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# Constructivism and STS Reflected in the Korean Education Programs for Secondary Science Teachers

**Heeyoung Cha · Wan-Ho Chung**
(The Korea National University of Education)

## ABSTRACT

This research aimed to investigate whether Korean education programs for secondary science teachers reflect constructivist perspectives. To identify how to introduce the idea of constructivism and STS into the courses of the current Korean education programs for secondary science teachers, two programs were selected: the Qualifying In-service Program held in Seoul and the pre-service programs established in the four departments of science education of the Korean National University of Education in Chungbuk. The course guidebooks, syllabi, and text materials prepared for implementation of the courses were collected and analyzed. E-mail correspondence with the program instructors who had conveyed both ideas to the trainees provided us more precise information about the characteristics of the classes, such as the total time provided the ideas and the teaching strategies used to implement the classes. The results indicated that the pre-service programs included the ideas of constructivism and STS more than did the Qualifying In-service Program. It is necessary that the courses included in the Korean in-service program, in particular the Qualifying In-service Program for secondary science teachers, have to be more focused on the constructivist perspectives.

**Key words**: Constructivism, STS, Teacher education programs

## I. Introduction

The constructivist perspective has affected science education; it has promoted science curriculum development and it has improved teaching behaviors in the science classrooms. Curriculum has been also accepting the idea of constructivism and STS(Science-Technology-Society) as a reform of science education. STS focuses on the constructivist perspective and this became an important focus for the world science education society during the last two decades. STS is primarily a viable instructional strategy to implement the reform of science education in terms of the constructivist perspective (Cheek, 1992; Lutz, 1996; Schulte, 1996; Yager, 1993; 1996).

The fundamental idea of STS instruction is based on constructivism. Therefore, constructivist teachers must focuses on changes in their instructions with STS programs. The teaching strategies used by constructivists in STS classrooms include:

- Seeking out student ideas before presenting teacher ideas or before studying ideas from textbooks or other sources.
- Encouraging students to challenge each other's conceptualizations and ideas.

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**Heeyoung Cha(heeyoungcha@hanmail.net)

- Utilizing cooperative learning strategies that emphasize collaboration, respect individuality, and use division of labor tactics.
- Encouraging adequate time for reflection and analysis.
- Respecting and using all ideas that students generate.
- Encouraging self-analysis, collection of real evidence to support ideas, reformulation of ideas in light of new experiences and evidence.
- Using student thinking, experience, and interest to drive lessons (this means frequently altering teachers' plans).
- Encouraging the use of alternative sources for information both from written materials and live experts.
- Using open-ended questions (Yager, 1993, p. 253).

McFadden (1991) offered some effective strategies of science teaching supported by many science educators based on constructivism, and school reform was required in both the curriculum and in teaching methods. He suggests that the reconstruction of an STS school curriculum based on constructivist learning strategies may be one of the most important factors for successful reform in science education. Based on the idea of integrating both STS as a curriculum organizer and constructivism as a learning strategy, many science educators have believed that STS programs conducted by constructivist teachers result in effective outcomes with respect to student learning about both science and technology.

Korean science educators have concerns with STS as a practical instructional model reflecting the constructivist perspective. Therefore, Korean science education has been affected by the ideas of constructivism and STS. The 7th Korean National Science Curriculum emphasizes the inclusion of the constructivist perspective in terms of learning and teaching. The current national curriculum includes a new subject, *Science in Everyday Life*. It was established to ameliorate the weakness of a previous science course, *Integrated Science*, which was designed with the ideas concerning STS in the 6th Korean National Science Curriculum(Ministry of Education, 1997). It is an elective course focusing on authentic STS as a viable instructional strategy, reflected constructivist perspectives for high school students beginning in 2003.

The United Nations Educational Scientific and Cultural Organization (UNESCO, 1991) has led a movement called "Science for All" which takes the position that teachers should be considered as curriculum designers, and not simply regarded as technicians who serve the purposes of the curriculum designers. This career component is more important in the STS approach than the traditional curriculum because STS emphasizes curriculum development from the teachers' perspectives.

