



Analyzing the Features of Solving the Science Problems by Proficiency Levels of Middle School Students in Korea

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Abstract

The National Assessment of Educational Achievement (NAEA) of Korea is the type of large-scale test measuring students' educational achievement. It has played a crucial role in monitoring the quality of the national curriculum, improving teaching and learning method, and establishing educational policies. The purpose of this study aimed to gain data for improving the national curriculum as well as teaching and learning method through in-depth analysis of the results of the NAEA for the past three years (2010-2012). This study was performed to identify the features of solving the science problems of middle school students according to their proficiency level; Basic, Proficient, and Advanced. This study revealed the significant information regarding the achievement standards or educational contents that students either fully understood or lacked understanding according to their proficiency level as well as the achievement standards that even advanced level students could not perform successfully. Thus, the findings implied how educational contents or achievement standards could be re-arranged by proficiency or school levels. In addition, we identified specific content that needs to be enhanced in order to meet the needs of students appropriately in different proficiency levels.

1. Introduction

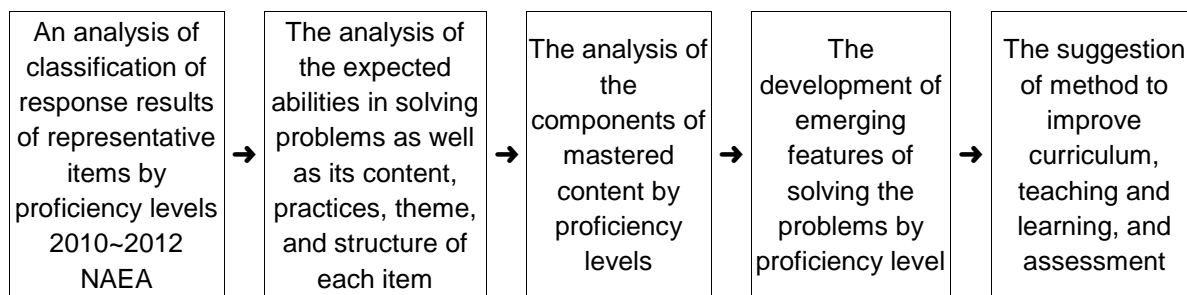
Institute for Curriculum and Evaluation (KICE) has been implementing The National Assessment of Educational Achievement (NAEA) to check the students' educational achievement whose results can be used as the fundamental data to improve the quality of current education. The purpose of this study was to identify the characteristics of 9th graders' abilities in solving problems in science field according to proficiency levels with the data of NAEA from 2010 to 2012. The significance of this study is to employ newly developed framework of NAEA in 2010 to check students' achievement and the quality of current education on the basis of the revised curriculum in 2009. For this reason, the response results of science items of NAEA 2010~2012 were analyzed. The withdrawn characteristics of students' abilities of solving the problem by proficiency levels would be used as the criteria in promoting the formation of science concepts[1] and improving teaching and learning method, and developing appropriate assessing tools[2] [3].

2. Method and Procedure

First, students' educational levels were divided into four; Advanced, Proficient, Basic, Below Basic. When majority of students could answer the question in each item, we say that students are proficient in that item. Therefore, the operational definition of 'proficiency' is when students answer the question correctly over 74% in multiple choices and over 60% in supply type question. The research procedure is as follows (Fig.1).



Fig. 1 The process of analyzing the features of science proficiency level



3. Results and Discussion

3.1 The distribution of items by proficiency level at the achievement standard

We analyzed the mastered items in science at 9th grade by the achievement standards and we also categorized the content by correct response ratio according to students' proficiency level from the data of 2010~2012 NAEA.

Table 1 The number of mastered items in science content

Domain	Sub domain	Number of total items	Number of mastered items (%)		
			Advanced	Proficient	Basic
Motion and energy	Force and motion	14	9	5	3
	Heat	2	2	2	1
	Electricity and magnetic	6	6	3	-
	Light and wave	8	8	7	2
	Sub total	30	25	17	6
matter	Condition of mater and its phase	10	10	8	4
	Characteristics of matter and separation of mixture	11	11	8	-
	Structure of matter	9	9	7	2
	Sub total	30	30	23	6
Life	Animal	18	18	16	4
	Plant	7	7	5	-
	Constitution and diversity of life	5	5	5	1
	Sub total	30	30	26	5
Earth and space	Geology	13	12	7	2
	Atmosphere and ocean	6	6	4	-
	Astronomy	11	11	7	2
	Sub total	30	29	18	4
TOTAL		120	109	84	21



