

Forecasting the Demand for Primary and Secondary School Teachers in a Unified Korea*

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This study attempts to predict the demand for primary and secondary school teachers in South and North Korea after unification. The scenario forecasting method was used for the prediction, based on the goal of the number of students per teacher in South Korea. It is anticipated that there will be a large demand for teachers – around 4,000 for elementary school and 4,500 for middle school every year – and this demand is expected to last for ten years after unification. The South Korean teacher-training system might not be able to afford such large demand for primary teachers, and so emergency short-term plans should be considered along with long-term plans for the supply of primary school teachers.

Key words: primary school, secondary school, teacher, demand, forecast

* This paper updated a part of the first author's doctoral dissertation, "The forecast of the demand of primary and secondary school teachers, and supply plans for the unified Korea"(University of North Korean Studies, 2019).

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1. Introduction

Teachers cannot be supplied instantly when a demand arises, because a minimum of four years is required to train teachers through teachers' colleges. Therefore, the supply of teachers must be prepared for in advance by means of plans that include an accurate prediction of upcoming demand. Although it is still unclear 'when' that time will be, it is necessary to anticipate the demand for teachers in order to establish an education system in North Korea successfully after Unification since there will be a drastic increase in demand for teachers when Korean unification occurs. Even though the operational plan for a successful education system after unification is an essential element, no research that focuses on predicting the demand for teachers after unification has been conducted. The purpose of this study is to predict the demand for primary and secondary schools after unification.

'Projections of Education Statistics,' a time-series forecast report that is published every year in the US through the NCES(National Center for Education Statistics), is the most widely known forecast report in the education field. This report provides estimates of the number of students and teachers for every state for the following ten years. In Korea, forecast studies on the demand for teachers using time-series data first began around the year 2000. Forecasting methods are divided into two types. First, a time-series data analysis method predicts the future values by establishing a model that describes the change in the time-series data of interest. Second, a scenario forecasting method sets

a variety of scenarios for major variables that cause a change in the time-series data of interest to predict the future value. The scenario forecasting method is used primarily when there is a critical variable, such as government policy, that affects the change in the time-series data of interest.

Kim(1998)¹⁾ introduced the time-series data analysis method for forecasting teacher demand in Korea. After the study Han, Jeong, and Shim(1998)²⁾ used the time-series regression model and Shim and Kim(2000)³⁾ used the Autoregressive Integrated Moving Average (ARIMA) model for forecasting the demand of early childhood education teachers. Kim(2000a⁴⁾, b⁵⁾, c⁶⁾) used the exponential smoothing model and ARIMA model for forecasting the demand and supply of teachers, and Cho, Kim, Park, Park, and Chang(2003)⁷⁾ used the double

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- 1) Kim, H. *Development of analytical model for educational statistical time series data*(Korean Educational Development Institute, 1998).
 - 2) Han, Y., Jeong, T., & Shim, S. *Projections of education statistics: forecasting students of preprimary, primary, and secondary education(1999-2008)*(Korean Educational Development Institute, 1998).
 - 3) Kim, B., & Oh, Y. "A comparative study on the forecasts of the supply and demand of school teachers in Korea," *The Journal of Educational Administration*, Vol.20, No.4(2002), pp.55-82.
 - 4) Kim, H. "Mid and Long Term Forecasts of the Number of Preschool Children," *Journal of early childhood education*, Vol.20, No.4(2000a), pp.35-57.
 - 5) Kim, H. "Mid and Long Term Forecasts of the Number of Elementary School Teachers," *Journal of educational administration*, Vol.18, No.2(2000b), pp.91-113.
 - 6) Kim, H. "Mid and Long Term Forecasts of the Number of Graduates of Universities of Education and the Number of Newly Recruited Teachers," *Journal of educational administration*, Vol.18, No.3(2000c), pp.133-149.

exponential smoothing model for forecasting the demand of elementary school teachers. Kim and Oh(2002)⁸⁾ used the ARIMA and the stepwise autoregressive model, and Cha, Seo, and Lee(2003)⁹⁾ used the ARIMA model for forecasting the demand of secondary school teachers. But, they found that the time-series data analysis method had greater forecasting error than the scenario forecasting method in predicting the number of teachers, since the government's plan was the decisive factor for the number of teachers in Korea. This was the reason why almost all of the teacher demand forecasting studies in the 21th century in Korea used the scenario forecasting method. This study will use a scenario forecasting method that applies the South Korean Ministry of Education's 'goal of the number of students per teacher by the year 2030'. The scenario forecasting method was used in this study under the notion that the Ministry of Education's 'number of students per teacher goal by 2030' can be the decisive factor in predicting the time-series data of the number of teachers.

7) Cho, D., Kim, H., Park, N., Park, Y., & Chang, D. *A study on mid-to-long term supply and demand plan of elementary school teachers and stable recruitment plan* (Ministry of Education and Human Resources Development, 2003).

8) Kim, B., & Oh, Y. "A comparative study on the forecasts of the supply and demand of school teachers in Korea," *The Journal of Educational Administration*, Vol.20, No.4(2002), pp.55-82.

9) Cha, Y., Seo, J., & Lee, B. "The forecast of the demand and supply of secondary school teachers," *The Journal of Educational Administration*, Vol.21, No.3(2003), pp.298-316.

2. Method

The study assumes three different hypothetical times of unification — the years 2020, 2025, and 2030 — and predicts the size of the demand for teachers in primary and secondary schools in both South and North Korea. The prediction of teacher demand is made by the following five steps:

- (1) Prediction of population by age
- (2) Prediction of each school-age population
- (3) Prediction of the number of students
- (4) Prediction of the required number of teachers by school level
- (5) Prediction of the newly required number of teachers by school level

Estimates of population by age are provided by Statistics Korea (KOSTAT). Estimates of the school-age population are calculated using the predicted population by age. The study assumes that the number of newborns is equal throughout the twelve months. The estimated number of students per school year is calculated by reflecting the enrollment rate of the last five years to the predicted number of the school-age population for primary, middle, and high school.