What are the most critical factors in fulfilling the new goals for science education? One thing is apparently teachers' awareness about the constructivist perspectives. They are charged with choosing the approaches to use in teaching the science classes. They are placed in the most important position where they can determine everything included in science classes. It is not too much to say that success or failure of science education will be upon them. They must be considered and involved with such a new direction of constructivist perspectives because they determine and conduct everything in their own science classes (Cha, 2001).

The premise that science teachers play the most important role to actualize the new goals of science education suggests a concern for how science teachers acquire and perceive the ideas of

constructivism and STS which should be implemented in their classes. Some science educators have supported the view that science teacher education programs should be more focused on the epistemological content concerning constructivism. Yager (1986), as an advocator of STS as a viable instruction reflected constructivism, argued that the reform effort for science teacher education programs must include information and experience with the nature of science and technology as well as the role of both science and technology in society. Most of them have acquired information about STS from their previous teacher education programs (Lee, 1996). Changes are needed to raise new science teachers who are prepared for the teacher understanding of what constructivism and STS are, and who perceive how these ideas can be implemented in school science classrooms.

From these contexts, this research was accomplished as a basic study to find whether the courses of the Korean science teacher education programs reflect the idea of constructivism and STS. It is expected that the research findings will provide a significant initiative for the Korean science education society to stimulate some research incentives in science teacher education programs on the questions of whether Korean education programs for secondary science teachers help them to meet the constructivist perspectives.

## Ⅱ. Research Questions

This study is concerned with investigating whether the courses of the pre-service and in-service programs for the Korean secondary science teachers reflect the idea of constructivism and STS. The research questions for the study are as follows.

1. Which courses or instructors of the pre-service and in-service programs involve the ideas of constructivism and STS?
2. To what degree are the ideas of constructivism and STS involved in each course of the pre-service and in-service programs?
3. How many hours deal with the ideas of constructivism and STS in each course of the pre-service and in-service programs?
4. Which instructional methods did the instructors who deal with the ideas of constructivism and STS use in the courses?

## Ⅲ. Methods

### 1. Programs Sampled

Two kinds of teacher education programs are involved in this research: in-service programs and pre-service programs. The in-service programs sampled were the Qualifying In-service Program for secondary science teachers held at the Seoul Education and Science Research Institute in 2000. The program was established for the teachers who have the lower level of certificate for teaching to obtain the upper level of certificate for teaching in Seoul province. Almost all teachers who have the lower level certificate for teaching participate in the program. It is because the program has been a requirement for the teachers who want to have the upper level certificate for teaching and to have more opportunities for gaining better positions,

including becoming the principal of a school and getting higher salaries. The Qualifying In-service Programs held in Seoul last for a short period of time-five weeks for the incumbent science teachers. The programs analyzed in this study were for physics and earth science teachers.

On the other hand, the pre-service programs selected for the research involved four departments in which science teachers are prepared, including physics, earth science, biology and chemistry education, at the Korea National University of Education (KNUE). The pre-service programs take a longer time - four years to finish. There is a reason for selecting the KNUE as a representative group among the Korean pre-service science teacher education programs. KNUE has a unique feature concerning its student body. The students enroll in the institute from all of the provinces in Korea. After graduating and passing the examination for official appointment as teachers, most work in their hometowns. This is the why the KNUE was selected for the sample of students from pre-service programs for this research.

## 2. Data Collection

The data for this research were collected through the following two procedures. One method of data collection was the collection of the course syllabi and text materials specially prepared, from the programs. Other data depended on the program instructors' responses requested for questions asked by e-mail.

First of all, to find answers to the research questions regarding how both ideas were taught in the classes and how many hours dealt with the ideas of constructivism and STS in the teacher education programs, the text materials and the course syllabi used in the programs were collected and examined. All of the course syllabi and the text materials concerning the features of the programs are summarized in Table 1.