3.1 The features of students' proficiency by achievement standard

The features of students' achievement at "Basic" proficiency

- Students can solve the problem on the basis of their daily life experience and the phenomenon they are familiar with. Students can also interpret what they just remember easily without higher order cognitive level. Students recognized the change pattern of natural phenomena; however, they could not connect the phenomenon to scientific concepts they knew.
- Students can remember and interpret the concept they are familiar with, but they lack skills of understanding, analyzing, inferring, and synthesizing the concepts. Therefore, teachers need to provide scaffolding strategies which are helpful students' cognitive development.
- Students at this level showed the proficiency in concepts coming from their daily life experience, so it is critical to provide students with physical experience and lab experimentation.

The features of students' achievement at "Proficient" level

- Students at this level can understand the concepts repeated in curriculum. In addition, students remember and understand the basic science concepts and principles and design the investigation partially. Students can find out the pattern of data to be interpreted from the investigation partially designed by themselves and solve the problem if more information is given. However, students at this level lack the skills of solving the problem with multiple concepts or have in difficulty in manipulating multiple variables necessary in solving the problem.
- Students at this level needs more structured teaching and learning guide in the followings; force and motion, force of electricity, electric current and motion of electron, characteristics of wave, change in state, mixture separation, solubility, molecular structure, structure and function of excretion organ, functions of different neurons. Students showed difficulty in explaining plant photosynthesis or respiration by BTB, classifying the rocks, comparing index and facies fossils, and understanding the unconformity, which indicate the necessity of teaching and learning strategies enhancing students' cognition at this level.

The features of students' achievement at "Advanced" proficiency

- Students at this level can analyze the data, interpret by the patterns out of the data, make conclusions, select and assign variables necessary to the purpose of experimentation, and design the investigation. Students showed the abilities of explaining or inferring the processes and functions related to the given concepts, situation, or themes with the simple information. Students at this level can understand the majority of concepts offered in the sub domain of motion and energy, matters, life, and earth and space; however, students lack the skills of connecting those concepts to be applied to new situation or what they are unfamiliar.
- Students have difficulty in understanding some concepts in the following sub domains; force and motion, work and energy, mineral classification, and orogeny.

4. Conclusion

First, students at basic proficiency level can remember and interpret simple and familiar concepts or data; however, they lack the skills of understand, analyze, infer, and synthesize general concepts and principles, therefore, it is essential to provide students with scaffolding for teaching and learning strategies helpful to developing those cognitive development. It is also critical to provide physical experience or lab experimentation by doing since they showed 'mastered' in the concepts of applied forces and characteristics of animals and plants which come from their daily life.

Second, students at this level showed cognitive skills of understanding the phenomenon invisible and unobservable; however, they showed different levels of proficiency in considering variety of variables, explaining the sequential steps of natural phenomena or functions, which indicate that there is strong connection between 'content' and 'practices' in their learning, That is, students can interpret the data whose concepts they are familiar with; otherwise, students have difficulty in interpreting the data.



Therefore, it is critical to construct hierarchically organized connecting to its practices composed of inquiry skills. In addition, when students showed the lack of proficiency at a certain skill, we should figure out that this lack results from insufficiency in concept or in practice.

Third, students at superior level showed understand the majority of concepts in sub domains; motion and energy, matters, life, and earth and space; however, they showed the lack of skills of applying those concepts to new situation or unfamiliar one, therefore, we need to provide students cases of new situation where students can extend concepts or skills with the use of what they know.

Fourth, we can imply that it is ideal to differentiate the basic from advanced concepts holistically on the basis of results of this study, NAEA, rather than organize the curriculum by basic and advanced concepts in each domain. It is recommended to provide more physical experiencing activities and experimentation for students to construct basic concepts strongly at the very beginning learning level. The appropriate scaffolding teaching and learning strategies are also recommended to be offered at different proficiency level on the basis of practical research [4].

Lastly, it is suggested to employ the result of NAEA to revise the curriculum to be measurable the features of students' achievement at different proficiency levels. That is, students at basic proficiency level are supposed to master the concept and practices coming from their daily life, so it is ideal to develop items/questions at different or new situation, which in turn imply new teaching and learning strategies on the basis of those data.

References

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