Overview and Comment on the Use of Modern Technology in Shanghai School Mathematics

Xu-hui Li

Department of Mathematics, East China Normal University

Shanghai 200062, P.R. China

xhli@math.ecnu.edu.cn

ABSTRACT

Shanghai is the most developed city and an opening frontier of China, its school education system as well as the conditions are of top level in China. Technologies are gradually popularized in Shanghai schools during recent years, which is an great step towards modernized future school education. Because of its natural close connection with technology (esp. computers and graphic calculators), mathematics requires more application of technologies. However, some important issues still remain to be investigated.

Based on a survey, this paper reviews the overall situation of technology in Shanghai school mathematics, observes the attitudes of school principals /teachers/students/parents towards technology, and makes some comments on current status as well as future development.

PART I Background

1. Math Education in East Asia doesn't need technology?

The application of modern technology into schools and colleges mathematics may face with similar difficulties and obstacles, but there are also some differences in them due to historical, cultural and social factors. The report of TIMSS seems to tell us that students in Japan and Korea can make good achievement in math without the help of modern technology (esp. calculators and computers). This situation can be generalized to most of the East Asian countries. So we may want to ask: Is it true? And why?

The necessity of using technology in math teaching and learning is out of question (as we can see from the survey in the later part of this paper), and the proper approach of using technology has been and will be continually investigated by math educators and researchers all over the world. As the same time, statistical and analytical reports has come out in some East Asian countries (e.g. [Senuma 1994] for Japan and [Hwang 1997] for Korea). In this paper, the author has no mean to discuss the first two matters but just want to make a brief analysis of the situation mentioned above from the context of Chinese history, then report the current status of technology and its utilization in Shanghai school (mathematics) teaching and learning. Some comments and proposal are provided in the last part.

2. Historical and Social Factors

On the one hand, traditional Chinese math is a Algorithm System which focus on computation, making full use of computational tools (esp. chips and abacus) to solve concrete and practical problems. So there was more emphasis and rely on (mental) computational skills during the process of learning mathematics.

On the other hand, Chinese traditional scientific philosophy make people neglect technologies (which were called "odd skills and crooked techniques"), despite of the world famous technologies (compass, papermaking, printing and gunpowder) invented in the splendid history of ancient China.

As these two traditions were mixed together, computational and relevant skills became not only the fundamental but also the main content of mathematics teaching and training. "Practice Makes Perfect", such kind of believes embedded solidly in most of the math teachers' brains for nearly two thousand years. So, when modern (electronic) technology has not been widely available in China in a short time, people have enough reasons to believe that too much dependency on technology will most likely cause declination of the students' ability of computation, and furthermore, the achievement of mathematics.

3. General situation in the whole country

Let's take computer as example. The whole country introduced computer into schools only since the end of 1980s, and the number of computers as well as relevant schools, teachers and students increased rapidly in the 1990s. Let's compare the data of 1989 with that of 1996:

Number of Schools Involved with Computer: from 7,081 to 40,851
Number of Computer Teachers: from 7,232 to 32,572
Number of Students Who Accepted Computer Education: from 3 million to 21.67 million
Number of computers: from 76,862 to 513,696

These numbers are really quite minor, however, compared with the number of schools in China: 26,000.

Using computers in Chinese schools includes three areas: teaching computer courses, teaching with computer (CAI) and administration with computer (CAM). CAI developed rapidly in the mid-80s, and computer in math education is one of the earliest and most prosperous CAI areas. There are over one hundred software for math education in China, most of them were done by software companies, and some were developed by math teachers or researchers of math education or educational technology. Compared with western schools, there are major differences of using computer in math education in Chinese schools: emphasize more on teachers' roles, pay more attention on students' mastery of math abilities, such as counting and geometry proof [Wang 1997]. The latter one is also characteristic of traditional Chinese mathematics.

PART II Current Situation in Shanghai

1. Shanghai stepping into the New Century

As the city with the largest population in China, Shanghai is also in the frontier of economical and educational reforms. Information technology begin to spread quickly into nearly every aspect of Shanghai educational field in recent years.

Also there is great change in the guideline of fundamental education. Traditional Chinese education is "Education for Attacking the EXAMS", only the students who managed to pass the various levels of exams can stand out of the others and grasp a chance to pursue higher education, and enter the official fields finally. These situations changed a lot nowadays, but scores in exams are still the most important standard for selecting good students, due to the large amount of population vs. the relatively little chance to receive higher education. This situation brought much disadvantages to students' development, so the National Educational Committee published a new policy: to drift to "Education for Enhancing the Students' QUALITIES". Undoubtedly using technologies will help to realize this policy, and Shanghai will also march in the far front of the reform.

