

Current Issues Impacting on Mathematics Education in Japan

Masataka Koyama

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Abstract: The aim of this paper is to highlight the current issues that impact on mathematics education in Japan. To do so, first as a background we outline the educational framework and the brief history of revising school mathematics curriculum from 1947 to 2007 for understanding Japanese education system. Second we give the information about pre-service and in-service mathematics teacher training. Then, we highlight some current issues impacting on Japanese mathematics education from three points of view. The issues on mathematics curriculum are identified in terms of the standard school hours and mathematical contents to be learned for primary and lower secondary school. The issues on children are identified by using a result of the international and national surveys on mathematics education. The issues on mathematics teachers are identified in light of the change of policy and situation concerning mathematics teacher training in Japan.

Key words: mathematics education, issues, Japan

1. Background

1.1 Educational Framework

In 1947, the educational system in Japan was reorganised, both in structure and curriculum. The so-called 6-3-3-4 system of schooling was implemented and has continued in fundamentally the same form to the present day. It is essentially composed of six-year primary school, three-year lower secondary school, three-year upper secondary school and four years of university. Schools and universities are classified as national, local public or private.

The first two levels for nine years — Primary and Lower Secondary — are compulsory education. Children usually start their formal education at 6 years old and change from Primary to Lower Secondary school at age 12 years. Unlike in many other countries, the school year in Japan begins on 1st April and ends on 31st March of the following year.

1.2 History of Mathematics Curriculum

In Japan, the curriculum standard for school is prescribed in the Course of Study issued by the Ministry of Education, Culture, Sports, Science and Technology (*Monbukagakusho*). It is the aim of the Course of Study to help ensure that an optimum level of teaching and learning be secured in all Primary, Lower Secondary and Upper Secondary schools, based on the principle of equal education opportunity for all. The Course of Study provides the basic framework for the curriculum; the aim of each subject and the objectives and contents of teaching and learning at each grade in school.

The Course of Study has been revised approximately every ten years. We could point out

the following as main features of mathematics education based on each Course of Study for mathematics in Japan (Nakahara, T., Fujii, T. and Koyama, M., 2000, pp.228-229).

(1) Life-unit Learning (from 1947 to 1957)

The Course of Study in this period was made under the strong guidance of the American educational mission. The so-called “Life-unit Learning” began to be implemented. The goal of the life-unit learning was to learn how to use mathematics in everyday life. This curriculum was severely criticized, because the level of children’s mathematical performance had dropped.

(2) Systematic Learning (from 1958 to 1967)

In 1958 the Ministry of Education changed the Course of Study from life-unit learning to studying mathematics systematically according to the sequence of mathematical development. The level of mathematical contents to be learned by children became higher.

(3) Modernization (from 1968 to 1976)

The Course of Study in this period was made according to the direction of the international movement of Modernization of Mathematics Education. For example, the concept and symbols of “set” were introduced and pure mathematics was emphasized. However, many children could not understand New Math, so the mass communication, parents and some mathematicians criticized this curriculum.

(4) Back to Basics (from 1977 to 1988)

The Course of Study in this period was influenced by many criticisms to the results of modernization and was characterized as Modification of Modernization. The basic contents of mathematics were emphasized, so the level of mathematical contents was pulled down.

(5) Integration of Cognitive and Affective Aspects (from 1989 to 1997)

In 1989 the Course of Study was revised to integrate cognitive and affective aspects. For example, the following objective for mathematics was set up in the primary level. “To help children develop their abilities to consider daily-life problems insightfully and logically, and thereby foster their attitudes to appreciate the mathematical coping with and to willingly make use of it in their lives.”

(6) Latitude through Intensive Selection of Educational Content (from 1998 to 2007)

During these ten years, such problems as “un-schooling” and “classroom in crisis” have become quite notable and they were attributed to excessively stressed life of children. Therefore the Course of Study was revised and its educational contents were slimmed down intensively. About 30% of mathematical contents were eliminated from Primary and Lower Secondary school level. The revised Course of Study was put into effect in April 2002 for all graders in Primary school and Lower Secondary school, in April 2003 for the first grade in Upper Secondary school, and so on.

