

Chapter 9

Mathematics Teacher Education in Korea

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Abstract

The purpose of this article is to overview the current status of both elementary school teacher education and secondary mathematics teacher education in Korea. The preservice training systems for elementary school teachers and secondary school teachers are first explained. It is important to note that Korean teacher preparation systems have not been formally changed since the 1950s when the government accredited teacher preparation programs for the first time.. Second, an analysis of the curricula of preservice training institutions reveals that knowledge subject matter is being given more emphasis today. Third, the selection and employment of teachers is discussed. Finally, the reasons why the teaching profession is becoming particularly attractive to young people today are described.

I. Introduction

Globalization in the 21st century, thanks in part to the development of information technology, requires commensurate change within modern society. Likewise, it also requires the reform of the members of society. Since education will play a critical role in this change, teachers, the real carriers of education, become very significant. People say, “the quality of education never goes beyond teachers’ abilities.” and “Success in education absolutely depends on teachers.” These sayings reflect the importance of teachers’ roles in education. They also imply that teachers are the real driving forces behind the improvement in educational quality (Park, 2003). For this reason, it is necessary to pay more attention to the education of teachers themselves. This article will examine the educational institutions of future teachers, their employment conditions, and some reasons for the general preference of teaching jobs.

Korea has two separate educational systems and types of institutions for elementary and secondary schoolteachers. First, therefore, this article will examine the two separate educational systems respectively and then the number of trainees in the institutions by years and grades. This examination will be accompanied by an analysis of the subjects and curricula in those two

different systems. Second, this article will analyze both the relative amounts of the subject material, the patterns of the questions in the examination of public school teachers and its results. Finally, connections to the reasons for the great preference for teaching careers as well as the causes of high rates of competition in the examination itself will be ascertained.

1. Teacher Education System

Teacher education is offered by universities of education, colleges of education, departments of education, those with teaching certificate programs in general colleges and universities, Korea National University of Education, junior colleges, the Air and Correspondence University and graduate schools of education. Altogether these schools recruit approximately 25,000 teachers every year.

(1) Elementary School Teachers

Elementary school teachers are trained at universities of education, the Korea National University of Education, graduate schools of education and departments of elementary education at colleges of education. Most of the elementary school teachers are trained at the eleven teachers colleges that make up the National University of Education. Since 1985, the department of elementary education at the Korea National University of Education has also annually produced 160 teachers. Finally, the graduates from the private university Ewha Womans University who majored in elementary education are also qualified to become elementary school teachers. Table 1 shows elementary teacher education institutes for the academic year 2003.

Table 1. Teacher Education Institutes for Elementary School Teachers 2003

Classification	No. of School	T.O. in The School Year 2003				
		Freshman	Sophomore	Junior	Senior	Total
National University Of Education	11	5,015	4,855	4,735	4,735	19,340
Korea National University of Education	1	160	160	160	160	640
Ewha Womans University (Private)	1	50	50	50	50	200
Total	13	5,225	5,065	4,945	4,945	20,180

Source – <http://www.moe.go.kr>

In addition to those universities described above but not included in this study, the two-year junior teachers colleges started to be upgraded to four-year universities offering bachelor's degrees for elementary teachers in 1981. In 1984 all such colleges were upgraded. Beginning in 1985, universities of higher education began to offer night and seasonal courses toward a bachelor's degree for in-service teachers without degrees. At universities of higher education, some 74% of attendees are female students, and measures to increase the number of male students need to be adopted to continue to improve these newly developing areas of elementary teacher training.

(2) Secondary School Mathematics Teachers

Secondary school mathematics teachers are trained at the universities' colleges of education, which exist only for that purpose, at the departments of education in general colleges, in education courses, and at graduate schools of education. There used to be some temporary institutions for teacher education to meet the lack of the teachers, but those institutions were all abolished in 1973 and now there are only authorized institutions.

The colleges of education, 13 national and 28 private, produce about ten thousand prospective teachers every year. The departments of education in general colleges, whose main purpose is teacher training, and the graduate schools of education, which are for the advanced training of inservice teachers, supplement the training in the regular departments for the university to prospective teachers, and produce about 2,300 graduates every year. Finally, the courses of the colleges of education supplement the training in the regular departments of the university to produce prospective teachers. In this way, about 13,000 teachers are produced from 2,735 departments in 132 colleges each year.

