Chapter 8
Pre-service Teacher Training for Secondary School Mathematics in Japan and Korea

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Abstract It is well recognized that there are many similarities between Japan and Korea in terms of school mathematics curriculum policy, students' high achievement in international assessments such as the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA), and negative attitudes toward school mathematics (Wong, Koyama, & Lee, 2013). On the other hand, not much has been written about the guidelines and contents of undergraduate mathematics education curricula in the two education systems, including teaching practicums for pre-service secondary school mathematics teachers. In this chapter, we attempt to fill this gap by identifying similarities and differences in Japanese and Korean approaches to supporting pre-service teachers' awareness and knowledge development in the department of mathematics education. We will mainly focus on two aspects of pre-service teacher training for secondary school mathematics: (a) prescribed conditions for teaching certificates and (b) undergraduate curricula for training secondary school mathematics teachers in Japan and Korea. To illustrate these aspects we examine Hiroshima University in Japan and Korea National University of Education in Korea, because their pre-service programs are typical models of each country's mathematics teacher training programs. We will identify similarities and differences between the programs, and discuss some issues to improve the guidelines and contents of undergraduate curriculum in training pre-service teachers for secondary school mathematics. Further comparative study on pre-service mathematics teacher training can be stimulated through more in-depth international analyses of these elements.

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Introduction

Education is a key factor in understanding Japanese and Korean societies. Both societies have substantial interest in children's education, so parents and governments make great investments into their children's education to provide them with a better life. The two societies likewise have a long tradition of treating teachers with great respect, perhaps influenced by Confucian heritage which emphasizes education and devotion to one's family. Both countries' universities also feature high-level teacher training programs, so teachers are believed to be well equipped with pedagogical and subject content knowledge. Such keen interest in education and the quality of teachers is considered one of the main reasons why Japanese and Korean students perform so well in such international comparative studies as the Trends in International Mathematics and Science Study (TIMSS), the Third International Mathematics and Science Study-Repeat (TIMSS-R), and the Programme for International Student Assessment (PISA) (Mullis, Martin, Foy, & Arora, 2012; National Institute for Educational Policy Research, 2001, 2004; Organization for Economic Co-operation and Development, 2010). But it has been reported that Japanese and Korean students have a low interest, value, and confidence in mathematics despite ranking in the highest grades on international mathematics tests (Mullis et al., 2012). Believing that this mismatch arises from traditional teaching methods such as memorizing and solving problems without understanding of mathematical concepts, the Ministries of Education (MOEs) of the two countries have carried out various programs and policies to improve the quality and capability of teachers, under the philosophy that the quality of education cannot exceed the quality of teachers.

This chapter characterizes these efforts by looking at curricula of the department of mathematics education of Hiroshima University in Japan and Korea National University of Education in Korea, both of which are among the top education programs in their respective countries. The two universities were selected as typical models of mathematics teacher training in Japan and Korea, based on their pre-service teacher training programs as well as their research on teacher education.

Prescribed Conditions for Teaching Certificates

In both Japan and Korea, the pre-service teacher training for teaching certificates is undertaken by universities which have 4-year programs approved by the MOE in partnership with university-attached schools, or with local schools if the university

has no attached school. Teaching practicums are mainly undertaken at university-attached schools or local schools. Training for secondary school teachers is provided not only at national universities of teacher education/faculties of education but also at other noneducational national, public, and private universities/faculties with certificate coursework approved by the MOE. This section describes the prescribed conditions for teaching certificates in Japan and Korea, respectively.

Required Credits for Teaching Certificates

Table 8.1 shows the prescribed conditions for secondary school teaching certificates according to the regulations for teaching certificates in Japan, in terms of the minimum credits required in 4-year undergraduate program at MOE-authorized universities (Koyama, 2008). Additionally, to earn teaching certificates university students have to take courses in four areas: the Constitution of Japan (2 credits), Health and Sports (2 credits), Foreign Language Communication (2 credits), and Information Studies (2 credits), all in the category of Liberal Arts. In terms of the prescribed conditions, there is a little difference between lower and upper secondary school teaching certificates. University students pursuing the lower secondary school teaching certificate need more credits in Curriculum and Teaching Methodology courses, including a course in Teaching Methodology of Moral Education and a Teaching Practicum in the category of Teaching Profession, compared to those pursuing the upper secondary school teaching certificate.