As to the policy on educational technology, Shanghai Educational Committee put much emphasis on the computer network in recent time. It is sponsoring the School Educational Information Network (SEINet) and will connect the system into and as part of Shanghai Information Harbor, which is being setup by Shanghai municipal government as a main scientific and technological project at the turn of this century.

The Committee encourage schools to participate activities on CAI and will publish relevant policy in no long time. In November 1997, Shanghai held the National Exhibition and Exchange Conference on Educational Technology. Hundreds of CAI and tutor software were presented and four of them were chosen as excellent software/system of the conference, one of which is a Geometry Automatic Proof System. The Committee are ready to generalize these software and appoint some school as Experiment Base.

Famous software like Maple, Cabri Geomtere and Mathematica are just introduced into the universities. There should be sometime before they enter experiments and are applied in high schools.

By the beginning of 1996, there are 9496 personal computers in Shanghai schools, 62% of which are PC-386, and 19% are linked into local networks. Computer course became required course in Shanghai senior high schools (Grade 10) since 1986, and will become required course in junior high school(Grade 8) in the autumn of 1998. As matching strategies, the Education Committee has provide training programm to 240 junior high school teachers and 540 senior high school teachers.

A new policy is quite attractive, that calculators are allowed to be used in classroom and examinations, and each of the students of Grade 10 (the first year of senior high school) should have a calculator (CASIO fx-82SX is recommended). Schools and

the society paid much attention and showed great interests on this policy. Undoubtedly it need further studies (the author also discussed it in the later part of this paper).

2. Technology in School Math: A Survey

There are 270 high schools in Shanghai. They are distributed in the 21 administrative districts and counties, and informally divided into three levels: City-level key schools, District-level key schools and Common schools, according to their dimensions and qualities. In the spring of 1998, the author organized a little-ranged survey which concentrating on the current status of modern technology in schools (mathematics). 17 principals, 80 math teachers, 92 students and 73 fathers(or mothers) were inquired. Since they covered different districts and all of the three levels, the author think that to much extent the result reflect the general situation in the whole city.

2.1 Point of View on Technology

Ten years ago, there were few computers in schools, technologies available are mainly slide projectors, overhead projectors (OHP), TV sets and audio/video tape recorders. At that time, "educational technologies" was specialized as "electrical audio-visual devices". Recently, however, computers are widely available, although not very advanced. So the view towards "using technology in school teaching" are modernized.

Table 1 "What's the meaning of using technology in school teaching"

	A	B	C	D	E	F	G
Principals	4	0	4	1	8	6	4
Math Teachers	21	4	2	20	54	15	9
Parents	52	48	41	35	56	40	22

A: Installing cable TV and OHP in the classroom
B: Setting up a modernized computer lab
C: Teaching computer lesson to the students
D: Using OHP and other supplementary devices in teaching
E: Teaching with the assistance of computers and software
F: School administration with the assistance of computers
G: Linking the computers into the network

Obviously most of the people (esp., the teachers) regard using technology as CAI. But for the parents, their response are widely distributed among the seven choices, which represent a typical misconception among the non-professionals: equipment means everything.

As to the necessity and possibility of using technology in teaching, both the

principals and the math teachers think application of technology is necessary and will affect every aspect of math teaching (esp. the teaching methods), but the conditions are not full at present:

Table 2 "How do you think of using technology in math teaching"

	A	B	C	D	E	F
Principals	0	7	6	0	8	0
Math Teachers	2	37	22	2	32	18

A: It makes little sense
B: It's necessary, but the equipment is not enough at present
C: It's necessary, but there's a lack of proper software
D: It's fully available now
E: It'll put positive effect on math teaching and learning
F: It needs further discussion

Table 3 "How do you think if your (children's) math teacher using technology in the classroom?

	A	B	C	D	E
Students	51	48	14	3	0
Parents	24	40	11	2	4

A: It's very interesting
B: It's very helpful
C: It has nothing to do with me
D: It's no good
E: It's hard to say

Table 4 " Which of the following aspects of math education may be influenced by technology"

	A	B	C	D	E
Principals	4	4	15	3	8
Math Teachers	20	14	48	23	35

A: The content of math textbook
B: The standards of math curriculum
C: The teaching methods
D: The examination system
E: The effect of learning

Table 4 tell us that people think teaching methods may most likely to be changed by technology, but they have reservations on the possible changes in students' learning, and the changes of examination system are not noticed as highly as we anticipated (in later analysis the author will show that technology won't popularized unless the examination system is thoroughly reformed).

