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Exploration of High School Science Teachers' Perceptions on Instruction and Assessment of Science II Elective Courses in the 2015 Revised Curriculum

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Abstract: The purpose of this study was to examine the status of the field application of the Science II career electives with the application of the 2015 revised curriculum up to the 3rd year of high school. This study focused on examining high school science teachers' perceptions of the student-participatory class and process-centered assessment in Science II subjects, which are career-intensive high school science electives. A total of 192 science teachers responded to the survey questionnaire, and 12 teachers participated in interviews. In the in-depth interviews conducted to supplement the survey results, questions were asked about changes in the overall class, the status of student-participatory classes, and changes in the assessment of Science II subjects due to the emphasis on process-centered assessment. The main research results included teachers'perceptions of changes in teaching and assessment methods with the application of the revised curriculum, the degree to which the eight skills used in Science II classes develop the key competencies of science, and the teaching and assessment methods commonly used in Science II classes. Science teachers generally agreed with the purpose and necessity of introducing student-participatory classes and process-centered assessment, which are the core purpose of the 2015 revised curriculum. However, they had difficulties in practice due to the excessive content of Science II subjects. Problems were also encountered with securing objectivity and fairness during assessments and the operation of online science classes due to COVID-19.

Keywords: science II electives, 2015 revised science curriculum, curriculum implementation, process-centered assessment, student participatory class

Introduction

The 2015 revised science curriculum started to be applied to high schools in 2018 and was applied to the 3rd year high school career-elective courses in 2020. In the 2015 revised science curriculum, 'Integrated Science' and 'Science Inquiry Experiment' were newly established as common subjects in high school, and the elective subjects were subdivided into general-elective courses and career-elective courses. General elective courses deal with the major learning areas for each subject at a general level, and consist of subjects that cover the basic understanding of each subject required at the high school level, and career-elective courses consist of courses that allow inter-subject convergence learning, career guidance learning, and in-depth learning by subject (MOE, 2014). Accordingly, the general elective courses consist of four Science I courses including 'Earth Science I', and II courses such as 'Earth Science II' were separated from Science I, and organized as career-electives.

In addition to subdivision and new subjects of elective courses, the Ministry of Education (MOE, hereafter) tried to innovate in teaching-learning, and assessment in the 2015 revised curriculum. The 2015 revised curriculum emphasizes student participatory classes in terms of teaching and learning, and process-centered assessment in terms of student assessment (Shin & Kwak, 2019). There are various definitions of student participation, but in general, it refers to a psychological process in which students are actively

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involved in school or learning activities (Christenson et al., 2008). The 2015 revised curriculum emphasizes that learners experience the joy of learning with initiative (Kwak & Shin, 2019). Student participatory classes need to provide opportunities for learners to take responsibility for their learning through the process of forming and consolidating knowledge on their own (Choi, et al., 2015).

According to the previous studies related to student participatory classes under the 2015 revised science curriculum, elementary and middle school teachers responded that the introduction of the 2015 revised science curriculum improved their awareness of student participatory classes (KOFAC, 2019). Kwak & Shin (2019) emphasized the role of the teacher as a facilitator of learning, developing open-ended questions, and recognizing the significance of activities as a way to promote student-participatory classes based on the results of observation of Integrated Science classes. High school teachers who participated in the curriculum-related teacher training responded that the more achievement standards that included value judgment and student cooperation, the easier it was to organize student-participatory classes.

In addition, high school science teachers emphasized the need to actively introduce student participatory classes in order to increase the selection rate of science electives in the 2015 revised curriculum (KOFAC, 2020). Despite the positive effects and expectations of these student-participatory classes, only 23.3% of teachers in charge of Integrated Science who answered that the proportion of participatory classes was higher than that of lecture classes, indicating that the quantitative proportion of participatory classes in Integrated Science classes was not very high. (Shin & Kwak, 2019).