Considering the uniqueness and the professionalism of the teaching profession, applicants to the colleges of education are required to earn high scores on an aptitude test and a "humaneness test" (interview) as well as the scholastics achievement test and the high school achievement score (GPA). To retain excellent students, the national colleges of education provide scholarships for 15 percent of their students. Table 2 shows the approximate number of mathematics teacher certification issued by the ministry of Education in 2003.

The goal of the 1995 Education Reform Act was to provide ways to train excellent teachers who can meet the needs of the era of globalization and the information age and the field of education. Thus, the Ministry of Education and Human Resources Development has revised the

education curriculum to focus the direction of teacher education institutions and reinforce the employment selection system of new teachers. To do this, in the curricula of the colleges of education, pedagogy and ethics of teachers are given more emphasis, and information management ability, including computer use, and class management and the skills of counseling students are emphasized. The Ministry also suggests that colleges increase the number of credits and time periods required in these courses. It also promotes a competitive relationship between colleges by investing mostly in better colleges. This will both evaluate and acknowledge those institutions that best train teachers and will encourage them to develop as teacher training institutions.

Table 2 Teacher Education Institutes for Secondary School
Mathematics Teachers 2003

Categories	Founding Body	Number of Institutions
College of Education	Department of Mathematics	National 13
	Education	Private 28
		Total 41
Graduate School of Education		National 35
		Private 100
		Total 135

Source – <http://www.moe.go.kr>

2. Curricula for Teacher Education

(1) Curricula for Primary Teacher Education

The curricula of teacher colleges for training prospective primary school teachers consists of general education course work and course work in one's specific major. Each category is further divided into electives and required classes. There are 35 credit hours of general education courses, which account for approximately 25% of undergraduate required courses.

General education also has elective classes in the humanities, language and literature, foreign language, social science, natural science, and the arts. In general education, there is a logical continuation between required and elective classes. Required courses are introductory and comprehensive, while elective courses are specialized extensions of corresponding required classes. As an example of the curricula of prospective primary school teacher institutions, Table 3 presents the curricula of mathematics education at Gyongin National University of Education.

Table 3. Curriculum of Gyongin National University of Education:

Mathematics Education.	
Content Knowledge subject	Pedagogy Knowledge Subject
Linear Algebra (2)	Assessment in Mathematics Education (2)
Calculus (2)	Theory of Mathematics Education (3)
Probability and Statistics (2)	Theory of Teaching Mathematics Materials (3)
Introduction to Abstract Algebra (2)	Psychology of Mathematics Education (3)
Topology (2)	Teaching Problem Solving (3)
Introduction to Geometry (3)	

The number of credit hours is reported in parenthesis.

SOURCE – http://www.ginue.ac.kr/Subject/math/edu_course.jsp

In order to get primary school teacher certificates with mathematics education as the declared major, preservice primary school teachers need to take at least 21 credits from subject matter knowledge and pedagogical knowledge of mathematics. In the case of Gyongin National University of Education, ‘Linear Algebra’, ‘Calculus’, ‘Probability and Statistics’, ‘Introduction to Algebra’, ‘Topology’, and ‘Introduction to Geometry’ are courses belonging to mathematics content knowledge subject while ‘Mathematics Education Assessment’, ‘Theory of Mathematics Education’, ‘Psychology of Mathematics Education’, and ‘Teaching Methods in Problem Solving’ are courses belonging to pedagogical knowledge subjects.

The distribution between subject matter knowledge and pedagogy knowledge in mathematics is well balanced according to Table 3 for the case of Gyongin National University of Education. Other primary preservice teacher institutions have a curriculum in mathematics education that is quite similar to that of Gyongin National University of Education.

(2) Curricula for Secondary School Mathematics Teacher Education.

In general, for all prospective secondary teachers, the curriculum of the colleges of education sets the graduation credit requirements in a range of 130 to 150 hours, of which liberal arts credits comprise 20 percent, the teaching major field 60 percent and electives 20 percent. The major field includes the study of curriculum, pedagogy of subjects, general pedagogy and practice teaching. The teaching certificate is conferred without additional testing by the president with the authorization of the Deputy Prime Minister and Minister of Education and Human Resources Development to students who have finished the course established by the Education Law.