Table 8.2 shows the undergraduate curriculum framework for the program in secondary mathematics education at Hiroshima University (HU) in Japan. The framework consists of two main education categories: Liberal Arts Education (40 credits) and Specialized Education (88 credits). The framework fulfils the requirements shown in Table 8.1 for both lower and upper secondary school teaching certificates of mathematics. Specialized Education is divided into four

Table 8.1 Prescribed conditions for secondary school teaching certificates in Japan

Category	Course	Lower secondary	Upper secondary
Teaching profession	Significance of Teaching Profession	2	2
	Basic Theory of Education	6	6
	Curriculum and Teaching Methodology	12	6
	Student Counselling	4	4
	Teaching Practicum	5	3
	Practical Seminar for Teaching Profession	2	2
	Subtotal	31	23
School subjects	Algebra, Geometry, Analysis, Probability and Statistics, Computer Science	20	20
Electives	Courses in Teaching Profession or School Subjects	8	16

Notes: In general, earning 1 credit requires attending fifteen 45-min classes

Table 8.2 Credits required to complete the program in secondary mathematics education at HU

Category of education and courses				Credits		
Liberal arts education	Core Courses	Introductory Seminar for First Year Students		2		40
		Peace Science Courses		2		
		Integrated Courses		6		
	Common Courses	Foreign Languages	English	8		
			Others	4		
		Information Courses		2		
		Area Courses		6		
		Health and Sports Courses		2		
	Foundation Courses			8		
Specialized education	Basic Specialized Courses	Mathematics Education		8	26	88
		Algebra		4		
		Geometry		4		
		Analysis		4		
		Probability and Statistics		4		
		Computer Science		2		
	Specialized Courses			20		
	Elective Specialized Courses and Free Elective Courses			36		
	Graduation Research			6		
Total credits for graduation				128		

categories: Basic Specialized courses (26 credits), Specialized courses (20 credits), Elective Specialized courses and Free Elective courses (36 credits), and Graduation Research (6 credits).

In Specialized Education, students take specialized (basic) courses from professors in the department of mathematics education in order to study both mathematics education and mathematics. Additionally, they take elective specialized courses to study the significance of teaching as a profession, basic theories of education, and student counselling, from professors in the department of education and the department of psychology. Teaching Practicum courses are included in this category. Depending on their interests, students can also take other specialized courses in either the faculty of education or the faculty of science. Finally, they have to do their own graduation research on mathematics education and submit a graduation thesis.

At HU, the department of mathematics education in the faculty of education accepts about 22 undergraduate students every year through highly competitive entrance examinations. Almost all students graduate with both lower and upper secondary mathematics teaching certificates, though in principle they can graduate the program without earning any teaching certificate. On the other hand, students of mathematics in the faculty of science and the faculty of integrated arts and sciences can get both or either certificate(s) when they take some Teaching Profession courses provided by the faculty of education for teaching certificates. Therefore,

Table 8.3 Prescribed conditions for secondary school teaching certificates in Korea

Category	Course	Minimum credits required
Teaching profession	Introduction to Education (2) Educational Philosophy and History of Education (2) Theory of Curriculum (2) Educational Evaluation (2) Educational Methodology and Technology (2) Educational Psychology (2) Educational Sociology (2) Teaching Practicum (4)	22
Basic mathematics subjects	Theory of Mathematics Education (3) Number Theory (3) Complex Analysis (3) Advanced Calculus (3) Linear Algebra (3) Modern Algebra (3) Differential Geometry (3) Introduction to Geometry (3) Topology (3) Probability and Statistics (3) Combinatorics and Graph Theory (3)	21
Elective Mathematics Subjects	Courses in other Mathematics Subjects besides Basic Mathematics Subjects	30

Notes: In general, earning 1 credit requires attending fifteen 50-min classes

about 60 students earn one or both certificates every year at HU. Although these certificates are issued by the Hiroshima Prefecture Board of Education, they are valid anywhere in Japan.

In Korea, secondary mathematics teachers are trained mainly in the department of mathematics education at colleges of education, and partially in the department of mathematics or the department of statistics at comprehensive universities and graduate schools of education. In general, the curriculum for all pre-service secondary teachers, including mathematics teachers, sets the graduation credit requirements between 130 and 150 credits of liberal arts courses, major courses, and free elective courses (Cho & Choe, 2012). Table 8.3 shows the major courses required by the Korean MOE for secondary school teaching certificates. Course categories include the Teaching Profession (22 credits) and Mathematics Subjects (51 credits), which includes seven of the eleven Basic Mathematics Subjects: Theory of Mathematics Education, Number Theory, Complex Analysis, Advanced Calculus, Liner Algebra, Modern Algebra, Differential Geometry, Introduction to Geometry, Topology, Probability and Statistics, and Combinatorics and Graph Theory.

