IMPORTANCE OF INTEGRATED SCIENCE EDUCATION IN SOUTH KOREA

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ABSTRACT

The purpose of this study is to give meaning to the importance of learner-centered experiential learning and inquiry/experiment in the era of the 4th industrial revolution.
In order to give this meaning, we explore what the revised curriculum pursues, and through the policy trends of overseas science education of UNESCO (UNESCO) and the U.S. Research Council (NRC), materials helpful in establishing science education policy in Republic of Korea is to present. Key concepts and contents were extracted by collecting literature data through prior research related to the science education policy trends in Republic of Korea, and public notices, public documents, reports, and plan documents of the government, public institutions, and academic organizations. In addition, based on the subjects and core competencies corresponding to the seven crosscutting concepts presented by the US next-generation science standard (NGSS), we intend to consistently pursue and draw conclusions about learning for deep understanding.

Keywords: Integrated science education, Science educational policies, Systematic, Cross-Cutting

INTRODUCTION

The purpose of this study, in support of the introduction of the Science Inquiry Experiment Course for the first year of high school in accordance with the 2015 revised curriculum for the Republic of Korea, is to examine the importance of learner-centered experience learning and the significance of experiment, practice, and inquiry in the era of the 4th Industrial Revolution. To achieve this goal, the present researcher examines how the competencies of each textbook in the science inquiry experiment are distributed. Through this, I will explore the pursuit of the revised curriculum and present materials that will support Korea's science education policy through the overseas science education policy trends as promulgated by UNESCO and the NRC. The study classifies and analyzes the presentation of seven kinds of scientific inquiry experiment in textbooks in Korea in the context of science education policy and key concepts and contents extracted from prior research papers, statements from governmental agencies and public institutions, notices from academic institutions, and various official and draft documents and reports. In addition, we have analyzed the core goals of the seven crosscutting concepts proposed by the Next Generation Science Standards (NGSS) of the United States by each inquiry activity in each textbook. The underlying purpose throughout has been to help students achieve a deeper understanding of scientific subjects and to more effectively exploit core competencies. The study reaches the following conclusions.

First, in addition to core competencies, Korea's curriculum competency emphasized adequacy of acquaintance with content rather than classroom innovation by learning for capacity building. The number of subject competencies in each textbook is higher than the number of textbook

competencies presented in teaching and learning materials.

Second, it shows that the top three subjects of science competency according to seven kinds of science inquiry experiment textbooks in Korea are, in order of their contribution to scientific inquiry, solving ability, thinking ability, and communication ability, emphasizing the element of inquiry ability.

Third, it is the result of analyzing the inquiry activities of each science textbook experiment that incorporates the ‘big idea’ encompassing several concepts together with the subject competence. In addition, it is the result of analysis of crosscutting between concepts and crosscutting concept connecting boundaries. Among the seven concepts of cross-cutting, we can see that 'measuring the phenomenon of scale, proportion and quantity directly observed' is included in all textbooks only to a large extent. In other words, learners understand the need for variables other than length, size, weight, time, and temperature. In addition, learners themselves explore the importance of the inquiry learning experience on their own thinking about numerical results.

Fourth, as the number of inquiry activities by each textbook in the science inquiry experiment increased, the number of cross cutting concepts increased. These findings suggest the necessity of transforming the system of various inquiry experiment into a coherent connected organizational system rather than simply showing numerical comparison.

In this way learners can, by participating in various experiments and inquiries through the inquiry learning experience fostering a systematic, integrated conceptualization of science that goes beyond the seven traditional fields (physics, chemistry, biology, earth science, etc.), deepen their understanding of natural phenomena in nature and their implementations in technology.

Furthermore, in order to activate classroom teaching of inquiry or experiment, a more coherent science education policy about learner experience is needed that will help policy formulation in the era of the forth industrial revolution.

Among the resolution elements of the comprehensive plan and measures for the improvement and development of science education in South Korea, various analyzes are identified for the resolution of science education after the government of the Republic of Korea converges. It didn't solve the biggest problem, and it happened again and again. The highest frequency of problems is that South Korean science classes are mainly conducted in the form of theory-focused lectures. The 2015 revised curriculum that seeks to solve this problem is an integrated curriculum in humanities and science. In the liberal arts and science integrated curriculum, all high school students in South Korea take an integrated science course without distinction between liberal arts and science. The introduction of the 2015 revised curriculum is being implemented in 2018. For the first year of high school, the subjects of integrated science and science inquiry experiment are selected as common subjects regardless of liberal arts and sciences.