Meanwhile, looking at the aspect of assessment, the MOE emphasizes the importance of 'assessment that emphasizes the learning process' in the 2015 revised curriculum, and suggests a shift to process-centered assessment that encourages students to reflect on their own learning (MOE, 2015). In this context, the process-centered assessment can be embodied as an assessment based on achievement standards, an assessment performed during class, an assessment of the task performance process, and the utilization of assessment results for learner growth (KOFAC, 2019). Looking at the previous studies related to process-centered assessment under the 2015 revised science curriculum, teachers responded that the transition to process-centered assessment was helpful in enhancing students' attitudes and interest in science and science classes, as well as enhancing their competencies (KOFAC, 2020).

Unlike the education authorities that emphasize process-centered assessment, it is true that the school field's response to process-centered assessment is somewhat confusing. It was found that teachers feel burdened in introducing process-centered assessment due to difficulties in securing fairness and objectivity of assessment (Jin et al., 2019; Kwak, 2020). In the case of high schools, a practical problem that makes it difficult to implement process-centered assessment due to uneven assessment results when multiple teachers are in charge of the same subject is also a factor hindering the introduction of process-centered assessment (Jin et al., 2019). It was found that teachers experience considerable difficulties in operating process-centered assessment when the perception shift from result-based assessment to process-centered assessment is not complete (Hong, et al, 2017; KOFAC, 2019).

Although the 2015 revised curriculum emphasizes student participatory classes and process-centered assessment, understanding how to implement and apply them in the high school field is lacking. In the case of science courses, some studies have been conducted focusing on Integrated Science, but studies on the operation of high school career electives are rare. In Science II career electives organized for in-depth study by subject, the key purpose of the 2015 revised curriculum is expected to develop in a slightly different way from Integrated Science or Science Inquiry Experiment. Therefore, it is necessary to examine the status of classes and assessment operation in Science II subjects. In this context, this study intends to explore the operation status of Science II subjects among career electives in the 2015 revised

curriculum.

The purpose of this study is to explore the perception and implementation status of the teaching and assessment of Science II subjects, focusing on the core purpose of the 2015 revised curriculum with science teachers in charge of science elective courses in schools, and to derive ways to improve the Science II curriculum based on the research result.

Methods

1. Survey with teachers

This research study was conducted in two main directions. First, a survey was conducted to investigate the perceptions of high school science teachers about teaching and assessment of the 2015 revised Science II subjects. To this end, the sampling targets were selected by distributing them by region so that high schools distributed throughout the country were included evenly, and only one science teacher in charge of the science electives at each school was requested to answer.

The survey was intended to explore the perceptions of high school science teachers on the teaching and assessment of revised Science II subjects. First, we tried to extract the variables necessary for constructing the questionnaire by analyzing the preceding studies related to the class and assessment of the 2015 revised science curriculum. Park et al. (2019) developed a questionnaire to monitor the 2015 revised science curriculum, and we revised the questionnaire to reflect the context of the career electives, and conducted validation of the questionnaire with 6 science education experts. The final questionnaire was developed through several preliminary surveys and repeated revisions and supplements. Table 1 shows the categories and contents of the questionnaires. Most of the questions used the Likert scale. The questionnaire items were subdivided into 5 categories, including background variables, operational status and change by instructional method, operational status and change by assessment method, and difficulty in the operation of science electives' in addition to consent to use of personal information (Table 1).

A total of 192 science teachers participated in the online survey. Among them, 95 (49.5%) were male teachers and 97 (50.5%) were female teachers. Teachers with less than 5 years of experience 44 (22.9%), 5-10 years 35 (18.2%), 10-20 years 52 (27.1%), and over 20 years 61 (31.8%) evenly distributed (Table 2).

2. Teacher in-depth interview

In order to investigate in-depth opinions on the operation status of Science II subjects and future improvement plans, in-depth interviews were conducted with 12 high school science teachers were (Table 3). These are all teachers who are in charge of elective subjects in the 2015 revised curriculum, and they are composed by arranging regions and majors. We tried to get answers from experts with a high understanding of the science elective curriculum by selecting teachers who participated in the development of science curriculum or textbooks.