The main characteristic of the Korean curriculum for secondary mathematics teachers is a strong emphasis on subject matter knowledge such that there is almost no curricular difference between the department of mathematics and the department of mathematics education. This means that most of the educational institutions attempt to maintain a high level of mathematics knowledge among future teachers,

and that Korean secondary mathematics teachers are expected to possess strong mathematical knowledge. However, recently there have been curricular reforms in the pre-service teacher institutions, aimed at enhancing the correlation between teachers' subject matter knowledge of school mathematics and their actual teaching practice (Kim et al., 2010). A number of universities offer programs to develop the teaching competencies of pre-service teachers and to make connections between theories and teaching practice. Through these programs, pre-service teachers are expected to develop their expertise in implementing curriculum, by applying and integrating the core structure of their subject matter knowledge to school curriculum (Kim et al., 2010).

Table 8.4 shows the undergraduate curriculum framework for the program in secondary mathematics education at Korea National University of Education (KNUE) in Korea. The framework consists of five main education categories: Liberal Arts Education (21 credits), Teaching Profession courses (24 credits), Mathematics Major courses (57 credits), Free Elective courses (38 credits), and a Dormitory Education Program (Pass/Fail). Liberal Arts Education consists of three types of programs peculiar to KNUE as a comprehensive university to cover all school levels from kindergarten to senior high school. Teaching Profession courses also include three types of programs to bring together theory and practice in the teaching profession. A unique aspect of the undergraduate curriculum for teaching certificates in Korea is that pre-service teachers have to volunteer for a minimum of 60 hours in their educational communities, in addition to the regular teaching

Table 8.4 Credits required for graduation in secondary mathematics education at KNUE

Category of education and courses			Credits		
			Major	Double major	
Liberal arts education	KNUE vision		3		
	KNUE Special	Leadership	6		
		Character			
		Globalization Manner			
	KNUE general		12		
Teaching profession	Theory of Teaching Profession		12		
	Basic Knowledge of Teaching Profession		6		
	Teaching Practicum	School Teaching Practicum	4	2	
		Educational Service	2		
Mathematics major courses	Mathematics Education	Compulsory	3	3	57
		Elective	6	6	
	Mathematics	Compulsory	18	18	
		Elective	30	30	
Free elective			38		
Dormitory Education Program			P/F		
Total credits for graduation			140	59	

practicum performed at the attached schools or the partner schools. This regulation was introduced to enhance pre-service teachers' general knowledge of the educational community. In the mathematics major courses, students in the department of secondary mathematics education take at least 57 credit hours of specialized courses from professors in the department of mathematics education. Additionally, they have to take 38 more credits from any area in the curriculum; usually they take mostly mathematics major courses to increase their abilities in pedagogical content knowledge and subject matter knowledge.

Table 8.4 also shows the undergraduate curriculum framework for the program in secondary mathematics education for double majors who want to earn certification in both mathematics and another subject like physics or technical education. All students who want to take mathematics as a double major have to take Mathematics Major courses (57 credits) and Teaching Practicum (2 credits) within the program in secondary mathematics education, besides the courses for their major subjects. Students who want double majors in mathematics and another subject do not need to take the Liberal Arts education, Teaching Profession, Free Elective, and Dormitory Education Program twice, except for taking 2 credits of Teaching Practicum for their minor subject.

The Teacher Employment Examination

In Japan, public school teachers are local prefectural or municipal public officials, and are employed 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. This means that students with teaching certificates cannot always become teachers after graduating from a university. In the summer, usually July and August, fourth-year students who want be teachers have to take two-step employment examinations for lower secondary or upper secondary school teachers in a certain prefecture/city. The first step is usually done through paper and pencil tests in psychology, liberal arts, education laws and regulations, and their major school subjects (here, mathematics education and mathematics). After passing the first step, students must take the second step examination, which usually consists of micro teaching, group discussion, and interviews. If students pass the second test, they will be able to become school teachers starting in April of the next academic year. If students unfortunately fail the employment examinations, they have to wait and take them again the next year. In the case of private schools, the institution itself selects teachers using its own employment examination.

The test items and discussion/interview questions for teacher employment examinations are developed by the individual local board of education without any involvement of university professors. The number of newly employed teachers is not stable but changes every year, based on prefecture/city recruitment and target figures deduced from several relevant factors, such as the increase/decrease in the number of school students and the current age profile of teachers in its region.

Generally speaking, the employment rate of university graduates as school teachers is low. Examination pass rates are available, but the data does not specify multiple tries. For example, the AY 2014 data for the employment examinations for secondary school mathematics teachers in Hiroshima Prefecture and Hiroshima City shows that 28 out of 129 examinees passed the second test for lower secondary school mathematics teachers, while 19 out of 146 examinees passed the second test for upper secondary school mathematics teachers to be employed in Hiroshima Prefecture or Hiroshima City (Hiroshima Board of Education, 2014). Those who pass the examination are assigned to a school in the area by the Local Board of Education.