The ‘goal of the number of students per teacher by 2030’ was reflected to estimate the number of teachers required in South Korea. It is assumed that the goal will be achieved by the number of students per teacher continuously decreasing at the same rate throughout every year. To

estimate the number of teachers required in North Korea, it is assumed that the target number of South Korea's 'number of students per teacher' will be gradually reflected in North Korea over the next ten years after unification and that the decrease in the 'number of students per teacher' will continue at the same rate after 2030. Also, even though school years are different between South and North Korea, it is assumed that the South Korean school system will be applied in North Korea after unification.

3. Results

1) Predicting the population

In order to predict the number of required teachers at each school level, the number of elementary, middle, and high school students should be estimated first. The estimated value of the population between ages 6 to 18 was used for this.

Table 1 shows the predicted values of population by age in South¹⁰⁾ and North¹¹⁾ Korea throughout 2020-2040. According to the table, the number of South Koreans between the ages of 6 and 18 will drop

10) Korean Statistical Information Service, South Korean population projection, http://kosis.kr/statisticsList/statisticsList_01List.jsp?vwcd=MT_ZTITLE&parentId=A#SubCont.

11) Korean Statistical Information Service, North Korean population projection, http://kosis.kr/statisticsList/statisticsList_03List.jsp?vwcd=MT_BUKHAN&parmTabIdM_03_02#SubCont.

Table 1. Predicted population by age

		2020	2025	2030	2035	2040
South	6	432,173	320,191	307,572	354,977	336,975
	7	459,346	341,496	296,038	350,092	342,880
	8	467,468	379,897	285,166	340,384	347,707
	9	475,072	424,619	287,220	329,495	351,131
	10	438,434	437,905	302,577	317,810	352,903
	11	444,976	430,137	318,656	306,144	353,255
	12	478,037	457,891	340,302	295,076	348,893
	13	449,752	466,377	378,840	284,463	339,515
	14	429,899	474,094	423,518	286,530	328,717
	15	437,588	437,315	436,601	301,695	316,939
	16	470,225	443,406	428,408	317,421	305,064
	17	474,242	476,627	456,109	338,968	294,070
	18	511,707	449,539	464,869	377,581	283,734
	total	5,968,919	5,539,494	4,725,876	4,200,636	4,301,783
North	6	329,337	349,284	358,079	341,734	309,949
	7	326,099	344,966	357,100	346,090	314,806
	8	323,394	340,432	355,053	349,898	320,003
	9	321,241	335,958	352,040	352,986	325,401
	10	320,082	331,780	348,244	355,203	330,659
	11	320,244	328,068	343,959	356,443	335,638
	12	326,410	324,881	339,475	356,619	340,404
	13	337,577	322,210	335,039	355,667	344,766
	14	336,743	320,075	330,883	353,638	348,569
	15	338,477	318,912	327,149	350,625	351,638
	16	342,335	318,996	323,874	346,788	353,794
	17	349,800	325,017	321,108	342,422	354,932
	18	362,184	335,998	318,855	337,803	354,956
	total	4,333,923	4,296,577	4,410,858	4,545,916	4,385,515

significantly, from 5.97 million in 2020 to 4.30 million in 2040. On the other hand, the number of North Koreans in the same age range will remain virtually the same, at 4.33 million in 2020 and 4.39 million in 2040. The 6 and 7-year population in 2025, and 6 to 11-year population in 2030 of South Korea is predicted to be smaller than that of North Korea.

2) Prediction of school-age population

Since the estimated population by age was based on July 1st at 00:00 AM(middle of the year), the time point of estimation must be changed to March 1st at 00:00 AM in order to estimate the school-age population by school year. In other words, the estimated number of students at each school level per year must be adjusted based on the fact that the children who were born in January or February go to school one year earlier than the children who were born between March 1st and June 30th in the estimated population.

The number of 1st grades(N_{t1}), 7th graders(N_{t7}), and 10th graders(N_{t10}) at the year t were estimated by the formula below using the size of the population at the ages of 6-7, 12-13, and 15-16, respectively. These estimates were performed for all grades assuming that all the children born in a certain year were distributed evenly over 12 months.

$$\begin{aligned}
N_{t1} &= 6\text{-year-old population} \times \left(\frac{8}{12}\right) + 7\text{-year-old population} \times \left(\frac{4}{12}\right) \\
N_{t7} &= 12\text{-year-old population} \times \left(\frac{8}{12}\right) + 13\text{-year-old population} \times \left(\frac{4}{12}\right) \\
N_{t10} &= 15\text{-year-old population} \times \left(\frac{8}{12}\right) + 16\text{-year-old population} \times \left(\frac{4}{12}\right)
\end{aligned}$$

However, since the early 1990s, North Korea has used January 1st as the day a child is eligible for a school year, and South Korea also changed that date from March 1st to January 1st in 2009(Primary and Secondary Education Act subparagraph 8577 of Article 13); hence the size of the school-age population in both South Korea and North Korea after 2009 were estimated using the following formula.

$$\begin{aligned}
N_{t1} &= 6\text{-year-old population} \times \left(\frac{6}{12}\right) + 7\text{-year-old population} \times \left(\frac{6}{12}\right) \\
N_{t7} &= 12\text{-year-old population} \times \left(\frac{6}{12}\right) + 13\text{-year-old population} \times \left(\frac{6}{12}\right) \\
N_{t10} &= 15\text{-year-old population} \times \left(\frac{6}{12}\right) + 16\text{-year-old population} \times \left(\frac{6}{12}\right)
\end{aligned}$$

Moreover, in the year 2009, the year that the policy change occurred, the children at the age of 6 who were born in January or February had already enrolled in primary school in 2008; only the children who were born between March to December were newly eligible for enrollment. Thus, the following equation was used to estimate the size of the school-age population for 1st grade in 2009.

$$N_1 = 6\text{-year-old population} \times \left(\frac{4}{12}\right) + 7\text{-year-old population} \times \left(\frac{6}{12}\right)$$

The predicted size of the school-age population for elementary, middle, and high school in South and North Korea are presented in Table 2. Although the primary school years are currently shorter in North Korea(five years), this estimation of the school-age population is made assuming that North Korea will eventually follow the school year system of South Korea(six years in primary school) after unification.

