

Technology in the proposed primary and secondary mathematics curriculum in Hong Kong

Chow Wai Man, Raymond
Department of Mathematical Sciences
Swinburne University of Technology
wmchow@hotmail.net.au

Peter Jones
Department of Mathematical Sciences
Swinburne University of Technology
pjones@swin.edu.au

Abstract

A new primary mathematics curriculum (to be implemented in 2003) and secondary mathematics curriculum (to be implemented in 2001) have been proposed and distributed to teachers for discussion. One of the main features of both curricula is the integration of the use of technology into teaching and learning of mathematics. In the primary curriculum, use of calculators will be taught in primary 4 and learning software are encouraged to be used from primary 1. Graphing calculators, spreadsheets, interactive geometry software and other technology are encouraged to be used by teachers in the classroom.

This paper examines the role of technology in the intended curriculum and discusses the difficulties and strategies in the implementation of the curriculum in this aspect.

Introduction:

The mathematics curriculum in Hong Kong is undergoing revision. The current primary level curriculum was published in 1984 and the secondary level curriculum published in 1985. It is interesting to note that the primary mathematics curriculum had been much influenced by the Cockcroft Report (1982) then recently published in United Kingdom at that time and a more student centred approach had been adopted. The development of interest and appreciation of mathematics had been one of the primary objectives in this curriculum. On the other hand, the 1985 secondary curriculum was still

emphasizing equipping students with the basic skills to continue science and engineering study.

There was little revision on these two mathematics curricula except that the Education Department introduced the Targeted Oriented Curriculum (TOC) (Curriculum Development Institute 1992) in the late 1980s which was an attempt to redefine the curriculum in terms of learning targets and objectives. The introduction of TOC opened the possibility of mathematics curriculum revision and a new primary and secondary curriculum will be introduced in 2002 and 2001 respectively.

This paper examines the integration of the use of technology into teaching and learning of mathematics.

Technology in primary mathematics curriculum

In the proposed primary curriculum, use of computer technology in teaching and learning were encouraged. This is a reflection of the policy as laid down in the policy address of the Chief of Hong Kong Special Administrative Region (HKSAR) in October 1997. In his address, the Chief of HKSAR (Tung, 1997) envisioned to build up Hong Kong into a high technology oriented society.

Large amount of money was poured to the school system to upgrade the infrastructure of schools to use information technology in teaching and learning. Every teacher will be connected to the Internet by 2000 and schools will be equipped with multimedia teaching laboratories and all schools will be online.

In the objective section (Curriculum Development Institute, 1997), use of modern technology is specified as one of the skills to be developed and also to use modern technology appropriately is seen as a desirable attitude in learning mathematics. In the detail content, the changes are:

1. addition and subtraction will be limited to numbers with no more than 4 digits (previously no limit was set and students usually practise addition and subtraction with more than 5 digits) ;
2. multiplication and division will be limited to multiplicand and dividend with not more than 3 digits and multiplier and divisor with not more than 2 digits (previously the limit is 4 digits and 3 digits respectively)
3. Mental calculations and estimation will be introduced and students will be taught to decide when to use calculators, mental calculation or estimation. (previously no calculators will be allowed to be used and estimation not taught).

It is also suggested that teachers should use computer software to facilitate learning mathematics starting from the first year in primary schools. A list of edu-tainment software is included and suggested to pilot schools. The emphasis of the use of the computer software is on concept learning, consolidation and promoting the interest in mathematics learning. However, most of the suggested

software is in the primary one to three levels and majority of them are English software, while the medium of instruction for primary schools is Chinese.

The use of calculators is introduced as an independent unit in primary four. Seven lessons to teach students how to use calculators are introduced in the curriculum. The learning objective for this unit is to teach students to use calculators in carrying out the four basic operations and conducting some suggested calculator games, as suggested in an appendix to the curriculum document.

Technology in secondary mathematics curriculum

In the curriculum document for the new secondary mathematics curriculum (CDI, 1998a), the impact of information technology has been stated as one of the five basic principles of the curriculum design. The positive role that calculators could play in the mathematics learning is affirmed. The popularity of graphing calculators, availability of computers and other technologies in the classroom are recognized and use of information technology in data analysis, simulation device, graphical representations, symbolic manipulation and observing pattern are seen as relevant.

Using modern technology appropriately to learn and do mathematics is seen as a skill in the learning objectives. A section on teaching suggestion has been devoted to the appropriate use of information technology (IT) in teaching and learning. The advantages of using IT over other tools are identified as: interactivity; visualization; and computation capacities including the volume of calculation and speed. A model of IT in school mathematics education in three levels, namely as a tool, tutor and tutee (Taylor, R.P. 1980) is suggested in the new syllabus. IT as a tool refers to its capacity of visualization of abstract concepts, manipulation of numbers and symbols or mathematical objects. When software packages illustrate mathematical concepts with texts, graphics and sound with graded exercises or tests, IT is viewed as a tutor to students. When students write programs in LOGO to explore mathematical properties, IT acts as the role of a tutee to help the learning of mathematics for the students.

The Curriculum Development Institute (CDI) produced an appendix booklet to illustrate the use of IT as a tool in teaching and learning of mathematics (CDI, 1998b). Exemplar activities on the use of Cabri, Winplot, Excel and Graphmatica, WinGeom, and supercalculator like the TI92 are provided to illustrate the possible use of IT as a tool. Internet resources related to teaching and learning of mathematics are also provided to teachers as reference to facilitate teachers to understand the context of using IT in teaching mathematics. Two more resources were also developed for the ten schools involved in a piloting project for the new curriculum.