Teacher in-depth interview was conducted to supplement the survey, and it was carried out to analyze the operation status of Science II subjects, which is recognized by in-service science teachers. For the class situation, questions were centered on changes in the overall class and matters related to

Table 1. Contents of the survey questionnaire

Category	Items
Consent to use of personal information	Consent to use of personal information and participation in the survey
Background information	Experience, school type, subjects in charge, certification area, school location
Current status of classes and assessment of Science II subjects	Awareness of the implementation and cultivation of science competency Application of science process skills in classes Operational status and changes by teaching and assessment method
Difficulty in operating science electives	Difficulties in and suggestions for operating science electives

Table 2. Survey participants by their teacher qualifications

Qualifications	No. of teachers	%
Common Science	5	2.6
Physics	44	22.9
Chemistry	60	31.3
Biology	48	25.0
Earth Science	35	18.2
	192	

Table 3. Participants of in-depth interviews

ID	Major	Features
Teacher P	physics	Author of science textbooks
Teacher H	physics	School curriculum director
Teacher Y	physics	High school credit system research school
Teacher M	chemistry	Author of science textbooks
Teacher A	chemistry	Author of science textbooks
Teacher T	chemistry	In charge of science intensive high school
Teacher L	biology	Author of science textbooks
Teacher J	biology	In charge of science intensive high school
Teacher F	biology	High school credit system research school
Teacher G	earth science	Author of science textbooks
Teacher E	earth science	Author of science textbooks
Teacher O	earth science	Science director in a general high school

student-participatory classes, and the assessment status focused on changes in the overall assessment and matters related to the process-oriented assessment. We also asked teachers' opinions about support measures for the settlement of the 2015 revised curriculum. In-depth interviews were conducted from July to October 2020, and all were recorded, transcribed and analyzed. The interview was a combination of an online and an offline face-to-face interview, and the interview time per teacher was 40 to 60 minutes. With the interview transcripts, two researchers performed each coding task, and based on the primary coded data, the final code was derived through discussion among researchers.

Results and Discussion

1. Implementation of student participatory classes in Science II subject

1) Survey results

Table 4 shows the survey result of teachers' perceptions on how the 2015 revised science curriculum affects the science teachers' classes. The average of the four questions examining the perception of change in teaching method was 3.77, indicating that teachers felt changes in teaching method. In particular, according to the purpose of the 2015 revised curriculum, teachers gave the highest score on whether 'contemplating various teaching methods to increase student participation' (3.91), which is also consistent with the results of the previous year's study. (Lee et al., 2020). These results show that science teachers are positively aware of the purpose of the 2015 revised curriculum that emphasizes student-participatory classes to develop key competencies.

In the 2015 revised science curriculum, eight skills are suggested, and these skills are regarded as a specific pathway for nurturing the core competencies. The perception of high school science teachers using 8 skills well through their Science II class was investigated (Table 5). The overall average for possible utilization was 3.77, and the skills recognized the most used were 'data collection, analysis, and interpretation' (4.04) and 'conclusion and evaluation' (3.99 points). The skills that were recognized as not being utilized

Table 4. High school teachers' perceptions of the impact of the 2015 revised curriculum on teaching

Item	M	SD
I reorganize the class according to the characteristics of the 2015 revised curriculum.	3.77	.75
I think about teaching methods to increase students' science competency suggested in the 2015 revised curriculum.	3.83	.77
Consistent with the 2015 revised curriculum, I consider various teaching methods to increase student participation.	3.91	.78
I think my classes have changed according to the 2015 revised science curriculum.	3.57	.89

Table 5. High school teachers' perceptions of applications of 8 science skills in classes

Item	M	SD
Problem Recognition	3.98	.72
Design and implementation of inquiry	3.82	.87
Data collection, analysis and interpretation	4.04	.75
Mathematical thinking and computer use	3.43	.89
Development and use of models	3.41	.88
Evidence-based discussion and argumentation	3.61	.90
Draw conclusions and evaluation	3.99	.72
Communication	3.90	.87
Total (N =192)	3.57	.74

relatively well were 'Mathematical Thinking and Computer Utilization' (3.43) and 'Development and Use of Models' (3.41). From this, it can be seen that in the case of the skills newly introduced in the 2015 revised science curriculum, teachers have difficulties in actually using them in science classes (Lee et al., 2020).