Like in Japan, completing the 4-year teacher education in Korea does not in itself guarantee a teaching position in public schools. Upon their graduation from the college of education, teacher candidates are conferred the "second-level" secondary school teacher qualification, which makes them eligible to apply for the national Teacher Employment Test (TET) for teaching in secondary schools. Each of 17 provincial superintendents selects teachers from those who hold teaching certificates through open competition, to hire teachers in their local public schools. If teacher candidates want to teach in a public school, they must pass the national examination with a high competition rate, ordinarily over 20 to 1. In the case of private schools, the institution itself selects its own teachers. The first open competition examination for the selection of secondary public school teachers was conducted in November 1991. The Provincial Offices of Education forms "the committee for teacher recruitment" and entrusts a research institute such as Korea Institute of Curriculum and Evaluation (KICE) to develop and score the TET. Table 8.5 shows the structure of the current TET for elementary and secondary school teachers in Korea (Lew, 2015).

Table 8.5 Structure of the current TET for elementary and secondary school teachers in Korea

Phase	Applicants	Test	Test Contents	Examination Type	Secondary School	Elementary School
Phase 1	All applicants	Pedagogy	Pedagogy	Essay Type	60 min	60 min
		Major A	Pedagogical Content Knowledge (25–35%) Subject Matter Knowledge (65–75%)	Short Answer Type	90 min	70 min
		Major B		Sentence Completion Type Descriptive Type	90 min	70 min
		History of Korea		Substitution by Korean History Ability Test		
Phase 2	Successful Candidates of Phase 1	In-depth Interview of PCK			10 min	60 min
		Making a Teaching Plan			60 min	20 min
		Teaching Demonstration			20 min	10 min
		English Interview				10 min
		English Teaching Demonstration				10 min

The TET for being a public school teacher has had a great influence on teacher quality as well as the curriculum of teacher education programs. Teacher training universities are sensitive to the TET in the management of their teacher training programs in order to increase the pass rates of their graduates. The TET consists of two phases: a written examination, and an interview and teaching demonstration. The first phase screens 150% of the number of final candidates through a general education theory examination, two types of mathematical examinations, and a Korean History Ability Test. The final successful candidates are chosen by the second phase, consisting of three kinds of interviews and demonstration processes: an In-depth Interview of Pedagogical Content Knowledge (PCK), Making a Teaching Plan, and a Teaching Demonstration. Unlike secondary teachers, for elementary teachers an English Interview and English Teaching Demonstration are also required, because English is introduced into the elementary school curriculum starting in the 3rd grade.

Undergraduate Curricula for Training Secondary School Mathematics Teachers

In Japan and Korea, mathematics teachers teach mathematics to their students based on the national standards, using mathematics textbooks approved/authorized by the MOEs according to the standards. The national standards for K-12 education in Japan and Korea are prescribed in the Course of Study or National Curriculum issued by the MOE, each of which provides the overall objectives of each subject and the objectives and contents of teaching for each grade level (Koyama, 2010; Wong, Koyama, & Lee, 2013). These Courses of Study and National Curricula are closely related with the curricula of the teacher training courses in both countries. This section begins with background information on secondary school mathematics to describe the curricula of the teacher training courses at HU and KNUE.

Background Information on Secondary School Mathematics

In Japan, the current Courses of Study for lower and upper secondary schools emphasize students' mathematical activities in the teaching and learning of mathematics so that through their self-directed mathematical activities students acquire fundamental mathematical knowledge and skills, cultivate their thinking-judging-representing ability, and foster a positive attitude toward learning mathematics (MOE Japan, 2008, 2009). Notably, for the first time the current Courses of Study have incorporated mathematical activities into the mathematics curriculum for grades 7–10 as "content" to be taught and learned, like in other content areas. For example, when learning each of four content areas and the connections among

them, lower secondary school students should be provided with opportunities to do mathematical activities like the following: (a) activities for finding out and developing the properties of numbers and geometric figures based on previously learned mathematics, (b) activities for making use of mathematics in daily life and society, and (c) activities for explaining and communicating with each other in an evidenced, coherent, and logical manner by using mathematical representations (MOE Japan, 2008). The secondary school mathematics teachers are also expected to contribute to students' character building through teaching mathematics in schools.

In lower secondary schools, all students learn mathematics for 3 years: 4 unit-hours per week in Grade 7, 3 unit-hours per week in Grade 8, and 4 unit-hours per week in Grade 9 (1 unit-hour is 50 min in lower secondary school). Lower secondary school mathematics consists of four content areas: "A. Numbers and Algebraic Expressions," "B. Geometric Figures," "C. Functions," and "D. Making Use of Data." The upper secondary school mathematics is organized around the idea of a "core-option" such that Mathematics I (3 credits), Mathematics II (4 credits), and Mathematics III (5 credits) are core subjects, while Mathematics A (2 credits), Mathematics B (2 credits), and Application of Mathematics (2 credits) are electives (1 credit in upper secondary school means one 50-minute class per week for a year). In upper secondary schools, students do not necessarily learn all mathematics subjects. In fact, Mathematics I (3 credits) is the only compulsory subject for all students. At the other extreme, those students who intend to study science at a university take all the available mathematics classes during their 3 years of upper secondary school.

