). Besides textbooks, other organised resource materials are also listed as the potentially implemented curriculum and they may include manipulatives as well as ICT resources. This paper will examine the curriculum document and the textbooks that are used in schools and how the teachers use them for the purpose of designing and implementing effective lessons.

The new Brunei mathematics curriculum that was launched in conjunction with the New Education System of the 21st Century (SPN 21), implemented fully starting early 2009 advocates the use of multiple representation. It is believed that children gain maximum benefit from school mathematics instruction if they can see the mathematical ideas through concrete models, diagrams, real life examples, virtual displays (ICT), words and symbols (CDD, 2009). The different modes of representation may lead to better mathematical understanding. Therefore, various kinds of teaching and learning resources were recommended to accomodate the different representations. Teachers are also recommended to employ differentiated content and instruction. The Ministry of Education, through the Curriculum

Development Department, provided Brunei schools with textbooks, workbooks (refer Figure 2), teachers' resource package (including teachers guide and manipulatives) and multimedia courseware (both hardware and software) for this purpose. These resources are provided to ensure that teachers will be able to design and implement effective lessons for the benefit of achieving students' understanding in learning mathematics.

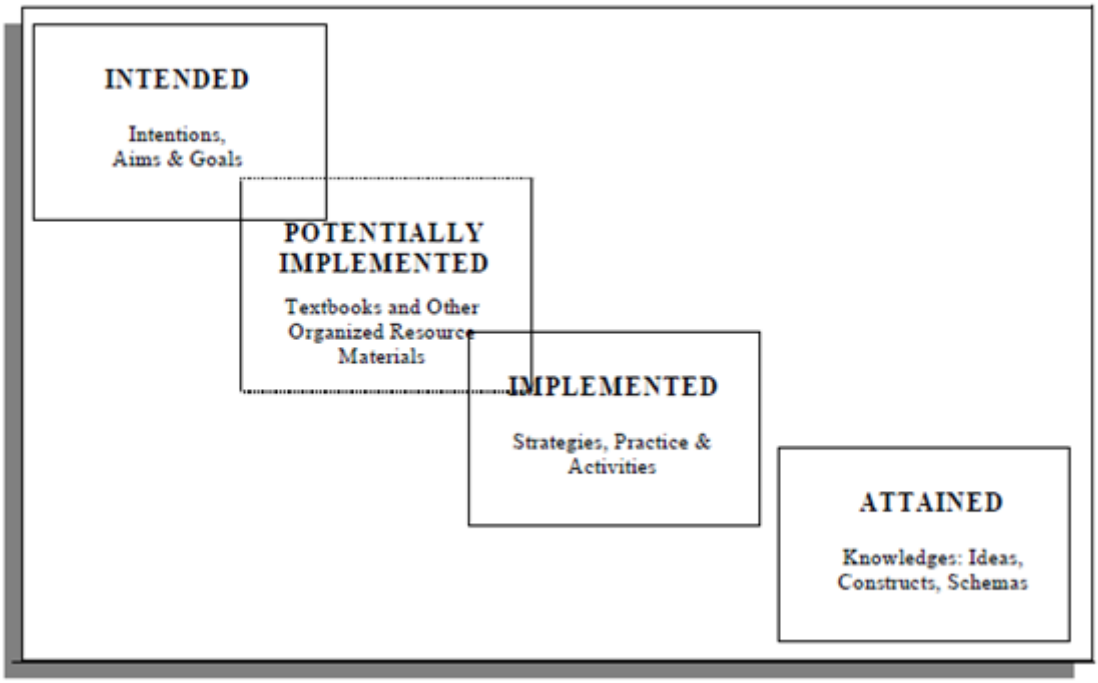


Figure 1: The tripartite model (Valverde et al., 2000, p. 13)

Teachers in Brunei consider it important to use the guidelines suggested by the Curriculum Development Department when designing and implementing mathematics lessons in their classrooms. The curriculum document suggests the following critical components that pupils must encounter in a mathematics programme in order to achieve the goals of mathematics education and encourage lifelong learning in mathematics. Pupils are expected to:

- *communicate* in order to learn and express their understanding
- *connect* mathematical ideas to other concepts in mathematics, to everyday experiences and to other disciplines
- demonstrate fluency with *mental mathematics and estimation*
- develop and apply new mathematical knowledge through *problem solving*
- develop *mathematical reasoning* and *creativity*
- select and *use technologies* as tools for learning and solve problems
- develop *visualization* skills to assist in the processing of information, making connections and solving problems
- develop positive attitudes and values towards mathematics.