The curriculum for colleges of education is comprised of these three areas: general education, courses in majors, and courses concerned with the teaching profession. Additionally, there are three types of curriculum models for colleges of education. The first and the most popular common curriculum model is the model that separates the teachers training course from the general education and major courses work. In this case, courses dealing with teaching are usually named “education courses, and teaching materials and methods”. The second model combines each teacher-training course with general education courses. In this model, courses related to teaching specific subjects, such as education courses and teaching materials and methods are designed as courses in a teaching major. The third and last model combines teaching courses with major subject matters, such as mathematics education in this case. In this model, some colleges of education designate specific general introductory classes to be taken along with the general education curriculum.

Tables 4 and 5 show two curricula of teacher education institutes for secondary mathematics teachers.

Table 4. Curriculum for Department of Mathematics Education:

Seoul National University	
Content Knowledge Subject	Pedagogy Knowledge Subject
Advanced Analysis 1(3)	Teaching Secondary School Mathematics (3)
Advanced Analysis 1(3)	Theory of Mathematics Education (3)
Geometry (3)	Computer and Mathematics Education (3)
Discrete Mathematics (3)	Mathematics and Education (3)
Differential Equations (3)	Theory of Mathematics Education (3)
Linear Algebra 1(3)	
Linear Algebra 2(3)	
Number Theory (3)	
Abstract Algebra 1(3)	
Abstract Algebra 2(3)	
Multiple Variable Functions (3)	
Introduction to Differential Geometry. (3)	
Complex Analysis (3)	
Topology 1(3)	
Topology 2(3)	
Real Analysis (3)	
Statistics (3)	
Numerical Analysis (3)	

The number of credit hours is reported in parenthesis.

Source-http://www.snu.ac.kr:6060/engsnu/academics/department_desc.jsp?org_code=715

In comparison with the curricula of preservice elementary school teacher institutions, subject matter knowledge is much more emphasized in the curricula of secondary mathematics teacher institutions. Curricula of most mathematics teacher education institutions in Korea have a similar structure to Table 4. However, there have been recent reforms in the curricula of preservice teacher institutions enhancing the correlation between teachers' subject matter knowledge of school mathematics and how to teach it. These reforms reflected to the curriculum of the department of mathematics education at Ewha Womans University. (See Table 5)

Table 5. Curriculum for Department of Mathematics Education:

Ewha Womans University	
Content Knowledge Subject	Pedagogy Knowledge Subject
Calculus I (3)	Statistics for Secondary School Teachers (3)
Logic and Set Theory (3)	History of Mathematics Education (3)
Advanced Calculus I (3)	Probability Education for Secondary School Teachers (3)
Advanced Calculus II (3)	Measurement and Evaluation in Mathematics Education (3)
Differential Equations (3)	Computer in Education (3)
Introduction to Differential Geometry (3)	Computer and Mathematics Education (3)
Number System and Its Structure (3)	Topology for Secondary School Teachers (3)
Fractal and Chaos for Prospective Secondary School Mathematics Teachers (3)	Algebra for Secondary School Teachers (3)
Topology (3)	
Abstract algebra (3)	
Measure and Integration (3)	
Complex Analysis (3)	

The number in parenthesis is number of credits.

SOURCE - http://www.ewha.ac.kr/ewhaeng/public/index_sch.htm

Depending on the university, courses on pedagogical content knowledge are more emphasized in the curriculum. After analyzing curricula of 32 preservice teacher education institutions in Korea, the curriculum of each institution equates to a similar model of either Seoul National University or Ewha Womans University.

As shown in Table 4, the curricula of Seoul National University only include 18 content knowledge subjects (78.26%), while including five pedagogy knowledge subjects (21.74%). Ewha

Womans University, on the other hand, only teaches 12 content knowledge subjects (60%) while teaching 8 pedagogy knowledge subjects (40%). This means that the curricula of SNU put more focus on content knowledge while Ewha Womans University on pedagogy knowledge.