In Korea, the current school mathematics curriculum was revised in 2011 (MOE Korea, 2012). This creativity-focused curriculum rejects rote learning and emphasizes mathematical process including manipulation activities; the connection between mathematics and everyday life; independent problem solving; reasoning, communication, and justification by students' intuitive understanding; and established knowledge and thinking skills (Lew, Cho, Koh, Koh, & Paek, 2012). In order to actualize such new instructional directions, the content that had been taught mechanically was substantially eliminated, which led to a significant reduction in students' workload (Hwang et al., 2011).

In lower secondary school, all students learn mathematics for 3 years: 3 unit-hours per week in Grade 7, 4 unit-hours per week in Grade 8, and 3 unit-hours per week in Grade 9. The curriculum is comprised of five areas: Numbers and Operations, Letters and Expressions, Functions, Probability and Statistics, and Geometry. Throughout the five areas the curriculum recommends the use of computer technology, for example, in drawing geometric figures and graphs, calculating, or manipulating data.

In upper secondary school, the mathematics subjects consist of six 5-unit elective courses: Math I, Math II, Calculus I, Calculus II, Geometry and Vectors, and Probability and Statistics. Math I and Math II include basic content needed for covering calculus, and Calculus I and Calculus II consist of basic calculus, calculus of polynomial functions, and calculus of transcendental functions. Additionally, as

knowledge of probability and statistics is widely required in modern society, Probability and Statistics is provided as one independent subject, and Geometry and Vectors has also been placed as an independent subject. In addition, the curriculum considers various levels of students by providing level-specific courses like Basic Math, Advanced Math I, and Advanced Math II. Basic Math is an introductory course designed for students who are not equipped with a sound foundation in lower secondary school mathematics. Some students can select Advanced Math I and II in order to reach a systematic understanding of high-level mathematical concepts needed for studying at the Science High Schools.

Undergraduate Curricula for Teaching Certificates

In the following sections, as a case study, we compare the undergraduate curricula for training secondary school mathematics teachers at HU and KNUE in order to identify similarities and differences between them. For that purpose, we decompose the two undergraduate curricula into four areas: mathematics education, mathematics, the teaching profession, and school-based work.

Mathematics Education

Table 8.6 shows the mathematics education curricula at HU and KNUE. At HU, for teaching certificates in secondary school mathematics, students are required to take two courses in Introduction to Mathematics Education in Year 2. However, for graduation, the students in the secondary mathematics education major are required to take all the mathematics education courses in Years 1 and 2, and required to take almost all of those in Years 3 and 4, in order to deepen their pedagogical content knowledge. This is designed to enhance their teaching skills and research abilities, which are needed not only for teaching mathematics in secondary schools but also for doing in-depth study/research on mathematics education in Master's and PhD education programs after completing the undergraduate program.

At KNUE, for teaching certificates in secondary school mathematics and for overall graduation, students are required to take Introduction to Mathematics Education, Researches in Teaching Materials, and Essay Writing in Mathematics. However, students are also required to take five courses in mathematics education in order to deepen their pedagogical content knowledge and enhance their teaching skills. Interestingly, Essay Writing in Mathematics is an integrated subject which is taken in the 7th semester (Year 4). It aims to foster students' critical writing abilities by integrating mathematics and pedagogy. In order to attain this end, students are taught to compose their thoughts logically based on their knowledge of algebra, mathematical analysis, geometry, topology, and statistics, and of curriculum, methodology, assessment, history of mathematics, and mathematical philosophy.

Table 8.6 Mathematics education courses in the HU and KNUE curricula (credits)

Year	Semester	HU	KNUE
1	1		
	2	Methodology of Mathematics Education (2)	
2	3	Introduction to Mathematics Education I (2)	Introduction to Mathematics Education (3)
	4	Introduction to Mathematics Education II (2) Design of Mathematics Education (2)	Research in Teaching Materials (3) Instructional Technology for Mathematics (3)
3	5	Curriculum in Mathematics Education (2) Evaluation in Mathematics Education (2)	Theory of Mathematics Curriculum (3) Teaching Methods of Secondary School Mathematics (3)
	6	Research on Mathematics Education (2) Research on Methodology in Mathematics Education (2)	
4	7	History of Mathematics Education (2) Practice of Mathematics Education (2) Practical Research on Mathematics Education (2) Practical Research on Methodology in Mathematics Education (2)	Essay Writing in Mathematics (3)
	8	Special Study for Graduation (6)	