1.3 Mathematics Teacher Training

(1) Pre-service Teacher Training

In conformity with this radical change of educational system, in 1949 the Educational Personnel Certification Law and then in 1954 the Regulations concerning the law were established and promulgated. The law and regulations opened the new route for teacher training. The teacher training for primary and secondary schools could be possible not only at national universities of teacher education/faculties of education but also at other non-educational national, local public and private universities/faculties with courses for teacher certificates approved by the Ministry of Education, Science, Sports and Culture (*Monbusho*). Although we had rather major changes in the law and regulations in 1988 and 1998, the spirit of ‘openness’ for teacher certificates

still remains. The categories and classes of teacher certificates and all conditions for each of them, including basic qualifications and required numbers of credits for teacher certificates, are prescribed in the law and regulations.

For each type of school, there are three categories of certificates, *regular*, *special* and *temporary*. The first two types are for regular teachers and the latter is for assistant teachers. Certificates for lower and upper secondary school teachers are further classified according to teaching subject. Lower and upper secondary school teachers therefore teach the subject for which their teacher certificate has been awarded, whilst teachers with a kindergarten or primary school teacher certificate are qualified to teach all subjects (Ministry of Education, Science, Sports and Culture, 2000, p.92).

There are three classes of regular teacher certificates, *advanced class*, *first class* and *second class*. Teachers holding an *advanced class* certificate have earned a master's degree (or its equivalent of 30 credits, obtained by a period of study lasting one year or more in an advanced university course). Those holding a *first class* certificate have earned a bachelor's degree and those holding a *second class* certificate have earned a title of associate, obtained by the completion of junior college. In addition to these basic qualifications, required numbers of credits for teaching and specialized subjects are prescribed by law and other relevant regulations for each teacher certificate class (Ministry of Education, Science, Sports and Culture, 2000, p.92).

For example, Table 1 and Table 2 show the prescribed conditions for regular teacher certificates in the 1988 and in the 1998 law respectively. When we compare the minimum required numbers prescribed in these tables, it is clear that the emphasis has been shifted from teaching subjects (for mathematic teacher, mathematics itself) to specialized subjects such as teacher profession, psychological counseling and mathematics teaching methods. This shift reflects the recent issues of children's school violence and maladjustment to their school and so on.

Table 1: The Prescribed Conditions for Regular Teacher Certificates (1988 Law)

Teacher Certificate	Class of Certificate	Basic Qualification	Minimum Required Number of Credits		
			Teaching Subjects*	Specialized Subjects**	TS or SS***
Primary School Teacher	Advanced Class	Master's Degree	18	41	24
	First Class	Bachelor's Degree	18	41	--
	Second Class	Associate	10	27	--
Lower Secondary School Teacher	Advanced Class	Master's Degree	40	19	24
	First Class	Bachelor's Degree	40	19	--
	Second Class	Associate	20	15	--
Upper Secondary School Teacher	Advanced Class	Master's Degree	40	19	24
	First Class	Bachelor's Degree	40	19	--

Note: * As for teaching subjects, for the primary school teacher certificate students are required to take the subjects such as Japanese Language, Social Studies, Mathematics, Science, Life Environment Studies, Music, Drawing and Handicrafts, Homemaking and Physical Education. For the lower and upper secondary mathematics teacher certificate, students are to take the subjects of Mathematics.

** As for specialized subjects, students have to take three subjects: basic theories for education, curriculum, and teaching methods. For the primary school teacher certificate, five credits for specialized subjects must be obtained by practice teaching. For the lower and upper secondary mathematics teacher certificate, students must obtain three credits by teaching practice.

*** The notation 'TS or SS' means that students must acquire the certain credits for teaching subjects or specialized subjects.

Table 2: The Prescribed Conditions for Regular Teacher Certificates (1998 Law)

Teacher Certificate	Class of Certificate	Basic Qualification	Minimum Required Number of Credits		
			Teaching Subjects*	Specialized Subjects**	TS or SS***
Primary School Teacher	Advanced Class	Master's Degree	8	41	34
	First Class	Bachelor's Degree	8	41	10
	Second Class	Associate	4	31	2
Lower Secondary School Teacher	Advanced Class	Master's Degree	20	31	32
	First Class	Bachelor's Degree	20	31	8
	Second Class	Associate	10	21	4
Upper Secondary School Teacher	Advanced Class	Master's Degree	20	23	40
	First Class	Bachelor's Degree	20	23	16

Note: * As for teaching subjects, for the primary school teacher certificate students are required to take the subjects such as Japanese Language, Social Studies, Mathematics, Science, Life Environment Studies, Music, Drawing and Handicrafts, Homemaking and Physical Education. For the lower and upper secondary mathematics teacher certificate, students are to take the subjects of Mathematics.