According to the table, South Korea's school-age population in 2040 compared to 2020 will drop from 2.74 million to 2.09 million for elementary, from 1.34 million to 1.00 million for middle, and from 1.42 million to 0.90 million for high school. It also shows that the school-age population in North Korea will be almost the same as 2020 in 2040, such as 1.94 million to 1.95 million for elementary, 1.01 million to 1.04 million for middle, and 1.04 million to 1.06 million for high school.

Table 2. Predicted size of school-age population

		2020	2025	2030	2035	2040
South	elementary	2,740,401	2,403,095	1,813,594	1,968,952	2,090,810
	middle	1,337,464	1,388,074	1,190,810	869,379	1,001,148
	high	1,419,115	1,363,460	1,335,252	996,027	899,471
North	elementary	1,938,934	2,018,287	2,105,173	2,109,797	1,951,684
	middle	1,006,764	964,182	999,234	1,062,927	1,039,356
	high	1,042,466	971,468	967,984	1,033,424	1,062,023

3) Predicting the number of students

(1) Enrollment rate

In order to predict the actual number of students attending school, the enrollment rate by school level was estimated. The average enrollment rates of elementary, middle, and high school for the last five years in South Korea were 99.42%, 100.90%, and 96.20%, respectively¹²⁾. According to the data in Table 3 provided by UNESCO, North Korea's primary and secondary school enrollment rate was over 100%. Meanwhile, statistics given by Korean Statistical Information Service(KOSIS) say there are 1.5 million primary students and 2.2 million secondary students in North Korea from 2011 to 2014 equally, and does not provide any information after 2015. Using the KOSIS data, North Korea's enrollment rate would be calculated as 87.10% and 96.27% for primary and secondary school, respectively. Since the estimated enrollment rates using KOSIS data are

Table 3. School enrollment rate of North Korea

	2008	2012
primary ¹⁾	101.7	100.6
secondary ²⁾	100.2	101.0

Note: 1) DPRK Education Commission. Democratic People's Republic of Korea Education for all 2015 National Review. Table 3.2.6 Gross enrolment ratio in primary education. 2014, p.30.

2) DPRK Education Commission. Democratic People's Republic of Korea Education for all 2015 National Review. Table 3.2.11 Total enrolment ratio in secondary education. 2014, p.32.

12) Korean Statistical Information Service, Statistics of education, http://kosis.kr/statisticsList/statisticsList_01List.jsp?vwcd=MT_ZTITLE&parmTabId=M_01_01.

unrealistically low, this study will use the enrollment rate data released by North Korea.

(2) Forecasting the number of students

First of all, it was assumed that the enrollment rate between 2014 and 2018 will remain the same until 2040. Table 4 shows the estimated number of South and North Korean students by multiplying the predicted enrollment rate shown in Table 3 by the estimated school-age population shown in Table 2. Since the enrollment rate was over 100% in North Korea, this study has set the estimated number of students for each school level as equal to the estimated number of school-age population for the corresponding grade until unification. But, after unification the enrollment rate of North Korea is assumed same as South Korea.

According to the table, the number of South Korean students is estimated to be 2.08 million, 1.01 million, and 0.87 million in 2040 for elementary, middle, and high school, respectively, which is significantly lower than the 2.74 million, 1.35 million, and 1.37 million in 2020. The largest drop of the number of students was predicted to occur in elementary school(645,824, 23.70%). The largest drop of the rate of the number of students was predicted to occur in high school(499,897, 36.61%). For North Korea, the numbers stayed virtually the same, because the estimated number of students was 1.94 million, 1.05 million, and 1.02 million in 2040, whereas it was 1.93 million, 1.02 million, and 1.00 million in 2020 for elementary, middle, and high school, respectively.

Table 4. Estimated number of students

		2020	2025	2030	2035	2040
South	elementary	2,724,507	2,389,157	1,803,075	1,957,532	2,078,683
	middle	1,349,501	1,400,567	1,201,527	877,203	1,010,158
	high	1,365,188	1,311,649	1,284,512	958,178	865,291
North	elementary	1,927,688	2,006,580	2,092,963	2,097,560	1,940,364
	middle	1,015,824	972,859	1,008,227	1,072,493	1,048,710
	high	1,002,852	934,552	931,201	994,154	1,021,666

4) Predicting the number of teachers

(1) Estimation of the number of students per teacher in South Korea

The Ministry of Education announced the goal to cut this number to the 2013 OECD average of 14.9-15.3 in primary schools and 11.2-11.5 in secondary schools by 2030¹³⁾. This is the same number that the current President pledged in his presidential campaign in 2017.

Assuming that the number of students per teacher in 2030 is set to be 15.10 and 11.35, the median of the goal interval, for primary and secondary school, respectively, and that the number of students per teacher decreases at the same ratio(i.e. harmonic mean), every year through 2030, a ratio of change(r) of the number of students per teacher in primary and secondary school through 2030 can be 0.99314, and 0.99468. Thus, the reduction rate($((1-r) \times 100)$) for the number of students per teacher

13) Ministry of Education, 2019-2030 mid/long-term teacher supply plan. Press release 2018.4.30. <https://www.moe.go.kr/boardCnts/view.do?boardID=294&boardSeq=74057&lev=0&searchType=null&statusYN=W&page=1&s=moe&m=0503&opType=N#>.