Mathematics

Table 8.7 shows the curricula of the mathematics area at HU and KNUE. At HU, to earn a teaching certificate in secondary school mathematics, students are required to take at least 20 credits in mathematics. For graduation, the students in the secondary mathematics education major are required to take all the mathematics courses in Years 1 and 2, and almost all of those in Years 3 and 4, in order to deepen their content knowledge and enhance their teaching skills and research abilities. At KNUE, for both the secondary teaching certificate and for graduation, students must take 18 credits in 6 required courses (Analysis I, Complex Analysis I, Modern Algebra I, Differential Geometry I, Topology I, and Probability and Statistics I) and 30 credits in 10 elective courses. Algebra for Teachers and Probability and Statistics are the courses designed to connect university algebra and school algebra and university Probability and Statistics with their school counterparts. Applied Mathematics and Practice I and II are comprehensive courses for senior students who are preparing for the Teacher Employment Test.

Table 8.7 Mathematics courses in the HU and KNUE curricula (credits)

Year	Semester	HU	KNUE
1	1	Introduction to Mathematics (2) Calculus and Its Practice (2)	Calculus and Practice I (3) Set Theory (3) Number Theory (3)
	2	Matrix Theory and Its Practice (2)	Calculus and Practice II (3) Modern Geometry (3) Discrete Mathematics (3)
2	3	Introduction to Algebra (2) Introduction to Geometry (2) Introduction to Analysis (2) Introduction to Statistics (2) Computer Practice I (2)	Analysis I (3) Linear Algebra (3) Mathematical Modeling and Practice I (3) Differential Equation (3)
	4	Practice in Introduction to Algebra (2) Practice in Introduction to Geometry (2) Practice in Introduction to Analysis (2) Computer Practice II (2)	Analysis II (3) Modern Algebra I (3) Mathematical Modeling and Practice II (3)
3	5	Research Methods in Algebra (2) Research Methods in Geometry (2) Research Methods in Analysis (2) Research Methods in Probability and Statistics (2)	Complex Analysis I (3) Differential Geometry I (3) Numerical Analysis and Practice (3) Modern Algebra II (3) Mathematical Planning (3)
	6	Study of Instructional Materials in Algebra (2) Study of Instructional Materials in Geometry (2) Study of Instructional Materials in Analysis (2) Study of Instructional Materials in Mathematical Statistics (2)	Topology I (3) Probability and Statistics I (3) Complex Analysis I (3) Differential Geometry I (3)
4	7	Study of Instructional Materials in Algebra Education (2) Study of Instructional Materials in Geometry Education (2) Study of Instructional Materials in Analysis Education (2) Study of Instructional Materials in Mathematical Statistics Education (2)	Algebra for Teachers (3) Topology II (3) Probability and Statistics II (3) Applied Mathematics and Practice I (3)
	8	Special Study for Graduation (6)	Probability and Statistics for Teachers (3) Applied Mathematics and Practice II (3) Mathematical History and Philosophy (3)

The Teaching Profession

Table 8.8 shows the curricula of the teaching profession area at HU and KNUE. At HU, ten courses in Years 2 and 3 are provided for the students to learn about various topics in education and psychology, and are required for teaching certificates. These

Table 8.8 The teaching profession courses in the HU and KNUE curricula (credits)

Year	Semester	HU	KNUE	
			Theory	Practical Knowledge
1	1		Introduction to Educational Theory (2)	
	2		Educational Psychology (2)	
2	3	Guidance on the Teaching Profession (2) Principles of Education (2)	Curriculum Theory (2) Educational Evaluation (2) Educational Methodology and Technology (2)	Introduction to Special Education (2)
	4	Education, Society and Educational System (2) Methodology of Special Activities (2) Psychology of Education and Vocational Guidance (2)	Educational Philosophy and History (2)	
3	5	Developmental Psychology of Children and Adolescents (2) General Curriculum Theory (2) Methodology on Moral Education (2)	Guidance of School Life (2)	Business Experience in the Teaching Profession (2)
	6	Educational Methods and Teaching Skill (2) Educational Counseling (2)	Educational Sociology (2) Educational Administration and Management (2)	Introduction to and Practice of Protection from School Violence (2)
4	7			
	8	Practical Seminar for Teaching Profession (2)		

courses are provided by professors in the department of education and the department of psychology in the faculty of education. In their 8th semester (Year 4), all students must take the Practical Seminar for Teaching Profession course, to reflect on and enhance the knowledge, skills, and abilities they have acquired. In this course they use their own teaching certificate portfolios accumulated during the previous 3 years, in accordance with the eight standards originally established for HU teacher training programs. In the case of secondary school mathematics teaching certificates, these include mathematics education and mathematics as well as education, psychology, and the teaching profession. This course is taught by a team

of professors in the faculty of education and local education practitioners such as principals, head teachers, and experienced teachers from secondary schools.