In order to check which types of classes are frequently used by high school science teachers in their science II class, 10 teaching methods that can be used in science classes are presented, and the frequency of use of each method compared with the 2009 revised curriculum is changed. was investigated. For the 10 teaching methods that teachers mainly use, teachers answered on a scale of 1 (decreased a lot) to 5 (increased a lot). Table 6 shows the results of changes in the frequency of use by class method in Science II class. Looking at the results of comparing Likert ratings, the overall average was 3.52, indicating that there is a slight change in the teaching method overall. By class method, an increase in frequency was confirmed in 'Survey/Presentation' (3.93), 'Information Equipment Utilization Class' (3.88), and 'Individual Task Study' (3.71), and 'Lecture-Oriented Class' (2.76) showed an increase in frequency. appeared to decrease. Through this, it can be seen that since the introduction of the 2015 revised curriculum, teachers are trying to increase the proportion of student-led teaching methods rather than teacher-led unilateral classes in Science II classes.

2) In-depth interview results

In the in-depth interview, questions were focused on the classroom conditions in the 2015 revised science II course implementation, especially the implementation of student-participatory classes. The actual implementation of student-participatory classes in science electives, as described by in-service science teachers, is as follows.

First, in the case of Science II, it is difficult for each other to talk about competency and student-participatory classes, as it is a course for specific students who want to prepare for the SAT. In most cases, science II subjects are organized in the third year of high school, but teachers pointed out that it is difficult to conduct student participatory classes because "if even one student takes the College Scholastic Ability Test (CSAT), they have to cover the content" (Teacher G, Teacher M). In the case of Science II subject, teachers argued that it was not easy to try student-participatory classes. even if the absolute evaluation was introduced because the goal of the students as well as teachers choosing them was to prepare for the CSAT (Teacher F, Teacher M). On the other hand, some teachers said that participatory classes were conducted in parallel by dividing them into "one or two students taking the CSAT and the majority of the rest" (Teacher T, Teacher G).

Teacher F: Science II is usually implemented in the third year of high school, and then it is also prepared for the CSAT. It is difficult to talk about competency or participation type, etc., because it is a course for specific students who need to prepare for the CSAT at the end.

Teacher G: Participatory classes and process-based assessment are possible, but the CSAT prevents them. Science II is organized in the 3rd grade of high school, so if even one person takes the CSAT, the content should be covered, and the exam papers must be submitted to the Office of Education.

Teacher T: In our school, there are students who take the SAT with Chemistry II, but there are only one or two of those students. If the class is tailored to the students taking the CSAT, the rest of the students will suffer.

Table 6. Frequency of use by teaching method

Items	M	SD
lecture-oriented class	2.76	.90
teacher's demo experiment	3.34	.84
Student-centered inquiry experiment	3.64	.80
science writing class	3.51	.81
Discussion/Debate Class	3.66	.86
Subject convergence class (STEAM)	3.64	.83
Investigation and presentation	3.93	.78
Individual research study	3.71	.82
Group research study	3.64	.86
Information technology application class	3.88	.84
Total (N =192)	3.57	.52

Second, as in Science II, the more difficult the content, the more difficult the student participatory class. Teachers pointed out that, in the case of career electives such as Science II, the participatory class "in which students organize and reorganize and present as much as they understood" had problems in terms of resolving misconceptions and understanding the content (Teacher E).

> Teacher E: Biology II seems to be mostly lecture-style classes. In order to be called participatory, the class is organized and conducted in the form of a student presentation. The more difficult the content, the more difficult the participatory class is yet, and the more difficult it is to know how to do it.