Table 5. Estimates of the number of students per teacher for South Korea

year	primary	secondary
2020	16,17576	11,97160
2022	15,95459	11,84456
2024	15,73645	11,71887
2026	15,52128	11,59451
2028	15,30906	11,47147
2030	15,09974	11,34974
2032	14,89328	11,22930
2034	14,68965	11,11014
2036	14,48880	10,99224
2038	14,29069	10,87560
2040	14,09530	10,76019

per year in primary and secondary school is 0.686% and 0.532%, respectively.

Table 5 provides estimates of the number of students per teacher by school level throughout 2020 to 2040 for South Korea. The number of students per teacher from 2031 to 2040 was calculated assuming that the reduction rate remained the same. According to the results, the number of students per teacher are 14.09530 for primary, and 10.76019 for secondary school in 2040.

(2) Estimation of the number of students per teacher in North Korea by assumed unification year

Table 6 provides estimates of the number of students per teacher in North Korea after unification by school level. The number of students per teacher is calculated assuming three different scenarios of the

unification time, 2020, 2025, and 2030. It is also assumed that the number of students per teacher by school level will continuously decrease at the same rate over the course of the ten years after unification, ultimately reaching the same number as in South Korea by the tenth year. In other words, it is assumed that if unification occurs in 2020, the number of students per teacher in North Korea will be the same as in South Korea in 2030. The same assumption is applied to the cases in which unification occurs in 2025 or 2030. It is also assumed that at the time of unification, North Korea's number of students per teacher will be at 22.00 for primary school, and 20.00 for secondary school(DPRK Education Commission, 2014¹⁴), which are the most recent statistics reported by the Education Commission of North Korea.

In addition, it was assumed that the reduction in the number of students per teacher by school level in North Korea in the ten years after unification(n_t) would take the form of a linear function, as shown below. This function is made under the assumption that the annual reduction over the course of ten years makes the number of students per teacher of South and North Korea the same at year ten after unification.

$$n_t = n_1 - \frac{(n_1 - n_2)}{10} \times t$$

where, n_1 =the number of students per teacher of North Korea at the time of unification

14) DPRK, National plan of action on education for all, 2008, p.14.

Table 6. Estimated number of students per teacher in North Korea
by assumed unification year

year	primary			secondary		
	2020	2025	2030	2020	2025	2030
2020	22,00	22,00	22,00	20,00	20,00	20,00
2022	20,62	22,00	22,00	18,270	20,00	20,00
2024	19,24	22,00	22,00	16,540	20,00	20,00
2026	17,86	21,25889	22,00	14,810	19,10510	20,00
2028	16,48	19,77666	22,00	13,080	17,31531	20,00
2030	15,10	18,29444	22,00	11,350	15,52552	20,00
2032	14,89328	16,81222	20,41906	11,22930	13,73572	18,15204
2034	14,68965	15,32999	18,83812	11,11014	11,94593	16,30408
2036	14,48880	14,48880	17,25718	10,99224	10,99224	14,45611
2038	14,29069	14,29069	15,67624	10,87560	10,87560	12,60815
2040	14,09530	14,09530	14,09530	10,76019	10,76019	10,76019

n_2 = the target ‘number of students per teacher’ of South Korea at
year ten after unification

n_t = the number of students per teacher of North Korea at year
 t after unification, where $t=1, 2, \dots, 10$

(3) Predicting the number of teachers

Table 7 and Table 8 show the predicted number of teachers in primary and secondary school for the assumed year of unification, calculated using the data shown in Tables 5, 6, and 7. According to these tables, the number of primary school teachers in South Korea is predicted to decrease from 168,431 in 2020 to 147,474 in 2040, a decrease of 20,957(12.44%). At the same time, the number of secondary school teachers is predicted to decrease, from 226,761 in 2020 to 174,295 in 2040, a decrease of

Table 7. Predicted number of primary school teachers by assumed unification year

year	South	North			total		
		2020	2025	2030	2020	2025	2030
2020	168,431	87,622	87,622	87,622	256,053	256,053	256,053
2021	167,896	90,756	87,910	87,910	258,652	255,806	255,806
2022	168,380	94,442	88,518	88,518	262,822	256,898	256,898
2023	166,088	98,574	89,299	89,299	264,662	255,387	255,387
2024	160,219	103,149	90,208	90,208	263,368	250,427	250,427
2025	152,872	108,171	91,208	91,208	261,043	244,080	244,080
2026	145,362	113,642	95,473	92,257	259,004	240,835	237,619
2027	137,362	119,548	100,042	93,302	256,910	237,404	230,664
2028	128,868	125,861	104,881	94,282	254,729	233,749	223,150
2029	122,448	133,481	110,723	95,803	255,929	233,171	218,251
2030	119,411	138,607	114,404	95,135	258,018	233,815	214,546
2031	119,079	141,191	120,622	99,829	260,270	239,701	218,908
2032	120,762	142,429	126,172	103,885	263,191	246,934	224,647
2033	124,269	143,271	131,860	107,962	267,540	256,129	232,231
2034	129,100	143,714	137,711	112,066	272,814	266,811	241,166
2035	134,180	143,778	143,778	116,223	277,958	277,958	250,403
2036	138,711	143,497	143,497	120,477	282,208	282,208	259,188
2037	142,417	142,918	142,918	124,889	285,335	285,335	267,306
2038	145,164	142,091	142,091	129,532	287,255	287,255	274,696
2039	146,862	141,060	141,060	134,492	287,922	287,922	281,354
2040	147,474	137,660	137,660	137,660	285,134	285,134	285,134

52,464(23.14%). In addition, the number of primary school teachers in North Korea is predicted to increase, from 87,622 in 2020 to 137,660 in 2040, an increase of 50,038(57.11%). At the same time, the number of secondary school teachers in North Korea is also predicted to increase, from 100,934 in 2020 to 192,411 in 2040, an increase of 91,477(90.63%) for the 2020 unification case.