The 70 physics and earth science teachers participated in the in-service programs, and the 66 seniors who graduated from four departments of the KNUE in February 2000, were asked about the real contents of the courses they had taken at the end of the programs. To identify the names of the program instructors who dealt with the issue of constructivism or STS in the

**Table 1.** Course Syllabi and Text Materials Collected and Analyzed

| Teacher Education Programs | The Course Materials Collected |
|---|---|
| The Pre-service Programs | The syllabi which were distributed to the pre-service teachers and which were kept in each department of science education during the academic year of August 1999 to May 2000 |
| | The course guidebook of the Korea National University of Education published in 1999 |
| The In-service Programs | The textbooks of the Qualifying In-service Program edited in the Seoul Education and Research Institute in 2000 |
| | The supplementary textbooks of the Qualifying In-service Program edited in the Seoul Education and Science Research Institute in 2000 |
| | The guidebook of the Qualifying In-service Program produced at the Seoul Education and Science Research Institute |

classes, students were asked to respond to the question, "From what course or instructors did you acquire this knowledge?" The details of the instructional characteristics regarding the ideas of constructivism and STS from the program instructors were investigated by examining responses to the questions via e-mail. The questions were sent to the twenty-nine instructors: the twenty-three instructors who taught the pre-service teachers with the courses for science education in the KNUE and the six instructors who had been identified that they had dealt with the ideas of constructivism and STS in the Qualifying In-service Program. Of the twenty-nine instructors who were dealt with both ideas in their classes, eighteen instructors, including thirteen from the pre-service program and five instructors from the Qualifying In-service Program replied to the e-mail questions sent.

### 3. Data Analysis

The course materials and the e-mail correspondence from the program instructors were analyzed qualitatively and quantitatively. The first data sources were the syllabi and the textbooks used in the programs. They were analyzed to find the answer to the questions of what kinds of courses, and how many hours, dealt with the ideas of constructivism and STS in each program. The responses of the science teachers who participated in the programs were used to keep track of the courses in which the ideas of constructivism and STS were considered. The other data were the responses from the program instructors provided via e-mail. These were collected to get more precise information to investigate the features of the instructions provided to deal with the ideas of constructivism and STS in the pre-service and the in-service programs. These were analyzed quantitatively and qualitatively and then interpreted. The software of 'Statistical Package for the Social Science (SPSS) 10.0 for Windows' was used for analyzing the data.

## Ⅳ. Results

### 1. Inclusion of the Ideas of Constructivism and STS in the Pre-service Programs

As a whole, the pre-service teachers who enroll in the four departments of science education of KNUE must complete the courses of one hundred-forty more semester hours during eight more semesters for their graduation (Table 2). According to the curriculum established by the departments of science education in the institute, they should take twenty-one more semester hours for liberal arts, fifteen more for general education, nine more for science education, forty-two more for science specialization, and fifty-three more for individual electives. Of nine semester hours for science education, six semester hours must be completed for the courses, which are required from each department, and three semester hours are for electives.

In particular, Table 3 and Table 4 show whether the courses of science education established in the fall semester of 1999 and the spring semester of 2000 in the four departments of science education in KNUE included the ideas of constructivism and STS, and how many weeks the ideas were considered in each course during the periods as evidenced by the course syllabi. The responses of seniors who were one group of the pre-service teachers subjects were added to these tables since they were the only pre-service students who had experienced the total

**Table 2.** Outline of the Curriculum of the Departments of Science Education in the Korea National University of Education

| The Types of Courses | | Semester Hours | | |
|---|---|---|---|---|
| Liberal Arts | | Requirement | 6 | 21 |
| | | Electives | 15 | |
| Major | General Education Requirement | General Education | 12 | 15 |
| | | Practicum | 3 | |
| | Science Education | Requirement | 6 | 9 |
| | | Electives | 3 | |
| | Science Specialization | Requirement | 22 | 42 |
| | | Electives | 20 | |
| Individual Electives | | | 53 | |
| Total | | | 140 | |

curriculum.

All of the syllabi produced in the fall semester of 1999 and spring semester of 2000 for the courses in science education except for one elective, which had been established in the biological education department titled "Research Methods in Biology" were collected and analyzed. According to the course syllabi collected, the ideas of constructivism and STS were dealt with in most of the courses of science education during one to three weeks.