** As for specialized subjects, students have to take three subjects: basic theories for education, curriculum, and teaching methods. For the primary school teacher certificate, five credits for specialized subjects must be obtained by practice teaching. For the lower and upper secondary mathematics teacher certificate, students must obtain five and three credits by teaching practice respectively.

*** The notation 'TS or SS' means that students must acquire the certain credits for teaching subjects or specialized subjects.

The teaching practice is mainly undertaken by university attached schools or local schools. To obtain the teacher certificates students are required to acquire the credits of teaching practice including one credit of lesson observations at relevant schools. For the primary and lower secondary school teacher certificates, students must acquire five credits for five weeks at schools, while students for the upper secondary school teacher certificate must acquire three credits for three weeks. In addition, from April 1998, new students are required to work for seven days as caregivers in special education schools and/or social welfare facilities to be awarded regular teacher certificates at primary schools and lower secondary schools (i.e. compulsory education schools).

As stated above, the spirit of 'openness' for teacher certificates still remains. Therefore, in general, the total number of trainee teachers at all universities/institutions in Japan is not easily nor directly controlled by the Ministry of Education. In the case of national universities of teacher education/faculties of education, however, the number of trainee teachers is controlled annually by the Ministry, being based on national recruitment and target figures deduced from all the relevant factors such as the increase/decrease in the number of pupils in each education sector (primary/secondary), the current age profile of teachers, the current financial situation faced by the government and so on.

For example, in the case of 48 national universities of teacher education/faculties of education, the number of trainee teachers has been changed as shown in Table 3. Recently, in 1997, the government set out a plan for reducing the total 5,000 trainee teachers at national universities/faculties in next three years. This policy decision seems to be made because of the recent weak financial situation and the lower employment rate of graduates from the national universities as school teachers; in 1997, only 41% of graduates were employed as teachers, including part-time teachers.

Table 3: Change of the Number of Trainee Teachers at National Universities

Year	Number of Trainee Teachers
1949	24,355
1959	16,085
1969	16,485
1979	19,770
1989	17,265
1999	11,270
2001	9,750

(Source: Social Meeting on Ideal Way of National Universities/Faculties for Teacher Training, 2001, p.7)

(2) In-service Teacher Training

Public school teachers are local prefectural or municipal public officials and are appointed by the respective local prefectural or municipal boards of education in which the schools are located. Public school teachers are selected for employment through competitive examinations under the provision of the Local Public Service Personnel Law.

In their first year of teaching, teachers are conditionally employed, as is stipulated by the Law for Special Regulations Concerning Educational Public Service Personnel. During this period new teachers are given 'induction training', and are then formally appointed if they receive a favorable evaluation of their performance during this conditional employment period.

A system of 'induction training' for beginning teachers was created in the school year 1989 by the Law of Special Regulations Concerning Educational Public Service Personnel. It is conducted for all new teachers in national and public primary, lower secondary and upper secondary schools, schools for the blind, the deaf and other disabled, for the first year of their appointment. This induction training program is spread out over the school year for a total of at least 90 days, 60 days or more of which are school based training during which new teachers receive instruction from their advising teacher, and not less than 30 days of which are spent attending lectures, seminars and various practical training sessions that include five day workshops held in education centers or other institutions outside the school. Prefectural boards of education and the boards of education in 12 designated cities plan concrete programs of induction training for new public school teachers and provide substitute teachers during the training sessions. In order to promote communication among teachers from different types of schools and from various geographical regions, the Ministry conducts a 9-day induction training ocean cruise in cooperation with the prefectural boards of education.

The competence and quality appropriate to the professional responsibility of teachers are developed gradually throughout the various stages of their career. Because the Law of Special Regulations Concerning Educational Public Service Personnel requires teachers to pursue consistent in-service training, various systematic programs are conducted at national, prefectural and municipal levels, at schools and at other levels.

At the national level, the Ministry of Education, Culture, Sports, Science and Technology holds 'central workshops' for the in-service training of principals, vice-principals, coordinating and advising teachers on subject matters that play the leading role at the prefectural level. The Ministry also sends about 5,000 teachers abroad every year in order to broaden their international perspective and to gain an increased consciousness of their chosen profession. The Ministry also gives grants for in-service training administered by prefectural boards of education, teacher training organizations and others.