A very interesting difference occurs in the next question:

Table 5 " What's the main reason for that technology has not been popularized nowadays in school math teaching"

	A	B	C	D	E
Principals	3	8	5	3	0
Math Teachers	9	24	61	37	2

A: The views of principals and teachers towards technology are rather old
B: Funds are insufficient
C: Math teachers have no enough time to learn and practice
D: The present examination system provide little space for technology
E: We should take it seriously and make experiments first

As leaders, the principals put much emphasis on the shortage of funds, while the teachers feel that time is the most important factors from their own angles (note that in one workday, a math teacher in Shanghai schools have to teach at least 2 hours, reading over the homework and preparing lessons for about 100-120 students). Funds and time are sure two key factors, but both the principals and the math teachers pay less attention to the examination system (which coincides with the data in Table 2), and they are all nearly neglect the importance of the consciousness of their own!

2.2 Utilization in schools mathematics

Most of the schools take a positive attitude towards technology:

Table 6 "What's the attitude of your school towards technology":

	A	B	C	D
Principals	15	2	0	0
Math Teachers	55	19	4	2

A: Encourage the teachers to try and research
B: Let the teachers make decision according to their actual need in teaching
C: Take it seriously so as not to affect the normal teaching process
D: It doesn't matter

Table 7 and 8 are the questions for math teachers and their response:

Table 7 "Are you familiar with computers"

Very much	OK	Not at all
18	55	7

" Can you teaching with the assistance of technology?"

No problem	Depend on the situation	No	Don't know
11	34	28	7

In the survey we found that most of the teachers who are not familiar with or cannot use technology are old teachers (who have taught math in schools for at least 20 years). The young generation of math teachers show more enthusiasm, which will be an advantage for the popularization of technology.

Table 8 "Which kind of technologies did you made use of in teaching during the past two years?"

Audio-visual devices	Computers	Calculators	Other devices	None
41	14	18	5	14

"What's the students' reaction, if used?"

Show much interests	Feel not bad	Feel bad	Not the same
34	27	2	3

"And how about the effect?"

Very good	OK	Bad	Hard to say
18	41	1	6

The above data are consistent with those from the students:

Table 9 "How do your math teacher use technology in the classroom?"

Often	Sometimes	Never
12	56	23

"And how about the effect, if used?"

Very good	OK	Bad	Hard to say
15	29	0	2

2.3 Future Plans of the schools and teachers

As to the future plan, teachers seem to be more practical than the principals:

Table 10 "What's your school's plan on technology for the next period of time"
(question for the principals)

Concentrate on normal teaching and won't invest much on technology	2
Add more modern technology equipment	5
Make full practice of using technology in teaching	11
Make decision according to the instruction of higher authorities and the situation of the other schools	1

Table 11 "What's your own plan for technology in the next period of time?"
(question for math teachers)
Concentrate on normal teaching and haven't considered about using technologies
15
Hope to do more on technologies, but the equipment/fund/time is insufficient
27
Be ready to make full practice of using modern technology in teaching
17
Be willing to participate if my colleagues research in that direction
33

Most of the math teachers hope to practice, but they feel certain difficulties and need someone else to lead or encourage them!

3. A Special Aspect: Calculators

In Shanghai schools, nearly 99% of the students in Grade 7 have a scientific calculators, and 100% student in grade 8 and upper have one (mainly CASIO and SHARP). Calculators are convenient and easy-carrying equipment for the students, but when they were bringing into the formal teaching process and even the exams, something more should be learn:

Table 12 "How do you think about calculator?"

	A	B	C	D	E
Principals	10	4	0	2	5
Math Teachers	24	12	7	6	41
Students	38	31	24	12	52
Parents	34	17	14	7	38

A: Its main function is scientific calculation
B: It can draw function graphs and edit programs
C: It can de linked with computers
D: It can even collect physical and chemical data
E: It's part of modern technologies

We can see that all of them regard calculator as one part of modern technology, but besides calculation, they seem to unaware with its powerful function of graphing and programming (and the students knows more than their teachers and parents!). If we know little a kind of technology, how can we make full use of it?

Table 13 "Now calculators are allow to be used in classrooms and examinations, how do you think about this?

	A	B	C	D	E
Principals	10	0	0	3	4
Math Teachers	13	3	6	26	42
Parents	29	3	2	40	5

A: Very good, and it should be generalized further
B: It doesn't matter
C: Its side effects are much more than its advantages
D: Both advantages and drawbacks exist, we should take it seriously.
E: Corresponding reform should take place for math textbooks and exams

Math teachers' reaction to this question seems to not coincide with their thought showed in Table 3. Maybe this is because calculators are more concrete and their generalization is easy to be linked with the teachers' daily teaching, as well as the reform of examination.