(CDD, 2009)

Textbook is the most important feature of teaching mathematics in the classrooms in Brunei, as in many other countries. The traditional textbook has long been a key reference material for teacher curriculum decision-making and the primary resource for student practice of mathematical techniques. Although some teachers sometimes refer to other reference books or search the internet for teaching ideas, textbooks remain the main teaching resources. The two recommended textbooks for Bruneian schools are the "Smart mathematics" (CDD, 2008a; CDD, 2008b) and "Star mathematics" (Cole, 2008a; Cole, 2008b) series, accompanied by their respective workbooks.

Figure 2: Recommended Bruneian textbooks, workbooks and teaching soft-wares

Both of the recommended textbooks mentioned above are used extensively by the teachers, where the preference for use differs from teacher to teacher. Both textbooks are very colourful and well-illustrated as well as easy to read when compared to previous textbooks used in Brunei. In a study by Burns and Charleston (1997) on the readability of English medium curriculum texts in Brunei primary schools, it was found that older textbooks are not easy in terms of readability and not interesting enough. Some teachers prefer to use 'Smart mathematics' because it has clear learning outcomes of each chapter, contain suggested warm up activities to introduce mathematical concepts, encourages pupils to think further in the 'Stop-Think-Go'

section, contain exercises for quick review and gives direction for appropriate worksheets in the workbook as well as summarizes the main points learnt in the chapter. On the other hand, ‘Star mathematics’ features workbook links, mathematics questions that are related to real-life situations, learning guides by prompting questions at appropriate juncture and cooperative learning activities. Workbooks of both mathematics books contain worksheet, skill practices and review paper.

Q1: HOW DO YOU USE YOUR TEXTBOOK IN YOUR COUNTRY?

Although textbooks act as the potentially implemented curriculum, Love and Pimm (1996) emphasised that it is the teacher who normally acts as a mediator between the student and the text, and are therefore resposible for any changes proposed. Many teachers rely on textbooks for instructional materials, which may or may not be adequate for effective teaching of lesson in terms of providing thinking problems that are non-routine, making connections and emphasise mathematics beyond basic skills. It is therefore interesting to find out how teachers use textbooks in this country.

Many Bruneian teachers rely solely on the textbooks recommended by the Ministry of Education. They might follow the sequence and recommendations given in the textbook closely where all problems and exercises would be presented and taught to the students. Most would try to adapt the textbooks according to their students’ ability and situation. From many meetings that the writer attended in the course of lesson study project, it was noted that when a group of teachers have to teach a topic, the first material that they will start with would be the textbooks. As an example, when the topic decided upon was ‘developing understanding for mental calculation of division of a number by powers of ten’, they turn to both textbooks but found and liked the activity shown in the ‘star mathematics’. The game suggested that students in groups of 2 to 4 to pick a card (with division statements typed on it) and then identify other card(s) that gives the same answer. They decided to adapt this activity with changes to suit the children

The teachers thought that the suggested game would motivate and interest pupils. However they felt that by just identifying the cards, pupils are not thinking enough and would not have the opportunity to give their reasons for doing so, when the theme for the particular lesson study calls for emphasis on mathematical reasoning, communication and connection. The pupils were not supposed to just know how to solve the problems, but they should also know the reasons why, when dividing by 100, they can take away two zeroes from the numbers being divided. At the end of the lesson, students were also asked to write down what they learnt that day instead of just completing the exercises in the workbook. In order to lead students to make connection between multiplication and division, the “follow-me” or “I have… who have… ” game was used as lesson starter. For this activity, every child was given a card with sentences such as 'I have 20. Who has 12X100?’ The teacher would start the game with by reading her card, for example ‘who has 3X10’. The student with the answer on his/her card would stand up and say I have 30, and continue to read the

rest the card that might say ‘who has 23X100’. The game continues until all students had the chance to participate. Then the teacher asked the pupils to explain the meaning of 3X10 or 23X100, etc. The pupils would say 3 groups of 10 give 30 or 23 groups of 100 gives 2300. During the development stage, the teacher continues by asking pupils to pick one of the nine cards containing division statements for example 450 ÷ 10. Students were asked to solve this by whatever method they knew. Some responded by saying that they use the reverse of multiplication (the answer is 45 because 45X10 is 450), some by long division etc. Here, the teacher asked students to interpret the meaning of multiplication that emphasize grouping. After going through more cards and arranging the cards in groups that shows certain kinds of patterns, students were expected to be able to then explain why they can take away zeroes when dividing. They were expected to be able to say something like ‘86X100 means 86 groups of 100 which gives 8600. 8600÷100 means finding how many groups of 100 there are in 8600. There are 86 groups of 100 in 8600 (because 8600=86X100 which means 86 groups of 100). Other pupils even point out to the reverse nature of multiplication and division.