Prefectural boards of education are required by law to be responsible for planning and encouraging daily in-service training in local public schools. Prefectural education centers which have lodging facilities, educational equipment and apparatus and professional staff, play an important role in in-service training. Prefectural boards of education also dispatch teachers to universities, research institutes, private firms and other institutions for long-term training in order to improve their professional competence and their social character. Moreover, prefectural boards conduct periodic in-service training at different stages of a teacher's career, for example, after 5 years, 10 years and 20 years of service. Another type of in-service training is directed towards meeting the learning needs of teachers in various positions such as principals, vice-principals and coordinating and advising teachers. In addition to these training programs offered by prefectural boards of education, various lectures and workshops are held by municipalities and educational organizations as well (Ministry of Education, Science, Sports and Culture, 2000, p.98).

2. Issues Concerning Mathematics Curriculum

In December 1998, the Ministry had revised the Course of Study for the primary and lower secondary school mathematics, and decided to introduce a five-day week schooling system and to create time for integrated learning as a new course (Ministry of Education, Science, Sports and Culture, 1999a; 1999b). As a result of the revision, the number of hours for mathematics teaching was reduced by 14% throughout the six years of primary school and 18% throughout the three years of lower secondary school, as shown in Table 4 and Table 5 respectively.

Table 4: The Standard School Hours a Year for Primary School Mathematics

<i>Grade</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>
1989 Course of Study	136	175	175	175	175	175
1998 Course of Study	114	155	150	150	150	150

Table 5: The Standard School Hours a Year
for Lower Secondary School Mathematics

<i>Grade</i>	<i>1</i>	<i>2</i>	<i>3</i>
1989 Course of Study	105	140	140
1998 Course of Study	105	105	105

Moreover about 30% of mathematical content was removed so as to foster children's positive attitude toward mathematics and to provide time for children mathematical activities that promote children's creative thinking in the limited time for mathematics.

The problems that were recognized by the Ministry at that time were:

- i) The teaching style for mathematics was a teacher-centered approach and children learn mathematics passively;
- ii) Children's ability to think mathematically and multilaterally was not sufficiently exercised;
- iii) While the children's average score in mathematics was relatively high, many children did not have a positive attitude toward mathematics.

The issues concerning mathematics curriculum are as follows.

- The Ministry says that the Course of Study is a minimum standard for all children. What

are minimum essentials in primary and lower secondary school mathematics?

- Are the above standard hours a year for primary and lower secondary school mathematics enough?
- Is it an appropriate decision that about 30% of mathematical contents were removed?

3. Issues Concerning Children

As a result of the international survey of the TIMSS in 1995 and TIMSS-R in 1999, the average score of Japanese children in mathematics is the fifth position and belongs to the higher rank. The average score of Japanese children in the fourth grade (1995) is +50 points and the score of children in eighth grade (1999) is +55 points in comparison with an international average score (National Institute for Educational Policy Research of Japan, 2001, pp.18-20).

On the other hand, the result of the children questionnaire in TIMSS-R (National Institute for Educational Policy Research of Japan, 2001, pp.48-58) shows that the Japanese eight graders' average time for studying mathematics after school is 0.6 hour (the international average is 1.1 hour) and that only 48% of Japanese eight graders like mathematics (the international average is 72%). It means that many Japanese children do not have a positive attitude toward mathematics. The same fact is also identified by the Japan national survey in 2002. The percentages of children who like mathematics are 53.9% in the fifth grade, 47.3% in the sixth grade, 44.4% in the seventh grade, 42.8% in the eighth grade and 45.0% in the ninth grade (National Institute for Educational Policy Research of Japan, 2003, p.17).

The issues concerning children's mathematical ability and attitude are as follows.

- While the children's average score in mathematics is relatively high, many children do not have a positive attitude toward mathematics. Why?
- Is there any relation between the children's negative attitude toward mathematics and the change of social and economical situation in Japan around them?
- Is there a reason of Japanese children's negative attitude that many children do not find the usefulness of school mathematics in their lives?

4. Issues Concerning Mathematics Teachers

Recently the situation concerning teacher training has been dramatically changed in Japan. In 1997, the government set out a plan for reducing in total 5,000 trainee teachers (about 30%) at national universities/faculties for teacher training. In 2002 the five-day week schooling system was implemented at all national and local public schools and the number of school hours for mathematics at primary and lower secondary level was reduced (Ministry of Education, Science, Sports and Culture, 1999a; 1999b). Moreover, from April 2004 all national universities were reorganized as independent administrative corporation universities. These political decisions clearly seem to have been made as a result of the recent weak financial situation and the lower employment rate of graduates from the national as school teachers in Japan.