At KNUE, there are two kinds of teaching profession courses: Theory of Teaching Profession and Practical Knowledge of Teaching Profession. In the theory of teaching profession area, nine 2-credit courses are provided for the students to learn about various topics in education and psychology, and are required for teaching certificates. These courses are provided by professors in the department of education. Students must choose six courses among these nine courses. In the practical knowledge of teaching profession area, three 2-credit courses are provided, and students must take all of them. This area includes a course on "Introduction to and Practice of Protection from School Violence," to learn how to take precautions against any violence in school, which has become a social matter of grave concern.

School-Based Work

Table 8.9 shows the curricula in the school-based work area at HU and KNUE. HU offers Introduction to Teaching Practicum for Lower and Upper Secondary Schools in the 1st semester of Year 1, for the students in the faculty of education. The main aim of the course is for the students to change from a learner's perspective to a

Table 8.9 School-based work courses in the HU and KNUE curricula (credits)

			KNUE	
Year	Semester	HU	Teaching Practicum	Educational Voluntary Service
1	1	Introduction to Teaching Practicum for Lower and Upper Secondary Schools (2)		Over 60 hours of service in any level of school during the period of enrollment (2)
	2			
2	3	Introduction to Care Practice (1) Care Practice (Required)		
	4	Classroom Observation at Secondary Schools (2)		
3	5	Preparation for the Teaching Practicum at Secondary Schools (2)		
	6	Teaching Practicum at Secondary Schools (4 or 2)	Teaching Practicum I (2)	
4	7		Teaching Practicum II (2)	
	8			

teacher's perspective. During this course they have a chance to observe mathematics lessons at HU-attached secondary schools, followed by group discussions on the observed lessons. The Year 2 courses on Introduction to Care Practice and Care Practice are required for lower secondary school certificate students to understand the situations, feelings, and behaviors of people concerning care practice, and to increase their awareness of how to interact with people in special needs schools and social welfare facilities. The students in the secondary mathematics education major take courses related to Teaching Practicum, from the observation of mathematics lessons in Year 2 to the preparation of a teaching practicum in Year 3. In the sixth-semester course called Teaching Practicum at Secondary Schools, these students do teaching practicums at HU-attached secondary schools. The practicums take four weeks (and earn 4 credits) for students pursuing both lower and upper secondary school teaching certificates, or two weeks (2 credits) for just the upper secondary school teaching certificate.

The teaching practicum is conducted using lesson study, such that the students make lesson plans with their mentors' advice, teach mathematics in classrooms, and observe peers' lessons, followed by reflections on each lesson during peer group discussion with their mentors. The secondary mathematics education majors receive regular reviews of their progress by their mentors, and some professors also visit periodically to check the students' progress. The final evaluation of each student's teaching practicum in schools is authorized by the committee on teaching practicum in the faculty of education, based on a report from the schools.

At KNUE, teaching certificate students have to complete both Teaching Practicum and Educational Voluntary Services activities. Class Observation, conducted during the first Teaching Practicum period in the 6th semester (Year 3), focuses on understanding the educational field as a classroom and a school, and improving the pre-service teachers' temperaments through observing educational activities, including teaching performed by a guidance teacher. Its objectives include school life guidance for normal students, extracurricular activity guidance for special students, and class management conducted by teachers and school administrators. In the second Teaching Practicum, taken in the 7th semester (Year 4), students conduct practically real classroom teaching experiences under the guidance of school teachers. This teaching practicum includes making lesson plans, teaching preparation with various educational media, imposing daily assessments, and an open class by a student teacher representative. Voluntary educational services of at least 60 h help pre-service teachers learn and understand lots of activities related to their educational community by supporting school curriculum and events, providing academic advising to underachievers, and guiding students with special needs. To confirm their service, students must get official certification from the organizational institute, and send it to the relevant dean of colleges before the semester ends. The dean decides whether the student passes or fails the course. Seventy percent of students' total score for the teaching practicum comes from field points, and 30% from a university advisor's evaluation. Grades are assessed on an absolute scale.

Similarities and Differences

Japanese and Korean societies have had a long tradition of treating teachers with great respect, so students in both countries have relatively high motivation to become teachers. Based on the analytical results from our comparative case study, in this section we identify several similarities and differences between Japan and Korea, as represented by HU and KNUE, in terms of the prescribed conditions for teaching certificates and the undergraduate curricula for training secondary school mathematics teachers.

Main Similarities

Japan and Korea share significant similarities in three aspects.

First, in their prescribed conditions for teaching certificates as shown in Tables 8.1, 8.2, 8.3, and 8.4, the two countries have similar conditions for teaching certificates prescribed by the MOEs in terms of liberal arts, the teaching profession, and the school subject, and similar 4-year courses for pre-service teachers seeking teaching certificates.

