

WHAT MADE KOREAN STUENTS SCORE HIGH IN THE INTERNATIONAL COMPARISON STUDIES?

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Abstract

Korean students achieved high scores in the international comparison studies (Third International Mathematics and Science Study; TIMSS, Programme for International Student Assessment; PISA). Many foreign science educators are interested in the reasons of high achievement of Korean students. We examined the reasons as in-school factors and out-of-school factors through the analysis of the international comparison studies, educational system of Korea and in-depth interview with science teachers. In-school factors are composed of centralized educational system, school hours & content, concept-centered teaching and assessment with a multiple-choice exam. Out-of-school factors are composed of social atmosphere to eager to pursue higher education, desire to step up one's social hierarchy through academic clique, and widespread private tutoring after school hours. It was found that these factors significantly influence on Korean students' high achievement. However, such high achievements may not imply Korean students' real understandings of scientific knowledge and scientific literacy.

Keywords: International comparison study, high achievement

1. Introduction

Recently, it is the most important aim in education to make students be prepared to meet the challenges of the future and have the capacity to continue learning throughout life. Especially, the scientific literacy is emphasized in science. Scientific literacy is the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity [1].

The Organization for Economic Co-operation and Development's (OECD) Programme for International Student Assessment (PISA) represents a commitment by the governments of OECD member countries to monitor the outcomes of education systems in terms of student achievement, within a common international framework. It assessed how far students near the end of compulsory education have acquired some of the knowledge and skills that are essential for full participation in society. PISA is being implemented on a 3-year cycle. The first survey was conducted in 2000 and second survey was conducted in 2003. In PISA 2000, Korean students ranked first in scientific literacy. In PISA 2003, Korean students ranked first in problem-solving skills and fourth in scientific literacy (see Table 1).

Table 1. Results of the PISA(2000, 2003)

PISA 2000 Scientific Literacy			PISA 2003 Scientific Literacy			PISA 2003 Problem-solving		
rank	nation	point	rank	nation	point	rank	nation	point
1	KOR	552	1	FIN	548	1	KOR	550
2	JPN	550	1	JPN	548	2	HKO	548
3	FIN	538	3	HKG	539	2	FIN	548
4	GBR	532	4	KOR	538	4	JPN	547
5	CAN	529	5	LIE	525	5	NZL	533
...				
Ave.		502	Ave.		500	Ave.		500

*Korea Science Teachers Association (KSTA) is the organization of Korea science teachers. The mission of KSTA is to promote the excellence and innovation in science teaching and learning for all and to promote the public understanding of science. KSTA's current membership of more than 500 includes science teachers, administrators, scientists and others involved in science education. In order to enhance professional development for science teachers, KSTA has conducted many conferences. All presenters in this study are member of KSTA.

International Association for Evaluation of Education Achievement's (IEA) Trends in International Mathematics and Science Study (TIMSS) is being implemented in order to get information to improve teaching and learning in mathematics and science. TIMSS assesses achievement in mathematics and science at the fourth and eighth grades and collects a rich array of background information about the school and home context for learning mathematics and science[2]. The first cycle of TIMSS was in 1995. In science of TIMSS 1995, Korean fourth grade students ranked first and eighth grade students ranked fourth. In the second cycle (TIMSS 2000), Korean fourth grade students ranked fifth. And eighth grade students ranked third in TIMSS 2003 (see Table 2).

Table 2. Results of the TIMSS (8th grade, 1995, 1999, 2003)

1995			1999			2003		
rank	nation	point	rank	nation	point	rank	nation	point
1	SIN	580	1	TAI	569	1	SIN	578
2	JPN	554	1	SIN	568	2	TAI	571
3	KOR	546	3	HUN	552	2	KOR	558
4	HUN	537	4	JPN	550	4	HKG	556
5	GBR	533	5	KOR	549	5	JPN	552
...				
Ave.		521	Ave.		524	Ave.		474

Many foreign science educators are interested in the reasons of high achievement of Korean students. They might think that that Korean education system is effective and efficient because Korean students perform well above the other countries. In the field of Korean science education, few interests have so far been concentrated on the field of international comparative assessment [3]. The possible reason of it is that Korean students have made an excellent performance. Fortunately, some researches [4-11] showed a various problems and suggestions. But these researches mainly concentrated the result of comparison study.

This article examined the reasons why Korean students achieved high scores in the international comparison studies(TIMSS, PISA). And we discussed the authentic meaning that these factors affected the Korean students' real understandings of scientific knowledge and scientific literacy.

The aims of the present study were

- What are the in-school factors that the Korean students achieved high scores in the international comparison studies?
- What are the out-of-the school factors that the Korean students achieved high scores in the international comparison studies?
- What are the authentic meanings of these factors in Korean students' scientific literacy?