Interestingly, the department of chemistry education established a special course concerning STS, entitled "Chemistry in Life." According to the course goals included in the course syllabus, this course emphasized having students get a chance to meet chemistry for scientifically literate people, improving students' ability to apply chemistry to real life contexts, having students understand interdisciplinary characteristics of chemistry, and to encourage students to have positive attitudes toward chemistry. The senior subjects did not respond that they had acquired the information about STS from this course. It is assumed that the seniors sampled for this research had not taken this course, which might have been a new course.

Although, there was no evidence in the course syllabi to identify whether the courses included the ideas of constructivism and STS, the seniors' responses to the questions of "From what course or instructor did you acquire this knowledge?" provided the supplementary information that almost all courses in science education established in each department dealt with both concepts (Table 3 and Table 4).

The instructors who made up the course syllabi of the courses listed in the Table 3 and Table 4 could not correspond to the instructors who had taught the seniors subjects with the courses with same title, because the instructors in charge of the courses are frequently changed each year, even though the courses with the same titles continue each year.

Table 5 indicates the time involved with the topics of constructivism and STS and the teaching methods used in considering the ideas of constructivism and STS in the pre-service programs of KNUE. These data were provided by e-mail exchanges involving thirteen instructors who were reported by the seniors as the instructors who had dealt with the ideas of constructivism and STS in the programs. Of the thirteen, four instructors focused on constructivism and three instructors on STS. They responded that they emphasized these topics throughout the semester

and they applied various teaching methods such as discussion, student reports, and project work as well as lectures to their classes. In particular, instructor #1 sent the characteristics of her teaching regarding constructivism in very precise written details by e-mail. She even insisted that she was a constructivist and that she had strongly applied constructivist ideas in all of her instruction. Interestingly, most of the responses of seniors to the question of "From what course or instructors did you acquire this knowledge?" reinforced her argument in which she claimed to be the one from whom they got the knowledge about constructivism and STS. Her instruction seemed to influence strongly her students' conceptualization of the ideas.

**Table 3.** Courses in Science Education Established in the Korea National University of Education and the Inclusion of Ideas about Constructivism and STS in Terms of the Course Syllabi Designed for the Fall Semester of 1999 and the Responses by Seniors

| Depart-ment | Course Type | Course Title | Sem. Hour | Constructivism | | STS | |
|---|---|---|---|---|---|---|---|
| | | | | Course Syllabi | Seniors' Response | Course Syllabi | Seniors' Response |
| Physics Education | Required | Practicum in Science Teaching Materials | 3 | One week | Included | - | Included |
| | Electives | Seminar in Physics Education | 3 | Two weeks | - | - | - |
| Earth Science Education | Required | Teaching Materials in Earth Science Education | 3 | One week | Included | - | Included |
| | Electives | Seminar in Earth Science Education | 2 | - | - | - | - |
| Biology Education | Required | Practicum in Science Teaching Materials | 3 | One week | Included | - | Included |
| | Electives | Research Methods in Biology | 3 | Not Sure | - | Not sure | - |
| Chemistry Education | Required | Introduction to Science Education | 3 | One week | Included | - | Included |
| | | Study on Science Teaching Materials | 3 | One week | Included | - | Included |
| | Electives | Research Method of Chemical Education | 3 | - | Included | Two weeks | Included |
| | | Seminar in Chemical Education | 2 | Three weeks | Included | - | Included |

The rest of the instructors responded that they had dealt with the ideas in their classes for one to four weeks and applied the various teaching methods in their instruction. They had not depended only upon lectures when they encouraged student experiences with constructivism and STS; only one instructor responded that he had lectured when introducing the ideas for a week in the pre-service program.