Table 8. Predicted number of secondary school teachers by assumed unification year

year	South	North			total		
		2020	2025	2030	2020	2025	2030
2020	226,761	100,934	100,934	100,934	321,343	321,343	321,343
2021	225,556	103,728	99,242	99,242	329,284	324,798	324,798
2022	224,176	107,147	97,879	97,879	331,323	322,055	322,055
2023	225,417	111,268	96,831	96,831	336,685	322,248	322,248
2024	229,577	116,111	96,024	96,024	345,688	325,601	325,601
2025	232,678	121,685	95,371	95,371	354,363	328,049	328,049
2026	232,200	128,445	99,569	95,113	360,645	331,769	327,313
2027	230,966	136,883	104,822	95,442	367,849	335,788	326,408
2028	231,133	146,963	111,016	96,114	378,096	342,149	327,247
2029	227,535	160,406	119,325	97,968	387,941	346,860	325,503
2030	219,039	170,875	124,919	96,971	389,914	343,958	316,010
2031	208,497	175,495	135,416	103,859	383,992	343,913	312,356
2032	197,819	178,472	145,906	110,407	376,291	343,725	308,226
2033	186,634	181,464	157,846	117,650	368,098	344,480	304,284
2034	174,914	184,351	171,453	125,623	359,265	346,367	300,537
2035	166,082	187,009	187,009	134,372	353,091	353,091	300,454
2036	161,872	189,322	189,322	143,958	351,194	351,194	305,830
2037	161,334	191,194	191,194	154,482	352,528	352,528	315,816
2038	163,484	192,558	192,558	166,098	356,042	356,042	329,582
2039	168,030	193,382	193,382	179,042	361,412	361,412	347,072
2040	174,295	192,411	192,411	192,411	366,706	366,706	366,706

The number of required primary school teachers in South Korea peaked in 2020 at 168,431, and that number in North Korea is 143,778 in 2035 for the 2020 and 2025 unification cases. The total number of required primary school teachers peaks at 287,922 in 2039 for the 2020 and 2025 unification cases. The number of required secondary school teachers in South Korea will peak in 2025 at 232,678, and that number in North

Table 9. Predicted new demand for primary school teachers

year	South	North			total		
		2020	2025	2030	2020	2025	2030
2021	-535	3,134	-	-	2,599	-	-
2022	484	3,686	-	-	4,170	-	-
2023	-2,292	4,132	-	-	1,840	-	-
2024	-5,869	4,575	-	-	-1,294	-	-
2025	-7,347	5,022	-	-	-2,325	-	-
2026	-7,510	5,471	4,265	-	-2,039	-3,245	-
2027	-8,000	5,906	4,569	-	-2,094	-3,431	-
2028	-8,494	6,313	4,839	-	-2,181	-3,655	-
2029	-6,420	7,620	5,842	-	1,200	-578	-
2030	-3,037	5,126	3,681	-	2,089	644	-
2031	-332	2,584	6,218	4,694	2,252	5,886	4,362
2032	1,683	1,238	5,550	4,056	2,921	7,233	5,739
2033	3,507	842	5,688	4,077	4,349	9,195	7,584
2034	4,831	443	5,851	4,104	5,274	10,682	8,935
2035	5,080	64	6,067	4,157	5,144	11,147	9,237
2036	4,531	-281	-281	4,254	4,250	4,250	8,785
2037	3,706	-579	-579	4,412	3,127	3,127	8,118
2038	2,747	-827	-827	4,643	1,920	1,920	7,390
2039	1,698	-1,031	-1,031	4,960	667	667	6,658
2040	612	-3,400	-3,400	3,168	-2,788	-2,788	3,780

Korea will peak at 193,382 in 2039 for the 2020 and 2025 unification cases. The total number of required secondary school teachers peaks at 389,914 in 2030 for the 2020 unification case.

Tables 9 and 10 present forecasts of the net increase of primary and secondary school teachers in South and North Korea after unification as calculated from Tables 8 and 9. This assumes that the required teachers were all filled in the previous year, and is an estimate of the new demand

that results from the difference in demand between the previous and the current year. According to these tables, the demand for primary school teachers in North Korea will be between 3,134 and 4,694(1.86% to 2.79% of the primary school teachers in South Korea in 2020) in the first year after unification, depending on the time of unification. For secondary school teachers, the demand will be from 2,794 to 6,888(1.23% to 3.04% of the secondary school teachers in South Korea in 2020) in the first year after unification, also depending on the time of unification. During the ten-year period where the number of students per teacher in North Korea is being adjusted to match the number in South Korea, a similar or even bigger demand for new teachers will occur every year.

It was predicted that the demand for new primary school teachers of 5,080(3.02% of primary school teachers in South Korea in 2020) would be at its peak in 2035 in South Korea. It was also found that there would be an oversupply of 8,494 primary school teachers(5.04% of the primary school teachers in South Korea in 2020) in 2028. In South Korea, it was predicted that there would be a constant oversupply of primary school teachers from 2023 to 2031, but a constant excess demand from 2032 to 2040.