Second, in both countries a 4-year teacher education does not in itself guarantee a teaching position in secondary schools. The teacher candidates are selected through highly competitive teacher employment examinations. However, Korea has a national employment test entrusted to a research institute, while in Japan the individual local boards of education develop their own employment examinations without any involvement from a research institute or university professors. In any case, in both countries the employment rate of university graduates as school teachers is very low. This implies that local boards of education and governments have a high probability of hiring the most highly qualified candidates, all of whom have worked very hard at teacher training universities.

Third, in terms of the curricula for pre-service teacher training, the secondary school mathematics teacher training courses at HU and KNUE both seek to educate students in fundamental concepts of pure mathematics and school mathematics, as well as in mathematics education, aiming to foster qualified secondary school mathematics teachers. In order to become a respectable mathematics teacher, one must be equipped with knowledge of mathematical content, mathematics education, and teaching skills that can support teaching mathematics based on a desirable inclination to teaching and educational philosophy. To attain this goal, these programs provide knowledge of both mathematical content (such as algebra, geometry, analysis, probability and statistics, and applied mathematics) and mathematics education (such as mathematics educational philosophy, mathematics educational psychology, mathematics curriculum, and mathematics methodology and assessment). Moreover, the two universities have similar teaching practicums, through

which students gain teaching experience and clinical experience and discuss problems related to mathematics education in schools with experienced mathematics teachers.

Main Differences

On the other hand, we identify two differences between the curricula of HU and KNUE for training pre-service secondary school mathematics teachers. First, KNUE emphasizes mathematics content knowledge, as indicated by the fact that there is almost no curricular difference in mathematics content knowledge between the department of mathematics and the department of mathematics education. In contrast, at HU the department of mathematics education emphasizes mathematics pedagogical content knowledge, because it is separate from the department of mathematics in the faculty of science.

Second, there is a difference in the teaching practicum period. The secondary school teacher training courses at HU have a relatively weak teaching practicum; in the 6th semester, students seeking lower secondary school teaching certificates only need four weeks of teaching practicum in schools, while those seeking upper secondary school teaching certificates need just two weeks (Koyama, 2011). At KNUE, since 2009 students have taken an eight-week practicum instead. Concurrent with the extension of the teaching practicum period, the links between the university and practicum sites were reinforced to promote educational interactions between the attached school or partner school mentor teachers and professors, who take charge of the practicum to solve various difficulties related to the practicum. In contrast, HU provides more systematic preparation steps toward the sixth-semester teaching practicum. This leads to a difference in the variety of activities students experience during their teaching practicums. At HU, based on the systematized teaching practicum program shown in Table 8.9, pre-service teachers have the chance to observe mathematics classroom in schools, prepare for the teaching practicum by shadowing their peers in teaching mathematics, and teach mathematics using lesson study with the assistance of mentor teachers. At KNUE, based on the longer period of teaching practicum, pre-service teachers have the chance to experience various activities related to school management besides teaching mathematics.

Conclusion

In this chapter, we mainly focused on two aspects of pre-service teacher training for secondary school mathematics in Japan and Korea: (a) prescribed conditions for teaching certificates and (b) undergraduate curricula for training secondary school mathematics teachers. Our goal was to identify similarities and differences in

educational approaches to supporting pre-service teachers' awareness and knowledge development in the respective departments of mathematics education. These two countries share the philosophy that the quality of education cannot exceed the quality of teachers, even though there is a curricular difference between the two universities examined here. The philosophy has a significant effect on efforts in both countries to improve pre-service teacher quality.

As a case study, we looked at curricula from the department of mathematics education of Hiroshima University in Japan and Korea National University of Education in Korea. The two universities were selected because they are leading universities in terms of pre-service teacher training as well as research on teacher education, and because their pre-service programs are typical models of mathematics teacher training programs in the two countries. This case study remarkably illustrates the importance of educating students in fundamental concepts of pure mathematics and school mathematics, as well as improving their knowledge of mathematics education. In order to become a respectable mathematics teacher, one must be equipped with knowledge of mathematical content, mathematics education, and teaching skills that can support teaching mathematics based on a desirable inclination to teaching and educational philosophy.

However, there are still two remaining issues to be solved for further comparative study of curricula and practices in pre-service teacher training for secondary school mathematics. One issue is to form an appropriate balance between mathematics content knowledge and mathematics pedagogical content knowledge in a 4-year undergraduate course for secondary school mathematics teachers. The other is to realize an effective teaching practicum for pre-service mathematics teachers in the process of improving their competence as mathematics teachers. These issues are not easy to solve. We need in-depth international analyses and considerations to improve the quality of pre-service teacher training for secondary school mathematics, particularly in terms of activities and teaching methods for pre-service teachers.

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