



The Features of Solving the Biology Problems according to Proficiency Levels of 9 Grade Korean Students

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Abstract

The purpose of this study is to identify general capacity of solving the biology problems by proficiency levels of 9 grade Korean students. For this purpose, the response results of biology items of The National Assessment of Educational Achievement (NAEA) were analyzed for the past three years (2010-2012). It will be play a crucial role in monitoring the quality of the national curriculum, improving teaching and learning method, and establishing educational policies. This study was performed to make out the features of solving the biology problems of middle school students according to their proficiency level, being Basic, Proficient, and Advanced. The findings revealed valuable information regarding the achievement standards or educational contents that students, according to their proficiency level, either fully understood or lacked understanding. Basic level students could interpret materials when direct information was given, recall basic terminologies related in daily life and biological concepts repetitively learned in various subjects. Advanced level students could understand the related concept between photosynthesis and respiration in plant and interpret data of typical experiments which most basic level and a half of proficient level students could not solve. Advanced level students could understand most concepts and principles. And they could solve the biology problems based on very small information and have various process skills to solve many biology problems. The findings indicated how educational contents and achievement standards could be re-arranged by proficiency levels or school levels.

1. Introduction

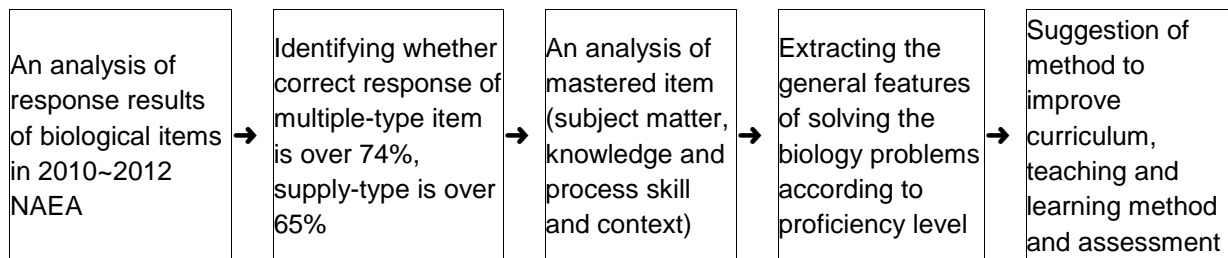
Korea has implemented The National Assessment of Educational Achievement (NAEA) which aims to check out the educational achievement of students and search for ways to improve the quality of education. The purpose of this study is to identify general capacity of solving the biology problems by proficiency levels of 9 grade Korean students. For this purpose, the response results of biology items of NAEA 2010~2012 were analyzed. Because new framework of NAEA was developed in 2010, 2010 was determined as the starting point of research. If the general capacity of solving the biology problems by proficiency levels is extracted by this research, it will be contribute to promoting the formation of biological concepts ([4] Koba & Tweed, 2009), improving teaching and learning method, and developing adequate assessment items ([2] Gullickson, 2003; [1] Glatthorn *et al.*, 1998).

2. Method and Procedure

First, students were classified as 3 groups according to their proficiency level- Basic, proficient, and advanced group by the ratio of their correct answers of science items in NAEA 2010~2012. When many students of each group answered correct responses about certain item, they were assumed to master that item. To master means that most of students of certain level group understand related concepts and have process skills required to solve the problem. Generally, supply-type items are more difficult than multiple-choice items. It is defined as mastery, when each group responded to a correct answer over 65% in case of supply-type items, 74% in case of multiple-choice items. A framework for analysis is as follows. ([3] Kim *et al.*, 2013).



Fig. 1 The procedure of analysis for extracting general features of solving the problems according to proficiency level



3. RESULTS AND DISCUSSION

3.1. The number of mastered items according to the proficiency level during the past 3 years

This study analyzed mastered items in biological domains, the achievement standards and correct response ratio according to students' proficiency level during 2010~2012 NAEA. **Table 1** is the number of mastered items by students' proficiency level.

Table 1 The number of mastered items according to students' proficiency level in biology domain

Domain	Developed items (%)	Number of mastered items(%)		
		Superior	Ordinary	Basic
Animal	18(60.0%)	18(60.0%)	9(30.0%)	1(3.3%)
Plant	7(23.3%)	7(23.3%)	2(6.7%)	-
Organism structure and Diversity	5(16.7%)	5(16.7%)	1(3.3%)	-
Total	30(100%)	30(100%)	12(40.0%)	1(3.3%)

30 Biology items were developed during the past 3years, 18 items (60.0%) were developed in animal domain, 7 items in plant domain, and 5 items (16.7%) in organism structure and diversity. The ratio of developed items by domains is adequate because there are 34 achievement standards in animal domain, 11 in plant domain, and 10 in organism and diversity domain of national standard assessment. Advanced level students mastered all of biology items developed in 2010~2012 NAEA. Proficient level students mastered 12 biology items (40.0%), Basic level students mastered 1 biology items (3.3%)(see **Fig. 2**).