Third, in the case of Science II, classes focus on understanding of science content rather than on science competencies. Teachers asserted that, "We do not teach with the competency in mind" (Teacher A, Teacher H), because in the case of the Science II subject, competency assessment is not compulsory at the school site. In the case of Science II subjects, it is not compulsory to assess competency at school sites, so teachers argued that "classes are not conducted with the competency in mind" (Teacher A, Teacher H). On the other hand, in the case of Science II subject of the 2015 revised curriculum, "Most of the achievement standards do not emphasize competency, such as 'can be explained', so teachers pointed out that the curriculum for developing competency and the statement of achievement standards do not match." (Teacher H, Teacher M).

> Teacher A: Although certain competencies are specified in each element of the textbook, classes are not conducted with the competency part in mind in the field. I don't think it's mandatory to assess what is right for each competency, so the focus is on whether or not the understanding of the content will be reflected in the assessment.
>
> Teacher H: Overall, the science curriculum itself is not competency-based. In the knowledge part and behavior part constituting the achievement standard, the quantity of knowledge elements decreased, but most of the achievement standards are 'explainable', so competency is not emphasized.
>
> Teacher M: The reflection of competency is often seen in textbooks in which teachers participated among the writing staff. There are textbooks that say that these competencies can be developed only when such activities are carried out.

Fourth, due to the COVID-19 situation, it is possible to implement student-participatory classes such as experimental activities in Science II subjects in offline classes by going ahead and securing free time through online remote classes. Teachers explained that the online remote classes "go through a lot of lecture-style" due to COVID-19, and that after securing free time, the back-to-school classes are operated as activity-oriented classes (Teacher T). In the end, even in the case of Science II, teachers explained that securing class hours is an issue for student participatory classes.

> Teacher T: The number of units also has an impact. The larger the number of units, the more time the teachers will have for activity-oriented classes. Since we were taking 3 units of intensive course per semester, the overall number of hours was not large, so we conducted lots of theoretical classes while taking remote classes due to COVID-19, so students could come to school and do experimental activities in class.

2. Implementation of process-centered assessment in science II subjects

1) Survey results

Table 7 shows the results of a survey of teachers' perceptions on how the 2015 revised science curriculum affects the assessment status of science II subjects. In the seven questions asking about the change in the assessment method for science II subjects, teachers showed a generally positive perception with a score of 3.81. The highest score was given to 'providing praise or feedback on students' performance or achievements' (3.93). Relatively high scores were also found for 'not only relative assessment but also increasing opportunities for individual achievement improvement'. On the other hand, it was found that the level of positive perception was relatively low for 'the assessment method of my classes has changed according to the 2015 revised science and curriculum' (3.60).

In order to check which types of assessment methods are frequently used by high school science teachers in their science II classes, 10 assessment methods are presented, and the change in the frequency of use of each method in the 2015 revised curriculum compared with the 2009 revised curriculum was investigated. For the 10 assessment methods mainly used by teachers, they responded on a Likert scale ranging from 1 (decreased a lot) to 5 (increased a lot). Table 8 shows the results of changes in the frequency of use by assessment method. Looking at the results of comparing Likert ratings, the overall average was 3.50, indicating that there was a slight change in the assessment method overall. Among the assessment methods, 'multiple-choice test' and 'open-ended test', which have been traditionally used a lot, had an average of 3.11, and many respondents answered that the degree of utilization did not change or slightly increased compared to the previous assessment method. In particular, in the case of 'multiple-choice test', they answered that the average was 2.96, which was slightly decreased compared to the previous one. On the other hand, the response distribution was close to 4 points (slightly increased) for the 8 assessment methods that are widely used as process-oriented assessment methods. In particular, 'report assessment' was 3.76 and 'essay test' was 3.68, indicating a marked change in the degree of use, and 'oral test' was 3.28, indicating a relatively low level of awareness of change. Therefore, as in Science I, in Science II class, teachers place more emphasis on report assessment or essay test as a process-oriented assessment, and less multiple-choice test than before (Lee et al., 2020).

