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ABSTRACT

The science curriculum in Korea has been revised five times in the past 30 years. However, the issue of textbooks and their role in teaching and learning still exists as a major problem. The purpose of this study is to investigate the presentation of the goals of the national curriculum in high school earth science textbooks by analyzing and comparing the third and sixth national curriculums. Analyses were conducted for concepts, inquiry skills, the development process of earth science concepts, and science-technology-and-society (STS) development. (Contains 23 references.) (YDS)

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Analysis of Korean High School Earth Science Textbooks from the Perspectives of Science Curriculum Revision

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I. Introduction

The National Curriculum, which can be called “educational constitution” in Korea, serves as the fundamental framework of the country’s elementary and secondary school education. The revision of the National Curriculum, which has been made seven times so far, has brought about changes in the structure and contents of textbooks themselves, as well. In the case of science education, the world trend has actively been reflected to the curriculums in Korea whenever they were modified. For instance, the Third National Curriculum (1974-1981) was centered on an academic focus, which was specified as understanding basic structure of science concepts, obtaining an inquiry skills, and fostering student’s attitude to learn science. Likewise, the Sixth Science Curriculum (1992-1997) placed more emphasis on the scientific process and newly

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introduced a subject of *Integrative Science*. These examples of the two curriculums show us how the world trend of science education led to a wide array of changes in science education of Korea.

Although science curriculum in Korea has been revised seven times for the past five decades, few people would agree that the spirit of curriculums was put into practice at schools and that the quality of the nation's science education has been improved. More importantly, the higher the level of school is, the more conceptualized the science education gets, regardless of what the modified curriculum says. The reasons are many fold why the national curriculums have failed to overhaul the school education system, particularly the nation's science education in high school. There are problems in the teaching and learning methods, the issue of college entrance examination has long been raised, and problems are still being found in students' learning material, including textbooks.

Among these various reasons, the issue of textbooks is the most serious problem, for they are the major educational materials in Korea. Most people in Korea would deny the fact that no matter how many learning materials are developed, they are written with the basis on school textbooks. Therefore, textbooks should include what needs to be learned and taught in school – in other words, how textbooks are directed

can determine the method of teaching and learning. In this context, textbooks should be developed in a way that they can live up to the goals of the national curriculum so that the curriculum can have more influence on the nation's school education. Otherwise, the curriculum will be no more than a "piece of paper" or a "revision for the sake of the revision itself." In other words, textbooks may look revised on the surface but beneath it, there would be no modification in the substance.

This study is to find out how effectively the goals of the national curriculums have been reflected to Korea's science textbooks, in particular to high school earth science textbooks. The purpose of this study is to be a reference material to the development of new *Earth Science* textbooks in the future. To achieve this purpose, high school earth science textbooks developed on the basis of the Third and the Sixth National Curriculums will be analyzed and comparisons between the two curriculums will also be made throughout this study.

II. Relevant Studies

Although most science educators in Korea agree that the goals of the national curriculums have not been sufficiently reflected to textbooks and they voice for a

change, few relevant studies have been conducted to resolve the issue, particularly in the field of earth science. One of a handful of studies that can be referred to here is the analysis done by Kim and his colleagues (1994). In this study, they compared Korean earth science textbooks with those of the United States. They referenced four groups of goal clusters in the *Project Synthesis* of United States as criteria for textbook analysis: personal needs, social needs, academic preparedness, and career decisions. The study says that out of these four goals, earth science textbooks in Korea have focused only on academic preparedness, virtually ignoring the other three goals.

In the field of physics (Choi, 1995, 1997) and biology (Kim & Chung, 1995) education, studies have been done to analyze how effectively the STS (Science-Technology-Society), one of the goals of the Sixth Science Curriculum, was included in middle school science textbooks. These studies, however, looked only into the aspect of STS and did not pay an equal amount of attention to other goals of the sixth curriculum. In addition, they only analyzed the textbooks that were already in use in school at that time. Other studies have been conducted to find out the differences among middle school science books (Koo & Choi, 1992) and the level of satisfaction concerning high school physics textbooks (Choi & Kim, 1994), and to draw up an evaluation framework for middle school science books (Choi & Kim, 1996). These

studies, however, have failed to consider the curriculum as their basis of evaluating or analyzing the textbooks.