With regard to the content knowledge subjects, both SNU and EWU have recently offered such IT-related subjects as computer and mathematics education, computing in education, and computer software for mathematics education for the purpose of helping their future teachers meet the demand of globalization. In particular, EWU emphasizes the importance of mathematics history by including the subject in its curricula. A comprehensive analysis of curricula at a total of 41 universities of education in Korea (13 national universities and 28 private universities) shows that the ratio between content and pedagogy knowledge courses is approximately the mean of those at EWU and SNU. In the case of secondary schoolteachers, there is technically no curricular difference of content knowledge between the departments of mathematics and mathematics education. This means that most of the educational institutions require a curriculum to maintain the high level of future teacher's knowledge in mathematics. Ultimately, it provides evidence that Korean secondary math teachers are well trained in content knowledge.

(3) Teachers Employment Test.

Even though the teaching certificate is conferred without additional testing, preservice teachers must take and perform exceptionally well on the Teachers Employment Test in order to become employed public school teachers. The selection and employment of teachers is achieved by this open test held by the metropolitan and provincial offices of education for the public schools in different parts of Korea. The schools determine the number of vacancies for mathematics education in a city or region. Then the students with the top scores on the TET at that office of education are recruited (receive jobs). For private schools the institution itself makes the selections, so are not included in this article. The TET for public schools is composed of a preliminary test on pedagogy (30%) and the major field (70%) and a second test, which is comprised of an essay and an interview. Detailed descriptions for content areas, and the percentage of each category and item type is shown in Table 6.

Nine core subjects from mathematics content knowledge are listed in the regulations of the Ministry of Education for Teachers Employment Test. Sample problems by TET from November 2003 are shown in Table 7.

The time limit to finish questions from the mathematics and mathematics education tests is 3 hours. The TET is comprehensive in the sense that it covers 10 core subjects in college mathematics, theory of mathematics education, and general education theory such as educational psychology, history of education, educational assessment, philosophy of education, etc. It is very demanding and competitive since almost all teacher certificate holders take the TET.

Table 6. Content Components of Preliminary Test in Teacher Employment Test. (MOE, 2000)

Content		Percent of items	Item type	Relevant knowledge
Education in general		30%	Multiple choice items	General pedagogical knowledge
Mathematics	Linear Algebra Abstract Algebra Complex Analysis Topology Real Analysis Differential Geometry Number Theory Probability and Statistics Discrete Mathematics	50%	Open-ended items	Subject matter knowledge
Mathematic Education	Theory of Mathematics Education	20%	Open-ended items	Pedagogical content knowledge

Source – <http://www.moe.go.kr>

Table 7. Sample problems of TET (2003)

Categories	Problem									
Educational Subject	The following items compare norm-referenced tests and criterion-referenced tests. Which item is the most properly to describe the characteristics of each test?									
	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"><u>Norm-referenced test</u></td> <td style="width: 50%; border: none;"><u>Criterion-referenced test</u></td> </tr> <tr> <td style="border: none;">1. Absolute evaluation</td> <td style="border: none;">Relative evaluation</td> </tr> <tr> <td style="border: none;">2. Emphasis on validity</td> <td style="border: none;">Emphasis on differential scale</td> </tr> <tr> <td style="border: none;">3. Viewing education As selective function..</td> <td style="border: none;">Viewing education as Developmental process</td> </tr> <tr> <td style="border: none;">4. Expectation of negative .. skewed distribution</td> <td style="border: none;">Expectation of normal distribution</td> </tr> </table>	<u>Norm-referenced test</u>	<u>Criterion-referenced test</u>	1. Absolute evaluation	Relative evaluation	2. Emphasis on validity	Emphasis on differential scale	3. Viewing education As selective function..	Viewing education as Developmental process	4. Expectation of negative .. skewed distribution
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4. Expectation of negative .. skewed distribution	Expectation of normal distribution									