Q2: HOW CAN WE USE OUR TEXTBOOK MEANINGFULLY?

The two mathematics textbooks that are being used in Brunei are supposed to incorporate the reform agenda of the SPN21. However, many teachers using the textbooks still deliver the content in the traditional way. This is due to different interpretations that each teacher has on how to teach the topics. So, how do we make the teachers use the textbooks meaningfully? One way is to make sure that the teachers are aware of the necessary mathematical processes such as mathematical thinking and communication that need to be incorporated in each lesson. They need to be given continuous professional development (CPD) and training. Teacher discussions and making them work together is also vital to this process and therefore one of the best ways would be via lesson study, which has become common in Brunei. During our lesson study project and cycles, teachers discussed how to make students think mathematically and not just be satisfied with knowing how to solve a problem. Activities chosen were those that would make students communicate with the teacher and other students. They want students to be able to give reasons and make connections of their learning. Therefore, each activity suggested was scrutinized and discussed until they are satisfied with the product, before being presented in a research lesson. A good example was as depicted in the topic mentioned above. Teachers first discussed how to make the activity chosen interesting. An element of suspense was injected when students were asked to pick a card with division statement from a stack. In answering each question, teachers usually ask why they do this and that. They were also asked to verbalize the meaning of multiplication statements and division statements. When all nine cards were revealed, they were asked to arrange and group the cards according to the patterns that they deem appropriate. Students were made to think of what happened when certain patterns were recognized. Finally, they were made to explain why when a number is divided

by 10 – they can remove one zero, by 100 – they can remove 2 zeroes and so on. Since the students' process skills were assessed during the activity, the emphasis on the process makes it more meaningful.

Q3: HOW DO YOU USE BLACKBOARD AND PROJECTORS IN YOUR COUNTRY?

Unlike teachers in Japan who has a very unique and purposeful way of using the blackboard, it is hard to categorize Brunei teachers' use of blackboard in any particular way. However, with the exposure to Japanese lesson study and maybe because of the influence from it, our teachers are beginning to realize the importance of planning the blackboard use.

Besides the traditional blackboards, with the advent of new technology and the encouragement for its use, teachers began using the smart-board and also the projector in their classrooms. The use of smart-board is popular among the young teachers in Brunei since all schools are provided with at least one interactive whiteboard by September 2007 (Khalid & Salleh, 2010). Pupils are keen to participate when teachers use interactive white boards because of the interactive nature smart-boards offer. However, ICT use is not encouraged in the classroom if it is used only as a way of delivering information because instead of 'chalk and talk' as was common previously, it is now 'power-point slides and talk'. Teachers also use the internet to search for interesting activities as well as computers to make lessons more effective. ICT based resources are also encouraged and provided or linked by the Ministry of Education through its official website.

Q4: HOW CAN WE INNOVATE OUR TEACHING APPROACHES FOR TEACHERS?

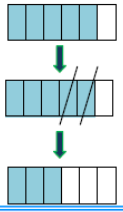
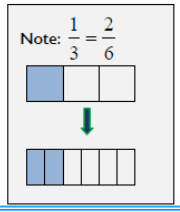
In view of the popularity of the smart-board among pupils, teachers are looking for tools or softwares that offer interactivity. Some topics, especially geometry, are best taught using educational softwares such as Geometers Sketch pad, Cabri Geometry of Geogebra. The dynamic geometry softwares provide opportunity for children to explore and observe the different behaviours of two-dimensional shapes for example, when certain properties vary. The software can also provide opportunities for students to discover patterns or properties of triangles embedded within a circle by 'drawing' many similar but different cases until a pattern emerge, which is not practical if students are just provided with papers and graph papers. The star mathematics text book supplied to primary schools is also accompanied with teacher resource compact discs which contains the ebook version of the text book. The ebook version has inter-activeness (enlarge images or texts and interactive activities). Realizing the importance of interactivity in teaching, the 'dbook' has been introduced to some teachers. The dbook, which is actually a software as well as a tool that could convert ordinary textbooks into "e-textbook", was introduced by Prof Isoda to 30 participants from the Vocational and Technical institution recently (Brunei Times, 2010). With the dbook, teachers who do not get the chance to use the smart-board can now have

interactivity in their classroom, because the dBook can be inserted with basic tools (like drawing, compass, ruler), animations and interactive simulations (using Adobe Flash) or videos. Recent interactive teaching tools like 'mimio' also made interactive teaching cheaper.

DISCUSSION AND CONCLUSION

The advent of the new technology will change the way teachers teach. However, teaching with technology needs to be complemented with the incorporation of other important process skills (such as mathematical thinking, communication and connection), and teachers will seek resources other than textbooks to get ideas on how best to teach a topic. An example of the process of designing and implementing an effective lesson in Brunei using ICT and textbooks is as depicted below. This is just one episode for teaching addition of unlike fractions that really happened during one of our lesson study cycle.