It is in fact uneasy to find outside of Korea a study on the relationship between the curriculum and school textbooks. In Korea, the revision of the curriculum brings about the revision of textbooks, but that is not the case in most other countries. What is fortunate is that in other countries, a number of studies have been conducted on the importance of science textbooks (Stake & Easley, 1978; Exline, 1984; Harms & Yager, 1981). More specifically, since the mid 1980s in the United States, diverse forms of textbook analyses have been done centering around the students' scientific literacy (Chiappetta et al., 1987, 1991, 1993; Garcia, 1985; Fillman, 1989). Other topics of such studies include how effectively and efficiently the goal of biological experiments was reflected to the biology textbooks (Lumpe & Scharmann, 1991); how aptly the concept of the "mole" is explained in chemistry textbooks (Staver & Lumpe, 1993), and; how visually the concept of "vaporization" is described in biology textbooks (Soyibo, 1995).

As the aforementioned examples indicate, many researches have been conducted in other countries to analyze the contents of their science textbooks, though they were not linked to a curriculum. Unfortunately, however, fewer people took interest in the

textbook analysis of earth science than in other fields of science such as physics or biology.

III. Procedure

The following processes were used to examine the way the purposes of the national curriculums are reflected in earth science textbooks of Korea.

1. Comparison of the goals of the Third and the Sixth high school earth science curriculums

The Third National Curriculum (1974-1981) first gave the subject of earth science the same importance as that was given to other high school science subjects including physics, chemistry, and biology. As was influenced by an academic-centered trend in science education, the third curriculum had four relevant goals: 1) to understand basic concepts and the structure of earth science concepts; 2) to acquire scientific inquiry skills, 3) to integrate natural phenomena caused by earth scientific forces, and; 4) to utilize the scientific knowledge and skills for the national development.

The Sixth National Curriculum (1992-1997) divided the subject of earth science into two: *Earth Science I* to understand science in their daily lives and; *Earth Science II* to have the necessary base for college science courses. The sixth curriculum's emphasis on the STS was also applied to the subject of earth science. The common goals of *Earth Science I* and *II* were 1) to understand basic concepts of earth science; 2) to develop and utilize scientific inquiry skills; 3) to foster students' scientific attitude; 4) to integrate the development process of earth science concepts, and; 5) to develop the aspect of STS.

The goals of the third and the sixth curriculums (Table 1) have concepts, inquiry skills, and attitude in common. The minor difference found in the aspect of attitude is that the third curriculum stressed the fact that knowledge should be used for the "national development," while the sixth curriculum placed emphasis on the "scientific" attitude with which students can develop curiosity and interest in the subject of earth science. Other features of these curriculums are that the third curriculum had, as one of its purposes, integrating earth scientific phenomena, and that the sixth has new goal items of understanding the development process of earth science and of the STS. These goals indicate the fact that the world trend of science education was reflected to the national curriculums.

Table 1

A Comparison of goals between the Third and Sixth Earth Science Curriculums

Goal items	The Third National Curriculum (1974-1981)	The Sixth National Curriculum (1992-1997)
Concepts	Understanding basic concepts and the structure of earth science concepts	Understanding basic concepts of earth science
Inquiry Skills	Acquiring scientific inquiry skills	Developing and utilizing scientific inquiry skills
Integrative Understanding	Integrating natural phenomena caused by earth scientific forces	
Attitudes	Utilizing scientific knowledge and skills for the national development	Fostering student's scientific attitudes
Development Process of Concepts		Comprehending the development process of earth science concepts
STS		Developing the aspect of STS

2. Analysis of high school earth science textbooks with the Third and the Sixth

Curriculums

A. Textbooks analyzed

Four different kinds of *Earth Science* textbooks from the third curriculum and four kinds of *Earth Science I* and *Earth Science II* textbooks from the sixth curriculum were

analyzed (Table 2). A total of 12 books and 3,095 pages were put on analysis.

Table 2
Textbooks analyzed

Earth Science (The Third Curriculum)			Earth Science I (The Sixth Curriculum)			Earth Science II (The Sixth Curriculum)		
Publisher	Year	Author	Publisher	Year	Author	Publisher	Year	Author
Gyemong	1979	Yoon et al.	Gumsung	1997	Woo, J. et al.	Gumsung	1996	Woo, J. et al.
Gumsung	1979	Chung et al.	Gyohak	1997	Woo, Y. et al.	Gyohak	1996	Woo, Y. et al.
Donga	1979	Kim et al.	Daehan	1997	Ahn et al.	Daehan	1996	Ahn et al.
Gyohak	1979	Yoo et al.	Jeehak	1997	Kim, C. et al.	Jeehak	1997	Kim, C. et al.