In North Korea, it was predicted that there would be a demand for 7,620 primary school teachers in 2029 with 2020 unification(4.52% of the primary school teachers in South Korea in 2020). If unification occurs in the year 2025, it was expected that there would be a demand for 6,218 in 2031(3.69% of primary school teachers in South Korea in 2020). And if unification occurs in the year 2030, a demand for 4,960(2.94% of

Table 10. Predicted new demand for secondary school teachers

year	South	North			total		
		2020	2025	2030	2020	2025	2030
2021	-1,205	2,794	-	-	1,589	-	-
2022	-1,380	3,419	-	-	2,039	-	-
2023	1,241	4,121	-	-	5,362	-	-
2024	4,160	4,843	-	-	9,003	-	-
2025	3,101	5,574	-	-	8,675	-	-
2026	-478	6,760	4,198	-	6,282	3,720	-
2027	-1,234	8,438	5,253	-	7,204	4,019	-
2028	167	10,080	6,194	-	10,247	6,361	-
2029	-3,598	13,443	8,309	-	9,845	4,711	-
2030	-8,496	10,469	5,594	-	1,973	-2,902	-
2031	-10,542	4,620	10,497	6,888	-5,922	-45	-3,654
2032	-10,678	2,977	10,490	6,548	-7,701	-188	-4,130
2033	-11,185	2,992	11,940	7,243	-8,193	755	-3,942
2034	-11,720	2,887	13,607	7,973	-8,833	1,887	-3,747
2035	-8,832	2,658	15,556	8,749	-6,174	6,724	-83
2036	-4,210	2,313	2,313	9,586	-1,897	-1,897	5,376
2037	-538	1,872	1,872	10,524	1,334	1,334	9,986
2038	2,150	1,364	1,364	11,616	3,514	3,514	13,766
2039	4,546	824	824	12,944	5,370	5,370	17,490
2040	6,265	-971	-971	13,369	5,294	5,294	19,634

primary school teachers in South Korea in 2019) will occur in 2039. Finally, if unification occurs in 2020 or 2025, it was found that there would be an oversupply of primary school teachers in North Korea in 2040. The total demand for primary school teachers in the unified Korea will peak in 2035, at 11,147(6.62% of primary school teachers in South Korea in 2020) with the 2025 unification case.

According to Table 10, the shortage and oversupply of secondary school teachers in South Korea is predicted to repeat during 2021 to 2040. That is, there will be a large oversupply from 2029(-3,598) to 2036(-4,210), and the trend will change from 2038(2,150) to 2040(6,265), showing a continuous excess in demand. The biggest oversupply in South Korea will be 11,720 in 2034(5.17% of secondary school teachers in South Korea in 2020), and the biggest excess demand will be 6,265 in 2040(2.76% of secondary school teachers in South Korea in 2020).

In North Korea, it is expected that there will be a constant excess demand for secondary school teachers after unification, regardless of the time of unification. If unification occurs in 2025, the demand for new secondary school teachers will peak in 2035 at 15,556(6.86% of secondary school teachers in South Korea in 2020), and the total amount of new demand for secondary school teachers will peak in 2040 at 19,634(8.66% of secondary school teachers in South Korea in 2020) if unification occurs at the year 2030. Also, just as in the North Korea, it was predicted that there would be a large-scale demand every year for new secondary school teachers in the unified Korea, regardless of the time of unification.

4. Conclusion

This study predicted that the demands for new teachers in North Korea will be 3,134 and 2,794, given 2020 unification, for primary and secondary school in the first year after unification, respectively. It was

predicted that the demand for new primary school teachers in North Korea will be 3,134, 4,265, and 4,694(average of 4,031) for 2020, 2025, and 2030 unification, respectively, and the demand for new secondary school teachers in North Korea will be 2,794, 4,198, and 6,888(average of 4,627), respectively.

The demand for elementary school teachers, 3,134, and for secondary school teachers, 2,794, represent 1.86% of all primary school teachers, and 1.23% of all secondary school teachers in South Korea in 2020. They also represent 72.5% and 92.4% of the average of annually hired primary and secondary school teachers of recent three years in South Korea. Hence even if we re-appoint all of the existing teachers in North Korea right after unification, we would still need nearly twice the number of newly hired teachers in South Korea in the first year after unification. It was also predicted that this demand will continue on a similar scale for the next ten years after unification. Kim(2019) predicted the demand of primary and secondary teachers using the same scenario forecasting method as this study. Kim(2019)¹⁵⁾ used the KOSIS 2017 population forecasting and the average of 2011-2017 enrollment rate. But, since the KOSIS 2018 population forecasting results used in this study was smaller than the KOSIS 2017 in some ages, and the average of 2014-2018 enrollment rate used in this study was higher than the average of 2011-2017 enrollment rate, the final results of this study is similar to that of Kim(2019).

15) Kim, H, "The forecast of the demand of primary and secondary school teachers, and supply plans for the Unified Korea"(Ph.D dissertation, University of North Korean Studies, 2019).

Kim(2019)’s prediction of average elementary and secondary teacher demand in the first year after unification of three assumed unification years were 4,055, and 4,580, respectively.

This prediction of new demand for teachers was based on the South Korean government’s goal to reduce the number of students per teacher to 15.10 for primary school and 11.35 for secondary school by 2030. If the annual rate of decrease required to achieve this goal is maintained through 2040, the number of students per teacher in South Korea will reach 14.10 for primary school and 10.76 for secondary school, which is lower than the 2018 OECD¹⁶⁾ average of 15 for primary school and 13 for secondary school. In this case, the total number of primary school teachers in the unified Korea will exceed 280,000, and that of secondary school teachers will exceed 360,000 in the year 2040. However, we should note that OECD defines ‘teacher’ as the ones who actually participate in classes, excluding principals, vice principals, and other management personnel. Therefore, if we redefine the concept of ‘teachers’ to be the same as OECD’s, the predicted numbers for ‘required number of teacher’ should be greater than the ones presented in this study.

In this study, the prediction of the number of required teachers based on the stated eight major assumptions is as follows:

First, when calculating the population by age, it was assumed that the birth months are evenly distributed in each year.

16) OECD, *Education at a glance 2018: OECD indicators* (OECD Publishing, Paris, 2018), p.350.

Second, the 2008 Primary and Secondary Education Act gave parents the choice of when their child would enter school if they were born in January or February, but it was assumed that every child enters school under the revised Education Act after that year.

Third, the enrollment rate of South Korea throughout 2020 to 2040 was assumed to be the same as the average enrollment rate from 2014 to 2018.