2. Methodology

In order to examine what made Korean students score high in the international comparison studies (PISA, TIMSS), we reviewed the research report and paper [3-11] and analyzed the educational system of Korea. In addition, we tried to do in-depth interview with science teachers. From these data, we found the many kinds of factors related the reasons. These factors were grouped into similar categories. Finally we made the 4 in-school factors that could be in the school and 3 out-of-school factors that could be found out of school. These factors are in the Table 3.

Table 3. In-school factors and out-of-school factors.

In-school factors	Out-of-school factors
<ul style="list-style-type: none"> • centralized educational system • school hours & content • concept-centered teaching • assessment with a multiple-choice exam 	<ul style="list-style-type: none"> • social atmosphere to eager to pursue higher education • desire to step up one's social hierarchy through academic clique • widespread private tutoring after school hours

3. Result

3.1 In-school factors

The reasons why Korean students marked high scores in the international comparison studies can be explained in two aspects; in school and out of school factors. 'In-school factors' are composed of these four factors: centralized educational system, school hours and excessive content, concept-centered teaching, and assessment with a multiple-choice exam.

The most important aspect is that the centralized educational system is running in Korea. For educational system, curriculum, textbook, teacher and student domains could be discussed. In Korea, a national curriculum has been implemented since 6-3-3 ladder structure of schools adopted in 1950. The curriculum is developed at the government level, and all schools are required to follow it.

Textbooks for elementary schools are developed by the Ministry of Education. And secondary schools textbooks are developed by teachers and other personnel, but distributed with approval by the Ministry of Education. So textbooks in Korea are much similar to one another. For example, same experiment topics are appeared in most of science books approved as it is shown in the Table 4.

Table 4. Comparison of experiment topics (Light) in Korea 7th grade textbooks

Textbooks	A	B	C	D	E	F	G	H	I
Experiment topics									
How we see an object?						○	○		
Reflection in a flat mirror	○	○	○	○	○	○		○	○
Image in a mirror				○		○	○	○	
Reflection and scattered reflection	○				○				
Refraction within various objects	○	○	○	○	○	○	○	○	○
Refraction in a lens	○				○		○		
Observation a coin in water		○	○		○				
Observe a refraction of light	○								
Dispersion of light	○	○	○	○	○	○	○	○	○
Observe a dispersion with a CD						○			
Composition of light	○	○	○	○	○	○	○	○	○
Making a color-top			○	○	○	○	○	○	○
Total reflection	○	○	○	○	○	○	○	○	○

Many universities in Korea have similar Pre-service Teacher education programs and the Ministry of Education employs nationwide examination of teacher employment for quality control. So, in order to apply for this examination, pre-service teachers must major in science or science education. Moreover students with high achievement recently enter teachers' colleges with preference to teaching jobs as future career.

A student domain is thought of the most important aspect. All students are in the nation-led compulsory education until middle school. So Korea students must achieve the national curriculum. A centralized educational system made an equalization of school and made it possible for students to get a government-demand intellectual level. In the results of the international comparison studies, the number of medium-grade students was more than higher and lower rank students. This consequence could be explained by the centralized educational system. It coincides with the national educational aim of equality of education, but we are anxious about the lack of higher rank students.

The second factor is the school hours and excessive contents. The number of school days of Korea is about 225 days. It is more than international average (193 days) (see Figure 1). As Korean students are at school for longer days than other countries' students, they have more opportunities to be educated. The quality of education covers very excessive contents and more difficult contents. Moreover, the executed curriculum includes more and more difficult contents than the regular curriculum. In the result of TIMSS-R, the degree of Korean student was positively skewed distribution. This distribution indicates that Korean students regard the problem of TIMSS-R easy.

The third factor is related the type of instruction. Concept-centered teaching is traditionally emphasized in Korea. The reason of it is the oversized class. Although it is being improved, there were over 45 students per a class a few years ago.

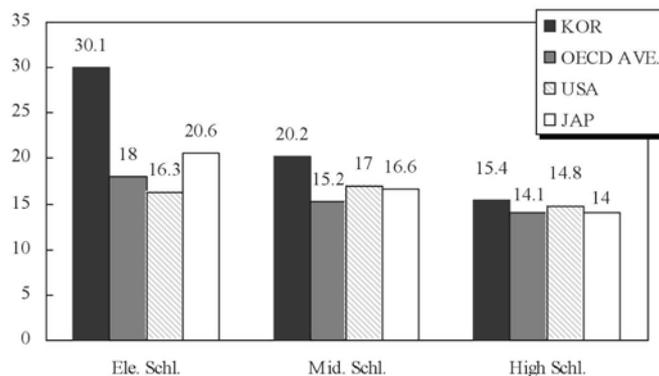


Fig 1. Students per a Teacher (KOR-2003, Other-2001) [12]