Meanwhile, at the end of December 2018, the Ministry of Education announced a change to the guidelines for writing the school life record that converts science career electives to absolute assessment. Accordingly, from high school freshmen in 2019, science career electives were converted to absolute assessment, and only achievement level (A~E) and distribution ratio by achievement level were recorded in the school life record instead of rank grades. Table 9 shows the results of a science teacher's perception of how this change in grading method affects the operation of the Science II curriculum and the improvement of the selection rate. With an average of 3.76 points, teachers responded that changing the grading method was generally helpful for the operation of science II subjects.

2) In-depth interview results

Through in-depth interviews, questions were asked about the assessment status of science II subjects in the 2015 revised curriculum. The actual status of the process-oriented assessment of Science II subjects, as described by science teachers, is as follows.

First, in the case of Science II, it is difficult to conduct a course-oriented assessment because the class burden is high and the number of units is often reduced. In the case of Science II subject, science teachers said that it is difficult to conduct a course-oriented assessment because of the large amount of class and the class ends early in September (Teacher Y). Also, in the case of Science II subject, teachers pointed out that it was not easy to conduct a course-centered assessment or participatory class because "students are in a hurry because they are in their third year of high school, and the classes are focused on

Table 7. High school teachers' perceptions of the Impact of the 2015 revised curriculum on assessment

Items	M	SD
I think that the assessment method in my class has changed according to the 2015 revised science and curriculum.	3.60	.89
I reflect the results of the process-oriented assessment and use them to improve my classes.	3.71	.87
I use a variety of methods to evaluate the learning process (e.g., performance assessment, self-assessment, peer assessment, etc.).	3.86	.82
I try to visualize the learning process and performance of students through presentations and exhibitions of learning outcomes.	3.73	.89
I strive to increase opportunities for improvement in individual achievement as well as relative evaluation.	3.92	.73
I offer praise or feedback on students' performance or achievements.	3.93	.77
I establish an assessment plan considering the achievement standards and achievement levels of each unit.	3.91	.73

lectures" (Teachers H, Teacher Y). Above all, teachers pointed out that it is necessary to give teachers time to adapt to the science competency teaching or process-oriented assessment because the 2015 revised curriculum "is in the third year of application and there are subjects that are being taught for the first time" (Teacher Y, Teacher H).

> Teacher Y: Science II has a much larger amount of lessons. In the field, since classes end in September, the amount of subject contents is large and the number of units is often smaller than the recommended number of units, so it is burdensome to conduct a process-centered assessment.
>
> Teacher H: The proportion of students choosing Science II is low, and high school 3rd graders are in a hurry. Science II is the only choice for students going to the top university, so science II has no choice but to focus on lectures. No matter what they do, the students are bothered or tired. The overall class atmosphere is not easy for process-centered assessment or participatory classes.

On the other hand, career elective courses such as Life Science II have a lot less content, so the learning burden is reduced, so inquiry activities and scientific writing can be strengthened. Teachers evaluated that process-centered assessments such as science writing and performance assessment became possible due to the decrease in the content of Science II subjects (Teacher E).

> Teacher E: For Life Science II, the content was greatly reduced, so the learning burden seems to have decreased. Compared to the 2009 revision, inquiry activities have been greatly strengthened. Since there is one scientific writing for each unit, performance assessments are conducted using scientific writing.