Fourth, after unification, the enrollment rate of North Korea was assumed to be the same as that in South Korea.

Fifth, the reduction rate of the number of students per teacher throughout 2020 to 2030 was assumed to stay equal throughout the whole period. The initial reduction rate was set to achieve the South Korean Government's 'goal of number of students per teacher' by 2030.

Sixth, the number of students per teacher of North Korea for primary school, 22.0, and for secondary school, 20.0, will stay the same at the time of unification.

Seventh, after unification, the number of students per teacher in North Korea will gradually decrease, eventually becoming equal to that in South Korea at ten years after unification.

Eighth, after unification, the number of students per teacher in North Korea will be reduced at the same size annually for ten years.

Because our predictions of how many teachers by school level will be needed are absolutely dependent on these scenarios, the predictions will be inaccurate if any of these scenarios are found to be unreasonable or wrong. Of these eight scenarios, scenarios 1, 2, 3, 4, and 6 are generally reasonable or do not have any additional data to deem them inaccurate

or wrong. However, scenarios 5, 7, and 8, while not unreasonable, are not the only reasonable assumptions.

The assumption made in scenario 5 produces the same predictions, such as fixing the smoothing coefficient as the geometric mean value of the reduction in the exponential smoothing model. Thus, the model based on scenario 5 becomes a simplified version of the exponential smoothing model with a restriction.

For the reduction of the number of students per teacher, the size, instead of rate, can be fixed in scenario 5. In this case, the reduction of the number of students per teacher will be slower in the early stages than is predicted in this research, and in the later years, the decrease in the number of students per teacher will be greater than this research predicts.

Also, although scenario 7, which suggests that the number of students per teacher will become the same in South and North Korea at year ten after the unification, is not unreasonable, this decision is entirely up to the government to make. The government can equalize the number of students per teacher in South and North Korea within an even shorter period than ten years, or can delay it because of resource issues, or can reevaluate the situation and adjust the target time when the actual unification occurs. If the target time is longer than ten years, the size of the new teacher employment per year will be reduced.

Although the prediction depends on the assumptions, one thing remains the same. The unified Korea will require a great many new teachers; so there must be plans to meet those demands in order to minimize the

confusion or conflict that may arise during the unification process.

The predictions made in this study did not take into account the inter-Korean population movement after unification. During the German unification, about 600,000 people(3.7% of the East German population) moved to West Germany between 1989 and 1990 after the Berlin wall fell. This trend of migration gradually declined in the mid-1990s, but it was still in effect. In the year 1994 alone, 1.04% of the East Germans migrated to West Germany(Heiland, 2004¹⁷⁾). Especially, because the younger generation was more active in moving West, East Germany's birthrate plummeted from 198.9 per 1,000 people in 1989 to 78.7 in 1994(Pritchard, 1998¹⁸⁾). The number of newborns decreased rapidly from 200,000 in 1989 to 80,000 in 1992(Mitter and Weiss, 1993¹⁹⁾).

The decrease in population naturally led to a decrease in the number of students, and such a decrease was observed at all levels of schools. Consequently, teachers in East Germany had to face a new problem: a drastic decrease in students(Wilde, 2000²⁰⁾). In contrast, in West Germany, the education budget for 2005 increased by 17% from 1990 because of

17) Heiland, F. "Trends in East-West German migration from 1989 to 2002," *Demographic research*, Vol.11, No.7(2004), p.176.

18) Pritchard, R. M. O. *Reconstructing education- East German schools and universities after unification* (Berghahn books, 1998), p.45.

19) Mitter, W., & Weiss, M. "Educational transformations in a 'United' Germany," In S. L. Jacobson(ed.), *Reforming education- The emerging system approach* (Thousand Oaks, Calif.: Corwin, 1993), p.220.

20) Wilde, S. "A study of teacher's perceptions in Brandenburg Gesamtschulen," in D. Phillips (ed.), *Education in Germany since unification* (Symposium Books, 2000), p.37.

the significant increase in the number of students (Mitter and Weiss, 1993²¹⁾). For the universities, the number of freshmen in East German universities increased temporarily in the early days of unification, from 32,300 in 1989 to 39,500 in 1990, but it dropped back to 34,300 in 1992 as the migration to West Germany started to become a rising trend, because the population composition of East Germany had changed(Kim, 1997²²⁾). If such a demographic shift occurs between South and North Korea, although the predictions of the required number of teachers in a unified Korea will stay the same, the predictions based on the regions (South/North) could be very different from the results shown in this study.

Also, in Germany, subjects such as English, French, Latin, Music, and Religion, which had a low demand in East Germany before unification (Galtress-Horl, 2000²³⁾; Kim, 2016²⁴⁾), met a rapid increase in demand after being introduced to the East German students. Since such a situation is highly likely to occur in Korea, it will be necessary to have a proper plan to deal with the demands for new subjects in secondary schools. In addition, the percentage of East German parents who did not want their

21) Mitter, W., & Weiss, M. "Educational transformations in a 'United' Germany," In S. L. Jacobson(ed.), *Reforming education-The emerging system approach*(Thousand Oaks, Calif.: Corwin, 1993), p.219.

22) Kim, Y. T. *Reunification of Germany and East Germany Reconstruction Process*(Seoul: Hanul Academy, 1997), p.387.

23) Galtress-Horl, K. "Retraining language teachers," in Phillips, D.(ed.), *Education in Germany since unification* (Symposium Books, 2000), pp. 84-85.