**Table 4.** Courses in Science Education Established in the Korea National University of Education and the Inclusion of Ideas about Constructivism and STS in Terms of the Course Syllabi Designed for the Spring Semester of 2000 and the Responses by Seniors.

| Depart-ment | Course Type | Course Title | Sem. Hour | Constructivism | | STS | |
|---|---|---|---|---|---|---|---|
| | | | | Course Syllabi | Seniors' Response | Course Syllabi | Seniors' Response |
| Physics Education | Required | Science Teaching | 3 | Two weeks | Included | Two week | Included |
| | Electives | Practicum in Physics Teaching Materials | 3 | - | Included | Two weeks | Included |
| Earth Science Education | Electives | Teaching Method in Earth Science Education | 3 | One week | Included | - | Included |
| | | Research in Earth Science Education | 3 | One week | Included | One week | Included |
| Biology Education | Required | Practicum in Science Teaching and Learning | 3 | - | Included | - | Included |
| | Electives | Research in Biology Education | 3 | - | Included | Whole weeks | Included |
| Chemistry Education | Required | Introduction to Science Education | 3 | One week | Included | - | Included |
| | | Instructional Theory of Science | 3 | Two week | Included | - | Included |
| | Electives | Instructional Theory of Science and Chemistry Experiments | 3 | Three weeks | Included | Two weeks | Included |
| | | Seminar II in Chemical Education | 2 | - | Included | One week | Included |
| | | Chemistry in Life | 2 | Whole weeks | - | - | - |

**Table 5.** Time and Teaching Methods Involved in the Instructions of the Ideas of Constructivism and STS in the Pre-service Programs of the Korea National University of Education Provided by the Instructors

| Ideas | In-structors | Degree of Inclusion during a semester | | Percent of the Total Instructional Time in terms of Instructional Methods Applied (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Time (in case of three s.h.) | % | L | D | R | P | I | F | Other | Total |
| Con-struc-tivism | 1 | Whole wks/sem | 100.0 | 20 | 20 | 20 | 20 | 20 | | | 100 |
| | 2 | Whole wks/sem | 100.0 | 10 | 20 | 20 | 20 | 30 | | | 100 |
| | 3 | Whole wks/sem | 100.0 | 25 | 25 | 25 | 25 | | | | 100 |
| | 4 | Whole wks/sem | 100.0 | 20 | 20 | 30 | 10 | 5 | | 10 | 100 |
| | 5 | Four wks/sem | 25.0 | 30 | 10 | 20 | 10 | | | 30(M) | 100 |
| | 6 | Three wks/sem | 18.8 | 50 | 10 | 20 | 10 | 10 | | | 100 |
| | 7 | Two wks/sem | 12.5 | 50 | | 50 | | | | | 100 |
| | 8 | Two wks/sem | 12.5 | 30 | 10 | 30 | 30 | | | | |
| | 9 | Two wks/sem | 12.5 | 20 | 20 | 10 | 40 | 10 | | | 100 |
| | 10 | Two wks/sem | 12.5 | 20 | 20 | 30 | 30 | | | | 100 |
| | 11 | One wk/sem | 6.3 | 50 | 10 | 30 | 20 | | | | 100 |
| | 12 | Less than one wk/sem | > 6.3 | 30 | | | | | | 70(Q) | 100 |
| | 13 | Less than one wk/sem | > 6.3 | 50 | 40 | 10 | | | | | 100 |
| STS | 1 | Whole wks/sem | 100.0 | 20 | 20 | 20 | 20 | 20 | | | 100 |
| | 2 | Whole wks /sem | 100.0 | 30 | 20 | 10 | 20 | | | 20(E) | 100 |
| | 3 | Whole wks/sem | 100.0 | 25 | 25 | 25 | 25 | | | | 100 |
| | 4 | Two wks/sem | 12.5 | 30 | 30 | 20 | 10 | | | 10 | 100 |
| | 5 | Two wks/sem | 12.5 | 40 | 20 | 10 | | | | 30(M) | 100 |
| | 6 | Two wks/sem | 12.5 | 40 | 20 | 40 | | | | | 100 |
| | 7 | Two wks/sem | 12.5 | 50 | | 50 | | | | | 100 |
| | 8 | Three wks/sem | 18.8 | 20 | 10 | 30 | 40 | | | | 100 |
| | 9 | One wk/sem | 6.3 | 30 | 20 | 30 | | 20 | | | 100 |
| | 10 | One wk/sem | 6.3 | 10 | 20 | 40 | 30 | | | | 100 |
| | 11 | One wk/sem | 6.3 | 50 | 10 | 30 | 20 | | | | 100 |
| | 12 | One wk/sem | 6.3 | 100 | | | | | | | 100 |
| | 13 | One wk/sem | 6.3 | 50 | 30 | 20 | | | | | 100 |