Figure 1 shows the number of students per one teacher. In the elementary school and middle school, the number of students per one teacher is more than any other country. And Korean teachers should have other school administrative jobs that are very, heavy burden. So they seem to have not enough time to prepare classroom teaching with various teaching methods such as lab activities, field trip, research project, discussion, etc. Therefore, Korean teachers tempt to deny an inquiry-based instruction in science class. They prefer lecture methods in a classroom rather than various activities at laboratories. And in Korean society, a notion of emphasizing knowledge acquisition is predominant perceived among teachers as well as students and parents. Because of the objectivity of evaluation and excessive content to study, a concept-centered instruction becomes common. This form of instruction has an advantage in all acquirement of knowledge and understanding of basic contents. It explains the result that Korean students marked higher score in the knowledge and understanding part than application part in international evaluation.

Fourthly, Korean students are familiar with a multiple-choice exam. Korean students marked higher score in the multiple-choice exam than the descriptive exam in the international evaluation studies. We think that this is resulted by students' studying type. They are spending much time on multiple-choice exam exercise. In Korea, all education system is deeply related to an entrance into a school of higher grade, especially university and so multiple-choice exam has become a standard for a fair and objective estimation. So Korean students have many experiences to meet the multiple-choice exam and have the know-how to select correct answer in the multiple-choice exam.

3.2 Out-of-school factors

We examined the out-of-school factor why Korean students marked high scores in the international comparison studies (TIMSS, PISA) as follows: social atmosphere to eager to pursue higher education, desire to step up one's social hierarchy through academic clique, and widespread private tutoring after school hours.

First, traditionally not only many Korean students but also their parents are eager to go to the university. And actually many of them go to the university. Many Korean high school students would like to enter the university. Only 55.5 % of high school students in Japan and 62.9% of high school students in USA entered the university. However 79.7% of general high school students of Korea entered the university in 2001 (see fig. 2). In many other countries, high school students desire to get a job after graduate. In contrast, all of Korean students strongly desire to enter the university.

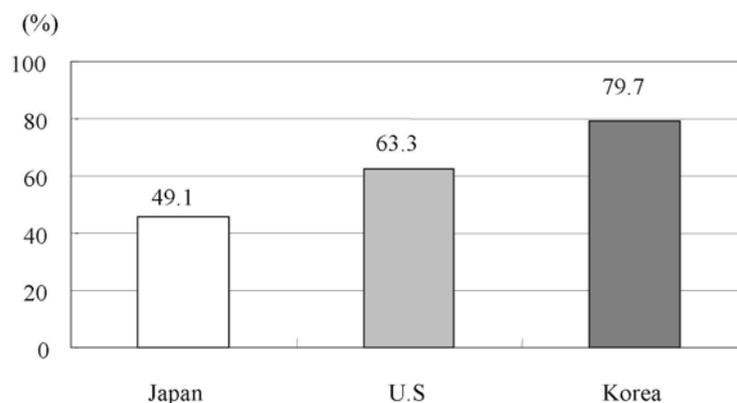


Fig 2. The ratio of students who go to the university (2001) [13]

Secondly, there have been desire to rise in the hierarchy through academic clique in Korea. Unlike other country, there

have been no better ways to raise their social status than through education in Korean history. Kwago, the recruit system of the Choson Dynasty by means of state examination is a good example. Although it was the system of the past, similar atmosphere remains these days [14].

Looking back on recent history, Korean had their land seized from them by Japanese and Korean war. It made people hard to live and it made earning differential more serious. So raising their social and economic status through academic clique was the best policy. Desire to get an academic clique became tradition. It means, traditionally, they have regarded scholarship as an ultimate good in their society. Korean people believe that academic clique can reproduce social relationship. According to this, many people might have high desire to get a university education. Even though many other countries have such trend, this situation seems to be more remarkable.

Thirdly, in Korea, there is widespread private tutoring after school. Actually students spent most of their time to study after school. Mainly they are concerned about basic subject such as Korean and math, English. But science is important for them. About 75% of elementary students go to the private institute for tutoring [15]. The high school students spend their after school times in studying. 24% of the high school students remain in school at night in order to study. 32% of the students went to the private learning institute in order to supplement their learning. Though these data was from high school students, elementary and middle school students had similar trend.

Table 5. After school Activities (%) [15]

independent study at school at night	Private learning institute	part time job	club activity	spending time with friends	total
24.0	31.9	4.1	4.2	35.8	100(N=850)

In addition to the regular school curriculum and its heavy work load, students have to deal with extra workload from private tutoring. Pre-study is being done. The institutes cover the school curriculum even before the school starts, as well as the review. This targets the improvement of the learning effect through repetition. That's why the students achieve more in acquiring factual knowledge.