On the other hand, as has been shown by national and international surveys, many children at primary and secondary schools have a negative attitude towards mathematics, while the average score of Japanese children's achievement in mathematical knowledge and skill is relatively high. The diversity in mathematical achievement/ability of primary and secondary school children has been increasing. Moreover, mathematics curricula and teaching methods cannot ignore the rapid progress and spread of technology and the influence of calculators and computers on mathematics education.

These changes and facts necessarily force mathematics teachers to reflect seriously on their educational philosophy and teaching methods for mathematics. Training courses for mathematics teachers at universities also have to be changed to meet the needs of pre-service and in-service teachers and of Japanese society (Koyama, 2004, p.164).

The issues concerning mathematics teacher training are as follows.

- The teacher training courses have a weak school based component; for primary and lower secondary school teacher certificates there are only five weeks of teaching practice and for the upper secondary school teacher certificate just three weeks of teaching practice at schools (Koyama, 2008). Is it enough? If not, how can we make a balance between university-based work and school-based work?
- The number and capacity of schools for trainee teachers is limited. Is it possible to find local public schools where there are good mentors for mathematics?
- The link between content knowledge (mathematics) and pedagogical knowledge (education) is not always strong. Does the teacher training course need more staff specializing in mathematics education?
- Many incoming primary teachers do not have enough understanding of mathematical concepts for a specialist in mathematics. Is it reasonable and possible to ask them to take tests of all six mathematics subjects such as Mathematics I, II, III, A, B and C taught at Upper Secondary school?
- The employment rate of graduates from national universities as school teachers is very low. How should we do to improve the rate?
- The recent changes in education necessarily force mathematics teachers to reflect seriously on their educational philosophy and teaching methods for mathematics. Is the Lesson Study (*Jugyo-Kenkyu*) in school effective for that purpose?

5. Final Remarks

In this paper we highlighted some current issues that impact on mathematics education in Japan. First the issues on mathematics curriculum were identified in terms of the standard school hours and mathematical contents to be learned for primary and lower secondary school. Second the issues on children were identified by using a result of the international and national surveys on mathematics education. Third the issues on mathematics teachers were identified in light of the change of policy and situation concerning mathematics teacher training in Japan.

In March 2008, the Ministry of Education revised the Course of Study for the primary and lower secondary school mathematics (Ministry of Education, Science, Sports, Culture and Technology, 2008a; 2008b). The revised Course of Study will be put into effect in April 2011 for all graders in Primary school and in April 2012 for all graders in Lower Secondary school.

As a result of the revision, the number of hours for mathematics teaching is increased by 16% throughout the six years of primary school and 22% throughout the three years of lower secondary school as shown in Table 6 and Table 7 respectively. Some mathematical contents are newly added and shifted to primary from lower secondary and to lower secondary from upper secondary school mathematics in the policy of more emphasizing school mathematics in the next decade than the present. Moreover, in the process of teaching and learning mathematics, children's mathematical activities are more emphasized as methods and contents in order to foster children's positive attitude toward mathematics, to appreciate learning mathematics, and to promote children's ability of thinking, representing and communicating mathematically by using the increased hours for mathematics in both primary and lower secondary school.

Table 6: The Standard School Hours a Year for Primary School Mathematics

<i>Grade</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>
1998 Course of Study	114	155	150	150	150	150
2008 Course of Study	136	175	175	175	175	175

Table 7: The Standard School Hours a Year
for Lower Secondary School Mathematics

<i>Grade</i>	<i>1</i>	<i>2</i>	<i>3</i>
1998 Course of Study	105	105	105
2008 Course of Study	140	105	140

About the mathematics teacher training, there are two changes to be noted in Japan. The one is that some universities have just established the two-year graduate school for teaching profession in order to improve teachers' professional ability to cope with practical issues in school. The other is the Ministry of Education in Japan has made such a decision that all school teachers must renew their teacher certificate every ten years by participating in in-service training programs of education in general and their teaching subject provided at universities/institutions mainly in the summer and winter vacation. The in-service training programs will be officially started from 2009 for a huge number of teachers in all areas in Japan.

It could be said that we are now at the starting point in a transit period for changing and improving mathematics education in Japan. To do successfully at the intended, implemented, and attained levels, we need to face up to and overcome the current issues highlighted in this paper.

Note: This paper is a modified and longer version of the paper presented at the seminar on mathematics education at University of Missouri Columbia, USA in September 2004.

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