L: Lecture, D: Discussion, R: Student Reports, P: Project Work, I: Laboratory Investigations, F: Field Trips, E: Evaluation, Q: Quiz, M: Instructional Material Development

## 2. Inclusion of the Ideas of Constructivism and STS in the In-service Program

Table 6 is an outline of the curriculum which was specially designed for the in-service teachers who participated in the Qualifying In-service Program held in the Seoul Education and Science Research Institute in the summer of 2000. Fifty-four courses were required for physics teacher majors and fifty-nine courses for earth science teachers. Those courses were designed

**Table 6.** Outline of the Curriculum of the Qualifying In-service Program Held in Seoul Education and Science Research Institute in the Summer, 2000

| Categories of the Courses Established | | | Hours | |
|---|---|---|---|---|
| Liberal Arts | | | 24 | |
| General Education | | | 34 | |
| Science Education | General Science Education | | 28 | 44 |
| | Physics Education for Physics Teachers | | 16 | |
| | Earth Science Education for Earth Science Teachers | | | |
| Science Specialization | Physics for Physics Teachers | Lectures | 38 | 70 |
| | | Experiments | 32 | |
| | Earth Science for Earth Science Teachers | Lectures | 40 | |
| | | Experiments | 30 | |
| Field Trip | | | 8 | |
| Total | | | 180 | |

with two to eight hours per course. The trainees were engaged for 180 hours to complete all of the courses as long as they wished to obtain the upper-level teaching certificate, which is the final objective of the enrolled teachers.

Twenty-four hours were required for the courses of liberal arts, thirty-four hours for general education, forty-four hours for science education and seventy hours for science specialization. Among them, each trainee must take forty-four hours for science education, as enumerated in Table 7.

The three courses entitled "Individual Research", one of the courses included in general science education, and "Practical Approaches of Earth Science Classes", and "Application of NIE (Newspaper In Education) to Science Education", courses in earth science education, unfortunately could not be analyzed because text materials did not exist in the volume and hence could not be analyzed for this study.

Analysis of the text materials which each instructor used in teaching in-service teachers and which in-service teachers learned in the program, shows that one course entitled "Instructional Methods of Earth Science" dealt with constructivism, and three other courses, entitled "21st Century Science (Human Genome Project)", "The Rationale and Application of Individualized Instructional Model", and "Instructional Method of Earth Science", all included significant ideas about STS.

According to Table 7, the courses for physics teachers did not include the ideas of constructivism and STS. These teachers could only had a chance to consider the ideas of STS from only two courses in general science education, entitled "21st Century Science (Human Genome Project)", and "The Rationale and Application of Individualized Instructional Model". On the other hand, the earth science teachers had more chances to have the experience and to gain information about constructivism and STS than did physics teachers. They received more information about the ideas of constructivism and STS from the course entitled "Instructional Methods of Earth Science".

The trainees responded that constructivism was dealt with in five of the courses in science education and STS was included in three of them (Table 7). The courses that dealt with the ideas of constructivism and STS were not the same as the courses identified by the trainees. Of