Mathematics	Algebra	<p>Let G be an infinite group and $\sigma : G \rightarrow G$ be defined by $\sigma(g) = g^{-1}\sigma(g^{-1})$ (g^{-1} is the inverse of g)</p> <p>7-1. Show that G is an isomorphism.</p> <p>7-2 Show that the isomorphism of G into G are just two mappings, that is, the identity map and σ.</p>
	Analysis	<p>If x_n is a real number and $x_n^k = x_n^k$</p> <p>A sequence $\{x_n\}$ is defined by $x_1 = 3, x_{n+1}^3 = 6x_n^2 - 8x_n$</p> <p>Show that a sequence $\{x_n\}$ is a bounded increasing sequence and evaluate $\lim_{n \rightarrow \infty} x_n$.</p>
	Complex Analysis	<p>Let f be an analytic function in C satisfying</p> <p>1. $f(1) = 1$ 2. $\forall z \in C, f(z) \leq z$</p> <p>Show that $f(z) = z$</p>
	Geometry	<p>What is the angle between the plane $x + z = 0$ and the unit tangent vector on all the points on the curve $x(t) = (3t, 3t^2, 2t^3)$?</p>
	Topology	<p>Let R be the set of real numbers and the subset of its power set is:</p> <p>$\mathcal{T} = \{R - \{p\} \mid p \in R\}$.</p> <p>Answer the following questions.</p> <p>1. What is the topology with \mathcal{T} as its sub-base (2 points)?</p> <p>2. What is the derived set of the set of natural number N in the topology space (R, \mathcal{T})?</p>
Mathematics Education	<p>There follows part of the conversation between mathematics teachers concerning mathematic problem solving education.</p> <p>(1) Questions for problem solving education should be made from situations real life and given in ordinary sentences.</p> <p>(2) I think that many typical questions in math textbooks can be suitable for problem solving education after appropriate modification.</p> <p>(3) I think that there is much correlation between problem solving education and mathematical thinking training.</p> <p>(4) I think that the questions with multiple solving approaches are best for problem solving education.</p> <p>(5) I think it is better not to connect the problem solving education with general mathematic classes.</p> <p>(6) I think the practice questions in many textbooks are not relevant to the improvement of problem solving ability.</p> <p>Choose three opinions that are not right about the problem solving education and explain the reasons for each choice.</p>	

Source – <http://www.kice.re.kr>

Table 8 shows the hiring ratios for elementary school teachers and secondary mathematics teachers who took the TET in November 2003 for the various Korean districts. This ratio varies depending on districts. In the case of secondary mathematics teachers, the overall success rate was about 16%. Only one out of six applicants passed the TET (were recruited for a teaching position). The number of new employment secondary mathematics teachers for public schools in 2003 is 814. The numbers listed in Table 8 exclude newly employed teachers by private schools, since the institution itself make selections for private schools.

Table 8 Competition Rate for Elementary school Teacher and Secondary Mathematics Teacher Employment Test (2003)

Districts	Secondary			Elementary		
	# of Applicants	# of Recruits	Hiring Ratio	# of Applicants	# of Recruits	Hiring Ratio
Seoul	422	63	6.69:1	1570	665	2.36:1
Busan	254	69	3.68:1	581	350	1.70:1
Daegu	227	50	4.54:1	789	379	2.08:1
Inchon	403	53	7.60:1	697	450	1.55:1
Kwangju	133	28	4.75:1	868	400	2.12:1
Daejeon	185	24	7.70:1	502	150	3.30:1
Wolsan	158	30	5.26:1	502	250	2:1
Gyeonggi	1,402	210	6.67:1	2330	1734	1.34:1
Kwangwon	183	25	7.32:1	397	350	1.13:1
Chungbuk	223	37	6.02:1	531	400	1.32:1
Chungnam	156	27	5.78:1	977	900	1.08:1
Jeonbuk	178	20	8.91:1	467	370	1.26:1
Jeonnam	190	39	4.87:1	975	100	2.41:1
Gyungbuk	400	68	5.88:1	579	520	1.1:1
Gyungnam	380	56	6.78:1	808	700	1.15:1
Jeju	58	15	3.86:1	154	115	1.34:1
Total	4952	814	6.08:1	12,727	8133	1.56:1