Table 8. High school teachers' perceptions of changes in the frequency of use of assessment methods

Items		M	SD
existing assessment	multiple-choice test	2.96	.74
	open-ended test	3.27	.84
process-centered assessment	essay test	3.68	.76
	observational test	3.62	.72
	oral test	3.28	.80
	lab and practical test	3.63	.77
	report assessment	3.76	.76
	Portfolio assessment	3.61	.81
	Discussion/Debate assessment	3.56	.84
	Project assessment	3.61	.82

Table 9. High school teachers' perceptions of changes in the frequency of use of assessment methods

Items	M	SD
The conversion to absolute evaluation of Science II subjects will help to increase the selection rate of students who further study science and engineering.	3.76	.87
The shift to absolute evaluation of Science II subjects will help to improve the quality of the class.	3.76	.85

Conclusion

In the third year of applying the 2015 revised curriculum to high schools, this study investigated the field application of science II electives. For teachers in charge of science elective subjects in high school, the perception and implementation status of science II classes and assessment were investigated through

questionnaires and in-depth interviews. 192 science teachers participated in the survey, and 12 science teachers participated in in-depth interviews to provide more in-depth answers on the operation of the curriculum.

Major results include that high school science teachers are feeling the change in teaching method due to the application of the 2015 revised curriculum, and science teachers positively perceived the purpose of the 2015 revised curriculum, which emphasizes student participatory classes to develop students' key competencies. Regarding the teaching method, the teachers answered that they are trying to increase the proportion of the student-led class method rather than the teacher-led class in the Science II class. In the in-depth interview, in the case of Science II, the teachers had a hard time talking to each other about competency and student-participatory classes, as it was a course for specific students who were preparing for the CSAT.

Teachers responded that there were positive changes in all items directly or indirectly related to process-centered assessment, such as providing praise or feedback in relation to assessment, and expanding opportunities for individual student achievement improvement. Regarding the difficulty of operating the science II subject curriculum, teachers most frequently selected the increase in the number of subjects they had to take charge of, online classes due to COVID-19, and excessive workload. Based on the results of this study, the conclusions and suggestions for the operation and improvement of the science II curriculum are as follows:

First, it is necessary to optimize the content of Science II subjects. In the case of Science II subject, it was found that it was difficult for science teachers to practice student participatory classes or process-centered assessments due to the preparation for the CSAT and classes that focused on understanding science content rather than core competencies. However, in the case of Life Science II, which has significantly reduced the content in the 2015 revised curriculum, the results of the status analysis showed that inquiry activities and scientific writing could be strengthened. Therefore, it is necessary to revise the curriculum with a focus on improving the quality of learning rather than quantity in the career elective subjects.

Second, it is necessary to strengthen scientific inquiry activities through science process skills. One of the reasons for emphasizing student participatory classes or process-centered assessment in the 2015 revised curriculum is to develop students' key competencies through science inquiry activities that consist of science process skills ranging from problem recognition to communication. In other words, it is not to accept existing knowledge, but to develop students' competency to produce knowledge and generate new ideas.

Even in the high school Science II class, the science inquiry process skills are not experienced as a whole, since they focus on knowledge transfer and interpretation. Therefore, it is necessary to reorganize science process skills so that teachers and students can experience a series of inquiry process skills that produce scientific knowledge through science classes. In addition, support for professional development of teachers is needed so that science teachers can get rid of their fear of instructing the process skills of science inquiry and have confidence that they are worth teaching, and increase teacher efficacy for step-by-step process skill instruction. Above all, it is necessary to prepare the conditions for teachers to develop their competence as assessment experts by actively granting teachers the authority to assess student learning.

Third, it is necessary to remove the external obstacles pointed out by teachers, and provide practical support so that the curriculum operation of Science II subjects can be substantiated. External institutional and systemic improvement are needed to ensure that science II subjects do not lead to classes focused on the transfer of scientific knowledge due to the preparation for the CSAT. For example, it is necessary to prepare practical support measures such as converting the CSAT to assessing science competencies and process skills, and reinforcement of inquiry and lab activities through the placement of

science lab assistants.

Meanwhile, it will be necessary to build a foundation for high school students to study their chosen subjects so that they can prepare for the post-COVID-19 and through online and offline blended classes that have now become a new normal. In particular, it will be necessary to provide a space and equipment that can connect to the Internet for socially disadvantaged students, and support for equipment and materials for the operation of online courses.

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