The suggestion from teachers guide is as follows:

Pupils should be able to:	Notes, Illustrations and Remarks	Performance Indicators
1.4.1 **Add and subtract related fractions.** [C], [CN], [V], [S]	▪ Recognise 'related fractions' as fractions whose denominators are related by a common factor, e.g., $\frac{5}{6}$ and $\frac{1}{3}$. These fractions can be converted into equivalent fractions with the same denominator for addition or subtraction. ▪ Demonstrate the process of addition or subtraction concretely and pictorially. *Example:* $\frac{5}{6}-\frac{1}{3}$ $=\frac{5}{6}-\frac{2}{6}$ $=\frac{3}{6}$ $=\frac{1}{2}$   Note: $\frac{1}{3}=\frac{2}{6}$	1. Add and subtract related fractions correctly.

[C] Communication [PS] Problem Solving
[CN] Connections [R] Reasoning
[V] Visualization [S] Skills
[ME] Mental Computation and Estimation

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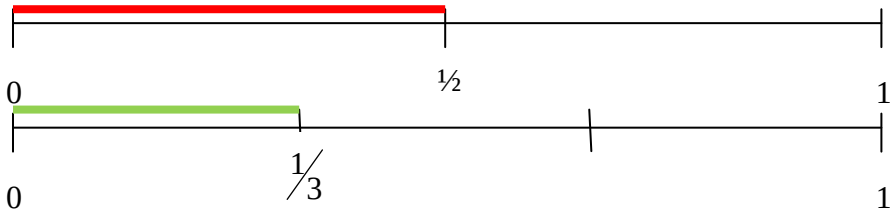
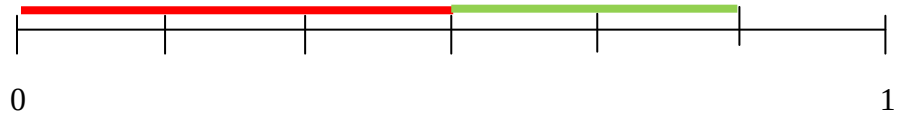
Pupils should be able to:	Notes, Illustrations and Remarks	Performance Indicators
1.4.2 **Add and subtract unlike fractions.** [C], [CN], [V], [S]	▪ Recognise 'unlike fractions' as fractions who denominators are not related by any common factor, e.g., $\frac{3}{5}$ and $\frac{1}{2}$. These fractions must also be converted into equivalent fractions with the same denominator for addition or subtraction. ▪ Demonstrate the process of addition or subtraction concretely and pictorially. ▪ Refer to 1.4.1 for demonstration techniques. ▪ Relate the demonstration process to the calculation method, as follows, *Example:* $\frac{3}{5}-\frac{1}{2}$ $=\frac{3\times2}{5\times2}-\frac{1\times5}{2\times5}$ $=\frac{6}{10}-\frac{5}{10}$ $=\frac{1}{10}$ Notes: $\frac{3}{5}=\frac{3\times2}{5\times2}=\frac{6}{10}$, $\frac{1}{2}=\frac{1\times5}{2\times5}=\frac{5}{10}$ ▪ Discuss two more examples before giving groupwork to calculate addition and subtraction of unlike fractions.	2. Add and subtract unlike fractions correctly.

It can be seen from the guide that teachers are encouraged to use computer and to incorporate communication, connections, visualization and skills to teach this topic. The 'Smart Mathematics' textbook do not talk about related fraction as described above and shows diagrams of how the different fraction were further divided to make like fractions. 'Star Mathematics' does, but straight away shows the process of making the denominator equal (by multiplying), without offering any pictures or diagram. Traditional teachers would ask students to find the LCM. In the end, students know how to find LCM without really understanding what it is and in the end would only be able to procedurally solve the problem.

During this particular discussion, teachers thought that it will be a good idea if the students can be made to practically divide the unlike fractions into equal parts to get like fractions. However, it is not easy if students were to draw the diagrams because they won't be exact. Therefore, it was decided that they will use ICT. After searching the internet, they found that it is easier to represent the fraction using number line. So, to solve $\frac{1}{2} + \frac{1}{3}$, they will represent the fraction as follows on the smart-board.



Students would then try to divide the two fractions above using the pen of the smart-board visually and would be directed to figure out how to get the equivalent fractions to make the 'unlike fractions' into 'like fractions'. They will finally figure out how to solve them, and at the same time communicate their reasons for doing so.



Then students are directed to the website http://www.visualfractions.com for more interactive exercises.

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