B. Criteria of analysis

The criteria of this textbook analysis were the goal items that were presented by the Third and the Sixth National Curriculums. The goal item related to students' "attitude," however, was excluded from the analysis for being difficult to be visualized in textbooks. The following is a detailed explanation about the goal items that were presented by the Third and the Six Science Curriculums:

1) Concepts

- What requires students to recall information, facts, concepts, principles, and theories.
- Information that should be learned by students and is included in most traditional textbooks.

2) Scientific Inquiry

- The scientific process such as students' observation, measurement, classification, inferring, data interpretation, calculation, and experiments.
- What requires students to think and engage in activities to “discover” facts. But if it simply requires them to recall information, it falls on the category of “concepts.”

3) Integrative Understanding

- What requires students to think integratively about specific areas of earth science including astronomy, geology, meteorology, and oceanography.

4) Development process of earth science concepts

- Introduction of experiment methods or ways of thinking of scientists in the past.
- Historical development of earth science concepts.

5) STS

- Explanation on the effects science has had on society.
- Explanation on how science is applied and how technology helps people or interferes in their lives.
- Explanation on social issues, including science-related careers.
- Information that needs to be provided for students, not necessarily discovered by them.

C. Data Collection

Data for the textbook analysis were collected in the following ways:

1. An analysis table was created for every unit of each textbook and the page number was entered in the table.
2. Page number was calculated to the second decimal place in consideration of the number of lines on the page. For instance, if a page contained 28 lines in total and 7 lines of explanation on the item in question, it was regarded as less than one page – 0.25 was the calculated page number. The number of pages that contained figures or graphs was also calculated in the same method.
3. Two graduate students majoring in earth science education conducted the analysis independently. Both of them are high school earth science teachers.

4. The book cover and the picture on the page right after the cover were excluded from the analysis.

IV. Results

The following is the result of the textbook analysis along with the Third and the Sixth National Curriculums on earth science education. Two analysts conducted their work simultaneously and independently on a total of 12 kinds of textbooks. The rate of agreement between the two analysts is in the range from approximately 88% to 97% depending on the textbook. The average is around 94%. Kappa's coefficient is in the range between 0.84 and 0.94, which indicates that there is a high rate of agreement between the two analysts and that the results of this study are reliable.¹

1. Analysis of high school *Earth Science* textbooks with the Third National Curriculum

The results of high school *Earth Science* textbook analysis with the third national

¹ Kappa's coefficient over 0.40 means that the rate of agreement is high (Rubinstein & Brown, 1984).

curriculum are shown in Table 3. The analysis was conducted in the fields of concepts, scientific inquiry skills, and the integrative understanding of earth science phenomena, with the exclusion of students' attitude. The results are the average of the two analysts.

Table 3

Textbook analysis of "Earth Science" with the Third National Curriculum

Goal item	Gyemong		Gumsung		Donga		Gyohak	
	N*	%	N	%	N	%	N	%
Concepts	218	89.9	243	89.3	269	95.2	225	88.0
Inquiry	21	8.8	24	8.7	10	3.6	28	10.9
Integrative understanding	4	1.3	5	2.0	4	1.2	3	1.1
Total	243	100	272	100	283	100	256	100

* N: number of pages

The results show that about 90% of all of the four textbooks deal with "concepts" while only the remaining 10% concerns scientific inquiry skills and the integrative understanding of earth science phenomena. In the case of *Earth Science* book published by Donga, even more than 95% of the book explains scientific concepts and information. Moreover, a meager 1-2% of the books deals with the integrative

understanding, though it should be given an equal importance as concepts and inquiry skills.

Table 4 shows the average of the four *Earth Science* textbooks by unit. As the table indicates, regardless of specific areas - geology, astronomy, meteorology, or oceanography - concepts and information are given the most priority in all textbooks analyzed. One aspect that attracts our attention is that the unit “Water Cycle,” which deals with water and energy circulating in the atmosphere, places more importance on inquiry skills and the integrative understanding than concepts and information.

Table 4
Textbook analysis of “Earth Science” with the Third National Curriculum by unit (%)

Units	Goal Items	Concepts	Inquiry Skills	Integrative understanding	Total
The Earth		88.9	9.8	1.4	100
Water Cycle		84.2	10.0	5.8	100
Rock Cycle		93.4	6.6	0	100
Earth History		91.5	8.5	0	100
Solar System and the Universe		94.4	5.7	0	100

2. Analysis of high school *Earth Science I* and *Earth Science II* with the Sixth

National Curriculum

The results of high school *Earth Science I* textbook analysis with the Sixth National Curriculum are shown in Table 5. The analysis was conducted in the fields of concepts, inquiry skills, the development process of earth science concepts, and the STS, with the exclusion of students' attitude. Just as the analysis of *Earth Science*, the results are the average of the two analysts.