Source – <http://www.moe.go.kr>

While the TET for elementary school teachers is not quite so competitive, the hiring ratio for secondary school teachers is much higher as clearly shown by the fact that the average competition rate of the test for primary school teachers is only 1.55:1 while for secondary school teachers it is 6.08:1, approximately four times higher. There are some reasons for the low rate of the test for primary school teachers. First, it is because of the government policy in 1999 to offer more job opportunities to young future teachers. To reduce the rise of teacher unemployment, the government changed the retirement age from 65 to 62 so that it resulted in many more vacancies in primary teaching positions. Second, the government introduced a system of transfer admission to universities of education to fill up the vacancies of primary school teachers. For a certain period, the government also allowed those who have the qualification of secondary school teacher to apply for the test for primary school teachers. Third, despite the fact that there are more primary schools than secondary schools, there are more educational institutes for secondary school teachers than those for primary school teachers. Therefore, there are more graduates with the qualification of secondary school teachers. The big gap between the hiring ratio of primary and secondary public school teachers has been considerably reduced due to the adjustment of supply by the government, but is still significant. This high ratio means that only applicants with excellent knowledge and ability can become secondary teachers.

4. Desirability of Teaching Positions in Korea

Currently in Korea, young people's preference for teaching careers is very high. As examined in the previous section, the high hiring ratio from teacher employment tests reflects the notion that many people think highly of the teaching profession. The reasons for the preference are as follows.

First, it is because of the social recognition given to teachers in Korea. Korean society, which is traditionally based on Confucianism, still believes a Confucian moral that the king, father and teacher have the same level, meaning that they all should be respected as those possessing authority. Therefore, the social status of teachers is really high.

Second, it is because of job stability. Due to the recent financial and economic crisis in Korea, many companies not only lowered the retirement age but also laid off many of their employees. This damaged the sense of stability in many job fields, by making the concept of the lifetime job disappear. Although the retirement age of teachers was lowered from 65 to 62

by government policy in 1999, it is still 6 years higher than that of other jobs. Furthermore, once teachers receive their teaching qualification, they are not required to obtain further qualifications. For these reasons, a teaching job is regarded as being much more stable than other jobs.

Last, it is due to the economic benefits that teachers receive, even though they are not highly paid. Teachers have better pension schemes. The public pension in Korea has two different pensions – common and civil-servant pensions. While the common pension is given to all those who are over 60, civil servants receive their pension from their 20th year of work. In addition, the amount of the pension is decided by their last level or job grade during the retirement year. Teachers, who are government civil servants, are also eligible for even better pension schemes than other civil-servants, as they are organized by KTCU, which is virtually a kind of financial institute for teachers.

The high preference for teaching is recently evidenced by the statistics issued by the Korean National Statistical Office in June 2004. It shows that 16.5 % of 1275 high school students surveyed in 6 major cities in Korea chose teaching as their future careers, which is the first choice of careers. In addition, the Korean Chamber of Commerce and Industry in May 2004 carried out research entitled “A survey on the economic awareness of high school students”, and released statistics showing that 22.7% of 777 high school students surveyed in Seoul chose teaching as their future careers, also the top choice.

Conclusion

According to the result in the TIMSS (the Third International Mathematics and Science Study) given to second-year middle school students in 1995 and 1999, Korea was third and second from the top respectively. Additionally, the results of the high school first-year in PISA (Programme for International Assessment) in 2000 showed Korea to be second from the top out of 32 countries. As the international comparative studies of mathematics ability show, Korean students have achieved very great things in mathematics assessments. This great achievement may be indebted to the superior quality of educational institutes and teachers as described in this article.

This study has examined the educational institutes of mathematics teachers, their curricula, teacher employment tests, and teacher status in Korea. Korea runs two separate systems of educational institutes for primary and secondary school teachers. Teaching careers are highly

preferred due to their high status and job stability. Since the financial crisis in Korea in 1997, their preference has been rising and also the academic performance of applicants to the universities of education in Korea has risen greatly. The analysis of the curricula of the universities of education has shown that more content knowledge subjects are taught than pedagogy knowledge subjects. Furthermore, it is not possible to become a public school teacher with only the university level teaching qualification. All teachers must pass the teacher employment test which is highly competitive.

Although excluded in this study, many training programs such as qualification and self-training are being developed to enhance the ability and quality of current teachers. In particular, many teachers take self-training courses at a number of the graduate schools of education, which play a large part in the role of retraining teachers. The government also provides teachers with a variety of training to encourage them to improve their quality and ability. All of these programs will continue to improve elementary and secondary mathematics education in the coming years.

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