Discussion:

1. Primary mathematics

The use of calculators in primary teaching has always been a controversial subject. In the eighties, a lot of efforts have been put into development materials and programs using calculators to facilitate learning of mathematical concepts had been developed. Research evidences indicate that there was no decline of computation skills from students using calculators in an early age in most of the research by western educators (Hembree & Dessart, 1986). Recently, there is a counter use of calculators as reflected in the recent Californian debate of the mathematics curriculum (it is suggested in the new curriculum that calculators should not be used until secondary years). It is against such a background that the use of calculators is endorsed in the new Hong Kong primary curriculum.

The curriculum focuses on the use calculators as a computing instrument. It is basically the result of a pragmatic philosophy towards mathematics: as calculators are part of the modern society, so we teach students how to use it. It is little related with pedagogical concern. Students are not seen as mastering a new learning tool when using calculators. The learning target will be seen to be achieved when students demonstrate the ability and experience to use a basic calculator.

A booklet on exemplar activities of using computer software in teaching mathematics had been produced for some pilot schools. Software on use of tangrams, drawing of planar figures, Excel worksheets and Powerpoint presentations were used in beginning of 1999. Few schools joined in the piloting process since most schools are still not equipped with a computer laboratory and classroom use of computer for the demonstration purpose has not been reported.

2. Secondary mathematics

There had been calls from both the teaching profession and the higher education sector on the use of technology in teaching mathematics since 1994 (Chow, 1996). The Hong Kong Association for Science and Mathematics Education (HKASME) had organized workshops on teaching of mathematics with technology since 1994. The responses from teachers were mixed as few teachers attended these workshops but teachers believed there would be great potential, possibility and impact of technology on teaching and learning of mathematics. The responses from the Education Department were negative at that time. Suggestions to equip schools with graphing calculators and computer software were rejected on the basis of irrelevance of technology with learning of mathematics.

The stand of Education Department reversed since 1997 when the Chief of HKSAR government identified IT as a first priority in the policy. Although use of software technology in teaching and learning of mathematics has little relevance with IT skills like the use of World Wide Web, email or networking

etc, technology has then been accepted as a main emphasis in the new mathematics curriculum framework. A theoretical justification and details in promoting the use of IT in teaching and learning of mathematics are provided in the new curriculum and the CDI started to organize workshops introducing use of software and graphing calculators in teaching mathematics since 1997. Mathematics teachers had responded very actively in these workshops. Funding to provide training to mathematics teachers to acquaint with new technology was available and courses developed by Education faculties of the universities.

There is little discussion on the differences between IT, as understood by the public and use of technology (basically various computer software) in teaching mathematics. There is also no learning target directly related to the use of technology as in the primary mathematics curriculum. Technology is viewed as a pedagogical issue. Even though a framework of IT as tool, tutor and tutee has been developed, only the tool model prevails in the new curriculum and well illustrated.

3. Evaluation of the curriculum development process

Fullan (1991) suggested a model on the change process in education consisting of initiation, implementation and continuation stages. It is obvious that the use of technology in teaching of mathematics at the primary level is still in the initiation stage. Fullan summarized eight factors associated with initiation stage, namely: existence and quality of innovation; access to innovations; advocacy from central administration; teacher advocacy; external change agents; community pressure, support, and apathy; funding; and orientation of advocates.

It is noted that in the present case, the innovation of teaching mathematics with technology originated from the government due to policy set by external agent outside the education sector. The funding will guarantee schools are equipped with computer laboratories before 2002, when the new curriculum will be first implemented. However, the essence and details of the innovation are yet to be developed. Teachers are at present still uninformed of the details and spirits of the new curriculum. Because of the training courses and publication of teaching packages, secondary mathematics teachers seem to be more informed about the innovation.

Fullan, Anderson & Newton (1986) emphasized on the development of local versions of curriculum by schools. Calculator activities and computer software in mathematics instructions have been tried out in western primary schools, it should not be difficult to adapt them to be in the local settings. However, little details on the use of calculators in the primary curriculum are yet to be developed and most teachers do not have access to it. House (1974) has warned that many innovations had failed because of the lack of attention paid to address this factor. The case of secondary curriculum seems to be a little bit better. In fact, some university educators started to have local research in this

area since 1998. Support groups are formed by the HKASME to help teachers to develop school-based activities.

The promotion of the use of IT in teaching and learning in general receives support from the public. However, there are constantly oppositions and challenges from experienced mathematics teachers on the necessity of the innovation. Many teachers are correct in pointing out that the change of pedagogical process will result in fostering a different set of mathematical skills even the curriculum content may be kept as the same. For example, students may develop different representations of concepts using interactive geometry software like Cabri but will lack training in writing up deductive proofs. These concerns have never been discussed as the innovation has yet come to the implementation stage.

Conclusion

Concluding from the previous discussion, it is easily seen that the success of integrating the use of technology in teaching mathematics in the primary level depends greatly on the resource input by the Education Department, which initiates the change. Efforts need to be made to put the innovation into greater details and accessible to teachers. At secondary level, the concern will be the development of local experiences and the organization and dissemination of the various input of advocators to the teaching profession as a whole.

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