24) Kim, C. H. "Education integration and policy implications in Germany," in Ministry of Unification(ed.), *Policy document on integration of education field*(Seoul: Ministry of Unification, 2016), p.55.

children to enter higher education had decreased after unification from 31%(1979) to 10%(1991), and the ratio of parents who wanted their children to enter higher education increased from 38%(1979) to 50%(1991)(Mitter and Weiss, 1993²⁵). Thus, in East Germany, there has been a significant increase in the number of students who went to secondary schools with an aim to enter a higher- education institution in the future(Schoreder, 2010²⁶). Among the school-age population who were eligible to go to secondary school, 30% of them transferred to a school in order to prepare for higher education, which was exactly twice that in the East Germany days(Schroeder, 2010²⁷). If a similar phenomenon occurs in North Korea after the unification, it might also affect the need for additional secondary-level schools or the need for new teachers in various subjects.

Since the biggest variable that influences the number of primary and secondary school teachers is the number of students per teacher, this study predicted the amount of demand for teachers based on the predicted results of the number of students and the policy goals regarding the number of students per teacher. However, the required number of teachers is affected not only by the number of students per teacher, but also by other policies that have already been introduced or will soon be introduced in

25) Mitter, W., & Weiss, M. "Educational transformations in a 'United' Germany," In S. L. Jacobson (ed.), *Reforming education - The emerging system approach* (Thousand Oaks, Calif.: Corwin, 1993), p.213.

26) Schroeder, K. *Germany 20 years after reunification - Why the two parts that belong together won't grow together*(Brasilien, 2010), p.8.

27) *Ibid.*, p.213.

South Korea, such as the ‘one classroom, two teachers system,’ ‘co-teacher system,’ ‘reducing the number of class hours per teacher,’ and the ‘master teacher system’. These variables were not considered in the study, since the effect of these policies on the number of teachers is not only significantly smaller than that of the number of students per teacher, but also because it is not certain when they might be introduced to the current education system. However, if changes in the system do occur in the future, they should also be added to the teacher-demand forecasting model.

Rust and Rust(1995)²⁸⁾ reported that 39,520 out of 189,770(20.83%) East German teachers left school after unification before the end of the 1992/93 school year. Meanwhile, 8% of the teachers are dismissed for political reasons. After unification, despite the massive layoffs of teachers in East Germany, there were no major issues with the supply of teachers in Germany. Before unification as of 1987, West Germany had 73 teachers per 10,000 people, whereas East Germany had 100. Whereas West Germany had 66.6 teachers per 1,000 students, East Germany had 84.1 teachers(Han, Kim, and Jung, 1998²⁹⁾). At the same time, although only 8% of college students were enrolled in teacher-education programs in the West, 22% of East German college students were enrolled in teacher-education programs(Pritchard, 1998³⁰⁾). Hence, when changing

28) Rust, V. D., & Rust, D. *The unification of German education*(New York & London: Garland Publishing, INC, 1995), p.210.

29) Han, M. G., Kim, C. H., & Jung, J. W. *Educational policies for the national integration(II)*(Seoul: Korean Educational Development Institute, 1998), p.127.

30) Pritchard(1998: 153) reported that the number of students per teacher in East Germany is 12.5, while Kiel(1996: 161) reported it as 9.

the education system of East Germany to fit the West German system, there was no excess demand that was unbearable under the existing system in East Germany. In 1989, there were 167,000 teachers and 2.1 million students in East Germany, so the total number of students per teacher was only 12.5(Pritchard, 1998³¹⁾). This is a completely different situation from that now in Korea, and Korean unification is sure to be entirely different from that in Germany.

The number of new primary and secondary school teachers that graduated college in 2020 are 3,717 and 5,528³²⁾ in South Korea, respectively. According to this research, the demand for new primary school teachers in the unified Korea is way beyond the capacity of the current teacher-training system in South Korea. For the secondary school teacher demands, although the average amount of demand was larger than that for primary school teachers, the current South Korean teacher-training system was found capable of meeting those needs. But, if teacher dismissals for political reasons happen as in East Germany, the new teacher demand will be larger than the forecasting results of this study. Therefore, the supply plans for primary and secondary school teachers should be prepared in both short-term and long-term measures.

■ 접수: 10월 22일 / 수정: 12월 7일 / 채택: 12월 8일

31) Pritchard, R. M. O. *Reconstructing education- East German schools and universities after unification* (Berghahn books, 1998), p.153.

32) Korea Educational Statistics Service. Retrieved October, 1, 2020 from <http://kes.kedi.re.kr/index>.

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통일한국의 초중등교원 수요 예측

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이 연구에서는 통일 이후 남한지역과 북한지역 초등과 중등교원 수요규모를 예측하였다. 연구결과에 의하면 통일시기를 2020년, 2025년, 2030년으로 상정하는 경우 통일 이후 첫해의 북한지역 교원순증 규모는 대략 초등교원이 4,000명, 중등교원은 4,500명 내외인 것으로 예측되었다. 이는 각각 남한의 최근 3년간 초등학교와 중등학교 연평균 신규임용 교원의 72.5%와 92.4%에 해당하는 규모로 통일이후에 북한지역에 재직 중인 기존 교원을 모두 재임용한다고 해도 현재 남한에서 해마다 신규 채용하고 있는 교원의 두 배 가까운 규모의 신입교원이 필요해지는 것을 의미한다. 이와 유사한 큰 규모의 수요가 통일 이후 10년간 지속되는 것으로 예측되었다.

초등교원의 신규수요는 현재 남한의 교원양성체제로는 감당할 수 없을 정도의 규모이며, 중등교원 수요는 비록 규모가 초등교원보다 더 클 것으로 예측되었지만 현재 남한의 교원양성체제에서 배출하는 인력이 수요에 대처할 수 있을 만큼 충분히 많은 것으로 나타났다. 독일통일의 경우와 같이 정치적 이유에 의한 교사이직이 크게 발생할 경우에는 이 연구의 결과보다 교사수요가 더 많아질 것이며, 이에 따라 교원 공급, 특별히 초등교원에

대한 장기 공급대책과 함께 비상적인 단기 공급대책을 함께 준비해야 할 것으로 보인다.

주제어: 초등, 중등, 교원, 수요, 예측