In particular, the experimental subjects of science inquiry experiment are selected as common subjects, so it is meaningful to include a two-hour class. In addition, the high school credit system will be implemented from 2025 for changes that support the development of core competencies of learners away from competition in the entrance exam education. The positive impact of wanting to strengthen the core competencies of learners implies the importance of

scientific inquiry and scientific inquiry experiment for inquiry-experiment-oriented education. In addition to the core competencies of recent overseas education trends, in Korea, subject competencies are introduced to introduce subject competencies. The relevance of learning for competency building and learning for understanding must be structured. By introducing Big Idea in the 2015 revised curriculum, we emphasized the content of the class. This is a part consistent with the Cross-Cutting concept for the purpose of learning for a deeper understanding. Through this, we would like to suggest improvement plans through subdivided classes as 7 cross-cutting concepts for continuous effort, interest, and development in the teaching methods of inquiry and experimentation. The Cross-Cutting concept suggests that it is necessary to play a role in coherently connecting organizational systems in various fields rather than learning by dividing subjects by chemistry, biology, and earth science. In particular, although existing learners did not have the opportunity to experience scientific inquiry by acquiring only the theory, in the case of South Korea, inquiry-oriented activity classes are revised by the curriculum, and they are greeted with good opportunities. The cross-cutting concept of the US next-generation science standard (NGSS) provides learners with cross-linking and connectivity between disciplines, leading to exploration, experimentation, and practice of core concepts and contents related to science and technology. This allows applications and key ideas to be enriched with a deeper understanding (NRC, 2012).

In other words, this concept connects learners with boundaries in fields such as physics, chemistry, life science, and earth science. The seven Cross-Cutting concepts of the next-generation scientific standard (NGSS) presented by the National Research Council (NRC) are as follows.

1. ‘Questioning related to patterns’ is to develop the way learners recognize, classify, and record observed patterns.
2. 'Understanding and predicting mechanisms through cause and effect' means that learners begin to think about what caused the relationship between patterns, and explain and investigate the relationship to find evidence to support their thinking. As a basis, it can be used to experiment through a given context, to guess and to explore, and to explain what will happen thereafter.
3. 'Measuring the phenomena of directly observed scale, proportion, and quantity' helps learners understand the need for variables other than length, size, weight, time, and temperature, and can judge numerical results.
4. ‘System Analysis and System Model Performance’ is a program that allows learners to verbalize their thoughts, describe and predict the roles of system objects, and discuss their impact on the limits of the reliability and precision of predictions.
5. “Investigating and Characterizing the Flow, Cycle, and Conservation of Energy and Matter” examines interactions in the fields of physics, chemistry, life sciences, earth and space sciences, engineering, technology, and applied sciences. Based on this, we understand by tracing the flow and circulation of energy and matter in science classes in all fields.
6. The investigation of the relationship between structure and function in 'shaping structure and function' can be applied to complex or difficult-to-observe systems or processes using accessible and visible systems in nature or in the man-made world. Improving their understanding of structure and function allows learners to apply them to investigate unfamiliar phenomena.
7. 'Exploring stability and change' allows small changes to occur even in stability, and the reasons for changes and non-changes can be considered and explored (NRC, 2013).

The seven concepts of Cross-Cutting begin with two concepts in understanding the essence of science. Observed patterns can be explained and supported to investigate them as cause and effect. Also, based on this, directly observed phenomena of scale, proportion, and quantity (Phenomena) may be related to mathematical relationships.

And the concepts of systems and systems models, the flow of energy and matter, structure and function, and the elements of stability and change are interrelated. The concepts of systems and systems models are reflected in the concepts of energy and matter flow, structure and function, stability and change (NRC, 2012). Each concept occurs in all fields of science and is called 'Unifying Concepts' or 'Common Themes' (NRC, 2012). It suggests the importance of recognizing common and integrative concepts in many areas of science rather than inducing them.

Accordingly, the cross-cutting concept is closely related to the science research experiment in the 2015 revised curriculum, and it can be expected to play a role in making the system of inquiry experiments in physics, chemistry, biology, and earth science into a coherently connected organizational system. It can be expected to strengthen basic literacy education through inquiry experiments.

References

Korea Institute of Curriculum and Evaluation, Republic of Korea. 2015. *A study on the development of the 2015 revised curriculum overview (middle and high school).* Research Report CRC 2015-28.

Minhu Shim. 2019. *A Study on the Improvement of Science Education Policy through the Analysis of Subject Competency in Science Inquiry Experiment Textbooks.* Master's thesis at Yonsei University Graduate School of Education.

Ministry of Education, Republic of Korea. 2015. *2015 Revised Science and Curriculum.* Ministry of Education Notice No. 2015-74.

National Research Council. 2012. *A Framework for K-12 Science Education: Practices, crosscutting concepts, and core ideas.* Washington, D.C.: National Academy Press.

National Research Council. 2013. *The Next Generation Science Standards.* Washington, D.C.: National Academy Press.

United Nations Educational, Scientific and Cultural Organization (UNESCO). 2005. Definition and selection of competencies, Paris.

UNESCO. 2015. Education 2030: towards inclusive and equitable quality education and lifelong learning for all, Incheon.