PART III Comments

1. One Important Problem: Consciousness of all of us

Fund and consciousness, which is more important for the popularization of technology in math education?

As the above situation as concerned, many people would say that it is mainly due to the lackey of fund. But when we think over the situation in Japan and Korea, who are the most developed countries in Asia and famous for its flying economy, we can find that technology are also not so popularly used in their school math as they were expected. So the author think, consciousness is more important than material or financial condition itself. That's just what we can learn from Japan and Korea.

On the one hand, most teachers and parents don't REALLY hope or don't know how to use technology in school math, and the society and leaders won't give more support (esp. beneficial policy and fund), just because they know little about the technology and haven't realized their power in education (the data for calculators is a good example).

These show that we (educators and mathematicians) haven't done enough to make people aware, and OUR views should be renewed by ourselves first!

On the other hand, we have done something with the aid of government and enterprises, but what's the real meaning of using technology: Pentium PC? Beam Projector? Or multimedia tutor CD? Do hardware and software mean all? Or just one or two open-class for using technology is enough?

Many schools leaders and teachers regard the amount of computers and the time for computer courses as the goal as well as the result of using technology; and most of

the teaching software in the market are multimedia CAL CD, which became the "exercise library" for the pupils and students, which make their load much heavier.

So, we should change from outer sensation to inner consciousness.

For the same reason, the new policy on calculators won't cause real effects use we do something accordingly. Here is an example. After an open math class of using graphic calculator, the Principal said: The display of calculator can attract the students and make them concentrate. It also show the power of modern technology and may renew the view of the students. The shortcomings are that the graph is not very clear and accurate, and the capacity of thinking is smaller. Most school teachers prefer utilization to self-study. They hope the new teaching technology to be both practical and convenient, and won't like it if it is complex and cost much time to get familiar and study.

From these truth we can say, that as mathematicians, math educators and math teachers, we need to do something as early as possible. The author make some brief proposal as below.

2. Proposal

In order to make technology more popularized and more valuable in math education, the first step is to promote theoretical and practical research in this area. Math educators, researchers and mathematician ourselves should spend willingly some time on learning and getting familiar with technology, waking up our self-awareness on technology.

Then we should set up close contact with three social groups: school math teachers, educational administrators and technical companies or enterprises who are interested in technological development, thus we can influence them with our new thoughts and get support from them: for our practice, beneficial policy and finical aid. The best way is to set up research project of different levels, which can combine the three groups with us tightly. The three groups in Shanghai are all of the top-level in the whole nation, to make fruitful cooperation with them should be out of question.

Accordingly, we need to bring about changes in the basic aspects of math education: curriculum, textbook, system and content of examination as well as the evaluation standard of math teachers' work (as we have mentioned above, the present school exam system, esp. the College Entrance Exam play the role as a baton (guiding stick), and became the biggest obstacle for fully improving the students' quality as well as the teachers' teaching ability). The second reform for curriculum and textbooks in Shanghai schools will start soon, and since the new term of governmental leaders took up their posts in this spring, some great reform steps have been and will be take in the educational system. Shanghai is sure to be the biggest experiment base.

We should not have any hesitation to grasp the good opportunity, carrying several new standards for math education, making technology spread quickly and properly

into modern school math education in Shanghai, and even the whole country.

REFERENCE

Hwang, H. J., The Current Status on Computer Usage in Korean Schools, *Research in Mathematics Education,* Vol. 1, No 1, 1997

Isoda. M, Connecting Mathematics with Machine Engineering and Art: Perspectives for Calculus and Geometry for All via Technology, paper presented at *Seminar on Mathematics Education in East Asia*, Shanghai 1997

Reports of Third International Mathematics and Science Study, US National Research Center, 1997

Samuna, H., Overview and Proposal on the Use of Calculators in Japanese Schools, *Computational Alternatives for the Twenty-first Century*, NTCM, 1994

Action Agenda for Shanghai School Mathematics into the 21st Century (1997-1910), Shanghai Educational Committee, 1997

Summary Report of National Research Center of Computer in Education (Shanghai Branch), 1997

Summary Report of Teaching and Researching Branch, Shanghai Educational Committee, 1995

Wang, J. Q., Computer in Mathematics Education in China, paper abstract presented at *Seminar on Mathematics Education in East Asia*, Shanghai, 1997