**Table 7.** Courses in Science Education that the Qualifying In-service Teachers had Taken which included the Ideas of Constructivism and STS in Terms of the Text Materials and Their Responses

| Categories of Courses | Course Title | Hours Assigned | | Constructivism | | STS | |
|---|---|---|---|---|---|---|---|
| | | | | Text Materials | Teachers' Responses | Text Materials | Teachers' Responses |
| General Science Education | 21st Century Science (Human Genome Project) | 2 | 28 | Included | Included | Included | Included |
| | The Rationale and Application of Individualized Instructional Model | 2 | | Included | - | Included | - |
| | Encouragement of Student Club Activity | 2 | | - | - | - | - |
| | The Korean History of Science and Science Education | 2 | | - | - | - | - |
| | Nuclear Power and Earth Environment | 2 | | - | - | - | - |
| | Development of Creativity in School Education | 2 | | - | - | - | - |
| | Application of the "Power Point" Software | 4 | | - | - | - | - |
| | Individual Research | 10 | | Not Sure | - | Not Sure | - |
| Physics Education | Instructional Method of Physics | 4 | 16 | - | - | - | - |
| | Evaluation of Physics Achievement | 4 | | - | - | - | - |
| | Development of Instructional Materials for Physics | 4 | | - | - | - | - |
| | Teaching Physics | 2 | | - | - | - | - |
| | Individualized Instruction in Physics | 2 | | - | - | - | - |
| Earth Science Education | Instructional Methods of Earth Science | 4 | 16 | Included | Included | Included | Included |
| | Evaluation of Earth Science Achievement | 4 | | - | - | - | - |
| | Development of Instructional Materials for Earth Science | 4 | | - | Included | - | - |
| | Practical Approaches of Earth Science Classes | 2 | | Not Sure | - | Not Sure | - |
| | Application of NIE (Newspaper In Education) to Science Education | 2 | | Not Sure | Included | Not Sure | Included |
| Total Hours for Each Major | | 44 | | | | | |

course, the degree that the text materials were emphasized may have depended on the instruction. In addition, the trainees provided more information that indicated one of the liberal arts courses, entitled "Environmental Conservation and 21st Century School Environmental Education" dealt with constructivism and STS.

Table 8 details the ideas included concerning constructivism and STS arising from the analysis of the text materials that were used for the Qualifying In-service Program held in the Seoul Education and Science Research Institute in the summer, 2000.

The content concerning constructivism included instructional strategies illustrating constructivism and STS curriculum development, ethical aspects of science and STS, and STS instruction illustrating the content for STS. The degree of the inclusion of each aspect was unplanned. The earth science teachers were provided more opportunities to experience the ideas of constructivism and STS than the physics teachers

**Table 8.** Details for the Inclusion of Ideas concerning Constructivism and STS in the Text Materials Used for the Qualifying In-service Program Held in the Seoul Education and Science Research Institute in the Summer, 2000.

| Ideas | Course Title | The Degrees of Inclusions | | The Content of Included in the Text Materials | Subjects |
|---|---|---|---|---|---|
| | | The Number of Included Pages for the Whole Texts | % | | |
| Con-struc-tivism | Instructional Methods of Earth Science | 2/23 | 8.7 | Instructional Strategies of Constructivism | Earth Science Teachers |
| STS | Instructional Method of Earth Science | 2/23 | 8.7 | STS Curriculum Development | |
| | 21st Century Science (Human Genome Project) | 3/9 | 33.3 | Ethical Aspect of Science and STS | Earth Science Teachers and Physics Teachers |
| | The Rationale and Application of Individualized Instructional Model | 0.5/14.5 | 3.4 | STS Instruction | |

To identify the features of the courses which included the ideas of constructivism and STS in the Qualify In-service Program, e-mail correspondence was sent to the instructors who were identified as dealing with the ideas of both by the trainees. A total of six instructors were sent the letters. Five of them answered the questions. Amount of time and a description of the features of their instruction regarding topics were sought. The instructions provided by the instructor are tabulated in Table 9. They reported that they had never devoted much time to helping the trainees know about the ideas precisely; rather they responded that they had provided brief information about their using the teaching strategies of lecture or discussion for a short time which meant for ten to thirty minutes of two to four course hours assigned.

Two of the instructors who reported dealing with constructivism, and three dealing with STS had just lectured to provide the information about the reform ideas for the trainees. Only one instructor who had taught the earth science teachers indicated that he made serious efforts to help the in-service teachers develop appropriate conceptions and perceptions about constructivism and STS. He reported that he did not depend on lectures to implement his goal for the trainees. His response corresponded to the responses of the in-service teachers who provided the information that they got the knowledge of the ideas of constructivism and STS from him, i.e., instructor 14.