The results show that “concepts” dominates all of the four textbooks, followed by inquiry skills, STS, and the development process of earth science concepts. But like the result of the analysis with the third curriculum, “concepts” occupy approximately 80% of the whole book while only the remaining 20% deals with inquiry skills, the development process of earth science concepts, and the aspect of STS.

Although concepts and information are given the highest priority in *Earth Science I* as a result of the sixth curriculum, the development process of earth science concepts is dealt with quite importantly in such units as “Matter of the Earth and its Change” and “The Universe,” which discuss Plate Tectonics and Cosmology respectively (Table 6). Likewise, the unit “The Past and Future of the Earth”, which presents the explanation on the environmental earth science issues, applies the aspect of STS more than any

other units.

Table 5

Textbook analysis of "Earth Science I" with the Sixth National Curriculum

Goal item	Gumsung		Gyohak		Daehan		Jeehak	
	N*	%	N	%	N	%	N	%
Concepts	138	83.8	164	85.8	160	87.8	158	77.0
Inquiry Skills	17	10.6	17	9.1	13	7.2	33	15.9
Development Process	4	2.3	5	2.3	3	1.5	6	3.1
STS	6	3.3	5	2.8	6	3.5	8	4.0
Total	165	100	191	100	182	100	205	100

* N: number of pages

Table 6

Textbook analysis of "Earth Science I" with the Sixth National Curriculum by Unit (%)

Units	Concepts	Inquiry Skills	Development Process	STS	Total
Goal items					
Matter of the Earth And its Change	83.4	12.6	93.4	91.5	100
The Atmosphere And the Ocean	84.2	12.3	10.1	9.0	100
The Universe	93.4	0.9	3.9	1.5	100
The Past and Future of the Earth	91.5	1.8	0.3	10.4	100

The results of high school *Earth Science II* textbook analysis with the sixth curriculum are shown in Table 7. As Table 3 and Table 4 show, about 80% of all of the four textbooks focus on “concepts.” Just as the results of *Earth Science I*, the “concepts” item is followed by inquiry skills, STS, and the development process of earth science concepts, with the three of which taking up around 20% of the entire contents of the books.

Table 7

Textbook analysis of “Earth Science II” with the Sixth National Curriculum

Goal Item	Gumsung		Gyohak		Daehan		Jeehak	
	N*	%	N	%	N	%	N	%
Concepts	241	80.9	276	84.0	286	86.4	266	78.0
Inquiry Skills	35	11.8	35	10.6	24	7.3	54	15.9
Development Process	10	3.5	6	1.8	7	2.2	9	2.7
STS	11	3.8	12	3.6	14	4.1	12	3.4
Total	297	100	329	100	331	100	341	100

* N: number of pages

Although basic concept is given the most priority in every unit of *Earth Science II*

textbooks, the books spare a larger part on scientific inquiry skills than *Earth Science I* textbooks (Table 8). In particular, the unit “Environment and Resources” contains a great deal of contents related to the STS. Additionally, just as *Earth Science I*, such units as “Matter of the Earth and its Change,” “Earth History,” and “Stars and the Universe” allow much space for the explanation of the development process of earth science concepts than any other units of *Earth Science II* textbooks.

Table 8

Textbook analysis of “Earth Science II” of the Sixth National Curriculum by Unit (%)

Units	Goal Items	Concepts	Inquiry Skills	Development Process	STS	Total (%)
The Earth		79.7	14.9	4.4	1.0	100
Matter of the Earth and its Change		80.1	13.7	6.1	0.2	100
Earth History		84.4	12.3	3.3	0.1	100
Weather and Climate		84.2	14.2	0.2	1.4	100
The Ocean		86.7	10.6	1.0	1.7	100
The Solar System		88.0	10.5	1.5	0	100
Stars and the Universe		87.8	8.6	3.4	0.2	100
The Environment and Resources		62.7	13.2	0.4	23.6	100

V. Discussion

The following can be taken into consideration as a result of the high school earth science textbook analysis with the Third and the Sixth National Science Curriculum.