4. Discussion

In this study, we examined the reason why Korean students marked high scores in international comparison studies as in-school factors and out-of-the factors. In-school factors are composed of centralized educational system, excessive school hours and contents, concept-centered teaching and familiarity with multiple-choice examination. Out-of-school factors are the social atmosphere to enter the higher education, consideration of education as a social status and overflowing private tutoring.

These factors affected Korean students' high achievement in international comparison studies. Many foreign science educators thought that Korean educational system might set goals to meet the authentic science aims and the challenges of the lifelong learning society. But high scores in science does not mean that students in Korea have positive attitude in science and self-confidence in science, which will be the most significant elements to perform high level of scientific creativity as well as scientific literacy. PISA scores do not really mean that Korean students are having scientific literacy in their daily life. Many good and excellent high school graduates do not pursue majors in science and engineering at universities and colleges, which will be resulted in lack of leading scientists and engineers near future. Female students are also not choosing their majors in science. Though concept-centered teaching method influenced on Korean students' high achievement, Korean science educator considered that this type of instruction is the largest problem in school science. Many science teachers recognized a large size class and the students' ability difference as the biggest impediment for instruction. Though Korean teachers tried to do an inquiry-oriented learning in school science, they were forced to do concept-centered teaching because of large size class, excessive contents and Korean examination system. Students regarded study of science as a means of going to higher learning institutions rather than seeking employment after graduation. So many Korean science educators are anxious about these situations in spite of high achievement of Korean students. Therefore the long-term educational policies and further study are needed for strengthening the affirmative factors and removing the negative factors.

5. References

- [1] OECD, *PISA 2003 Assessment Framework - Mathematics, Reading, Science and Problem Solving Knowledge and Skills*, 2003.
- [2] P. Gonzales, J. C. Guzman and L. Jocelyn, *Highlights from the trends in international mathematics and science study (TIMSS)2003*, National center for education statistics, 2004.
- [3] D. Shin and K. Ro, *PISA 2000 Science Results: Initial Report*, RRE 2001-9-4, Korea Institute of Curriculum and Evaluation, Seoul, 2001.
- [4] M. Hong, C Park and S. Kim, "An Analysis of Science Achievement of The Third International Mathematics and Science Study-Repeat(TIMSS-R)", *J. Korea Assoc. Res. Sci. Edu.*, Vol. 21, No. 2, pp. 328-341, 2001

The 9th International Conference on Public Communication of Science and Technology

- [5] J. Yoo, "Analysing and results of physics-related areas in the third international mathematics and science study-repeat

The 9th International Conference on Public Communication of Science and Technology

- (TIMSS-R) for the implications in the curriculum research”, *J. Korea Assoc. Res. Sci. Edu.*, Vol 21, No. 4, pp 757-772, 2001.
- [6] M. Hong, “An analysis of Korean middle school students' achievement of scientific inquiry and the nature of science in TIMSS-R”, *J. Korea Assoc. Res. Sci. Edu.*, Vol. 22, No. 2, pp. 336-344, 2002.
- [7] J. Myeong and M Hong, “An analysis of Korean middle school students' achievement of earth science in TIMSS-R”, *J. Korea Assoc. Res. Sci. Edu.*, Vol. 22, No. 3, pp. 649-659, 2002.
- [8] C. Park M. Hong, S. Kim and H. Jun, *The Third International Mathematics and Science Study-Repeat (TIMSS-R): A National Report II Korea Institute of Curriculum and Evaluation*, Seoul, 2000.
- [9] C. Park, M. Hong and G. Na, *Korean 8th grade students' Achievement in Mathematics and Science in TIMSS-R International Benchmark*, RRE 2001-10, Korea Institute of Curriculum and Evaluation, Seoul, 2001.
- [10] S. Kim, J. Yoo, D. Seo, C. Lee and C. Imm, *The Third International Mathematics and Science Study-Repeat (TIMSS-R) National Report for the Main Survey*, RRE 99-7-1, Korea Institute of Curriculum and Evaluation, Seoul, 1999.
- [11] D. Shin and K. Ro, “Factors of Korean students' achievement in scientific literacy”, *J. Korea Assoc. Res. Sci. Edu.*, Vol. 21, No.5, pp. 893-905, 2001.
- [12] D. Park, J. Kim, D. Bang and D. Son, *Research of teacher's standard lesson hours*, KEDI, CR 2003-3, 2003.
- [13] K. Kim, *Political Economics of Education in Korea, Breathing clique in Our Society*, summer seminar, 2001.
- [14] KEDI, *The ratio of students who go on to the next stage of education*, 2004 KEDI-annual educational report, 2004.
- [15] Korea Christian students Association, *Research Report about Teenagers' consciousness and life. Research data for teenagers*, 2002.