**Table 9.** Time and Teaching Methods Involved in the Instructions which Included the Ideas of Constructivism and STS in the Qualifying In-service Program Held in Seoul Education and Science Research Institute in Summer, 2000 Provided by the Instructors

| Ideas | Instructors | Degree of Inclusion | | Percent of the Total Instructional Time in Terms of Instructional Methods Applied (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Time Involved | % | L | D | R | P | I | F | O | Total |
| Constructivism | 14 | 50min/4hrs | 20.8 | | 50 | 50 | | | | | 100 |
| | 15 | 30min/2hrs | 25.0 | 50 | 50 | | | | | | 100 |
| | 16 | 10min/2hrs | 8.3 | 100 | | | | | | | 100 |
| | 17 | 10min/2hrs | 8.3 | 100 | | | | | | | 100 |
| | 18 | 0min/2hrs | 0.0 | | | | | | | | 0 |
| STS | 14 | 40min/4hrs | 16.7 | 20 | 40 | 40 | | | | | 100 |
| | 15 | 30min/2hrs | 25.0 | 70 | 30 | | | | | | 100 |
| | 16 | 10min/2hrs | 8.3 | 100 | | | | | | | 100 |
| | 17 | 15min/2hrs | 12.5 | 100 | | | | | | | 100 |
| | 18 | 10min/2hrs | 8.3 | 100 | | | | | | | 100 |

L: Lecture, D: Discussion, R: Trainees Reports, P: Project Work, I: Laboratory Investigations, F: Field Trips, O: Other

## V. Conclusions

This section provides conclusions adding some brief discussion in terms of the necessity for reflecting the reform ideas of constructivism and STS in Korean education programs for secondary science teachers.

As a whole, the research findings revealed that the Qualifying In-service Program sampled was less effective to include the idea of constructivism and STS than the pre-service programs. Many courses established in the pre-service program include the ideas of constructivism and STS, while the inclusion of the two ideas in the courses for the Qualifying In-service Program is rare. It means that the present Qualifying In-service Program may not include aneffective body of contents that help teachers to meet the constructivist perspective. Most of the time in the Qualifying In-service Program sampled was spent having trainees experience more scientific knowledge rather than being assigned more time for informing about the constructivist perspective. Most of the instructors who were involved in the Qualifying In-service Program

primarily lectured and did not use various instructional methods for the trainees that they were advocating.

In contrast, the threeor four instructors who taught the courses for the pre-service teachers emphasized the importance of both ideas throughout the semesters and most of the instructors who dealt with the ideas applied various teaching methods such as discussion, student reports, and project work in their teaching. They did not depend only on their lectures to provide the ideas for the pre-service teachers.

The Qualifying In-service Program is one of the most important in-service programs that almost all Korean science teachers who have three of more years of teaching experiences must complete. These programs are nationally established at special institutes in each province in Korea. The teacher, who wants to become an officially qualified teacher in Korea, must take the program once at least because many opportunities are provided for the officially qualified teachers. Therefore, all of the teachers want to attend the programs to gain their certificate. Unfortunately, the in-service program has not focused on the constructivist perspectives as a reform in science education. It is not consistent with the goals clearly stated in the current Korean National Science Curriculum. It is necessary for more inclusion of reform ideas in present in-service programs. The present in-serviceprogram, especially the Qualifying In-service Program must be reconstructed so that the entire curriculum is considered as a way of providing more ideas focusing on constructivism and STS for science teachers.

Teachers must play a critical role in science education reform. They need to be partners in making needed change. Choi (1999) reported that Korean high school science teachers whose perceptions were positive about STS even wanted to take part in a special in-service program which would provide them with an opportunity to get more ideas about STS. Most desirable suggestions for providing more chance to take information about reform ideas for prospective science teachers who are eager to seek new strategies of science teaching might be focused on the construction of the special curriculum for the new in-service programs designed to improve science teaching in terms of the constructivist perspective.

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