First, in Korea, there is not much difference between earth science textbooks that were used about twenty years ago and *Earth Science I* and *Earth Science II* books that are currently in use. Traditional textbooks are written in a way to place emphasis only on the “enumeration of information and concepts,” which is also precisely how the textbooks used for this analysis are structured. It is true that in textbooks that were written following the sixth curriculum, the portion of information and concepts has been reduced, while the content of scientific process has increased. But the ratio of such parts to the entire textbook serves as a clear indicator that textbooks are still focusing on concepts and information.

Second, textbooks are developed with the ignorance of goals of the revised national curriculum, which is the case not only with the Third but also with the Sixth National Curriculum. The four goals of the third curriculum including concepts, scientific inquiry skills, and the integrative understanding of earth science phenomena were not properly reflected to textbooks in question. As this study shows, “concept” is

excessively emphasized in textbooks, so the books virtually do not cover inquiry skills and the integrative understanding. This clearly indicates that the textbook writers in Korea did not accept the fact at all that the third curriculum places emphasis on scientific inquiry. Likewise, the five goals that were presented by the Sixth National Curriculum were not aptly reflected, either. As concept is emphasized too much, it is not balanced with the other goals including inquiry skills, the development process of earth science concepts, and the aspect of STS. It is true that scientific inquiry skills occupy more space than in *Earth Science* books of the third curriculum and the aspect of STS is partly reflected to the textbooks with the sixth curriculum. However, the portion of the STS is very small compared to that of the concepts item and is reflected only to a little part of the book, if ever, which deals with environmental issues.

There is a twenty-year gap between the third curriculum that was announced in 1974 and the sixth curriculum of 1992. Even though the two curriculums are different in their goals, according to the results of this study, the contents of the textbooks are not much different. This shows that the textbook writers in Korea did not consider the goals of the revised national curriculums when they developed books in accordance with the third and the sixth curriculums. This also tells that the revised curriculums were no more than a piece of paper and did not influence to school earth science

education.

It is of course difficult to equally reflect all the goal items of national curriculums. It is more difficult in Korea because one textbook covers all, while in other countries specialized textbooks are available: for instance, traditional textbooks focusing on concepts or textbooks only for scientific inquiry or only for the STS are developed. It is therefore necessary to break away from the past practice of enumerating information and to come up with a new measure that can fit the best the goals of national curriculums. For instance, one textbook is encouraged to contain several characteristics depending on every contents: a concept-oriented unit could cover the explanation of concepts such as the kinds of minerals and the names of different rocks; a inquiry-oriented unit could deal with Plate Tectonics that requires integrative geological knowledge, etc. In short, the practice of cramming all the goal items of the curriculum into one textbook should be corrected.

Now that high school earth science textbooks are just about to be developed in accordance with the Seventh National Curriculum in Korea, the efforts of the textbook writers should pay off by way of actively reflecting the spirit of the curriculum to the book. The new textbook should not be the one that is revised and complemented but a whole new kind of textbook. Otherwise it will be no more than another version of

textbook that is not much different from one used twenty years ago.

VI. Conclusion

The following is the conclusion of the analysis of high school *Earth Science* textbook and *Earth Science I* and *Earth Science II* with the Third and the Sixth National Curriculums, respectively.

First, the results of textbook analysis with the third curriculum show that high school *Earth Science* book places an excessive emphasis on concepts and information while practically ignoring scientific inquiry skills and the integrative understanding of earth science phenomena.

Second, the results of textbook analysis with the sixth curriculum show that high school *Earth Science I* and *Earth Science II* textbooks still emphasize general concepts and information, although the minor portion of which has been reduced. But it has also been found that the development process of earth science and the aspect of STS are also included in the books.

Third, the goals of the curriculums are not considered enough when textbooks are developed. In this context, the spirit of the seventh curriculum should be reflected to

the new textbooks so that the curriculum can play its due role in school education.

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Abstract

The purpose of this study was to verify how the National Curriculum has been reflected to the development of high school "Earth Science" textbooks. To achieve this purpose, the Third and Sixth National Earth Science Curriculum and 12 high school "Earth Science" textbooks were selected for analysis. The criteria for the analysis were the goals of each National Curriculum. The results were four "Earth Science" textbooks developed by the Third National Curriculum and eight "Earth Science I" and "Earth Science II" textbooks developed by the Sixth National Curriculum overemphasized the 'concept' goals comparing with other goals such as inquiry, integrative learning, development of knowledge, and STS. It is suggested that every educational goal in the national curriculum should not be neglected in the textbook development.

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