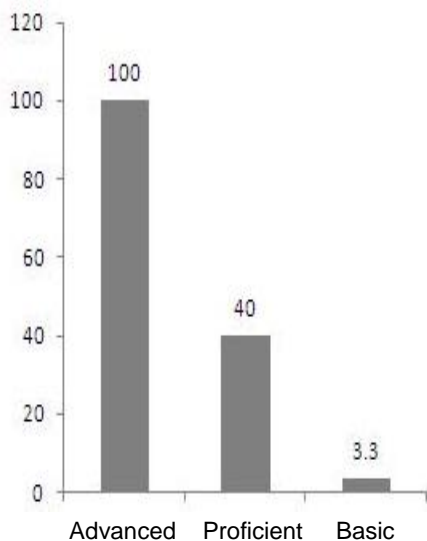


Fig. 2 The ratio of mastered items according to students' proficiency levels

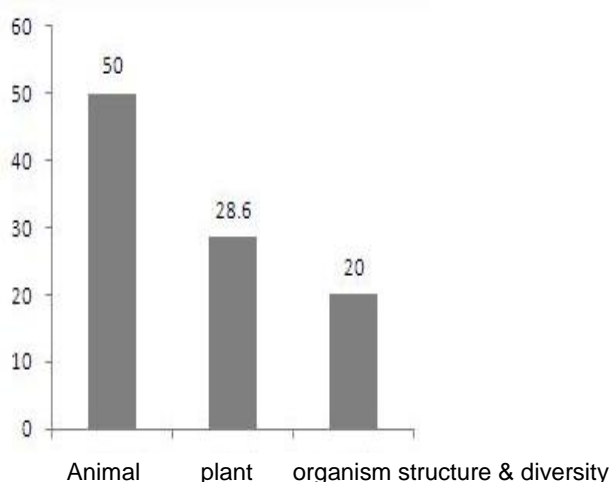


Fig. 3 The ratio of items that proficient level students mastered in life science domain

Proficient level students mastered 50.0%(9 of 18 items) in animal domain, 28.6%(2 of 7 items) in plant domain, and 20.0%(1 of 5 items) in organism structure and diversity domain(see **Fig. 3**). The results tell us that the proficient level students found it most difficult to master the concepts of organism structure and diversity domain and they found it less difficult to master the concepts of plant domain. It is relatively easy for them to master concepts of animal domain.

3.2. An analysis of the features of mastered items according to proficiency levels

Table 2 An analysis of the features of mastered items according to proficiency levels (example)

Proficiency level	Domain	Standard achievement	Developed year (Number)	The feature of item
Basic	Animal	Understand how drugs related to the nervous system influence the human body.	2010(18)	(Material) Addiction of Tobacco (Knowledge/Recall) Recall what kind of the ingredients of tobacco cause to addict. (Context) Daily life
Ordinary	Animal	Perform experiment which to know changes of pulse rates during exercise.	2012(23)	(Material) changes of pulse rates during exercise. (Process Skill/Interpret) Interpret the changes of pulse rates during exercise. (Context) Experiment
Superior	Organism structure & diversity	Observe cells through microscope operating	2011(24)	(Material) Observe cells through microscope operating (Process Skill/Operate) Know the detailed method of microscope using to find out a clearness image. (Context) Classroom



Basic level students could interpret materials when direct information was given, and recall basic terminologies related in daily life and biological concepts repetitively learned in various subjects. Proficient level students showed more features than basic level students. They mastered 12 biology items (40.0%) developed in 2010~2012 NAEA and could solve various problems required process skills. For example, they could master many achievement standards in animal domain-Setting up a control group in familiar circumstance, interpreting graphs not required indirect reasoning, applying knowledge to daily context which learned in classroom, *et al.* Proficient level students found it very difficult to master the concepts of organism structure and diversity domain. And they found it less difficult to master concepts of plant domain. It is relatively easy for them to master concepts of animal domain. Advanced level students mastered all of biology items developed in 2010~2012 NAEA. They could understand the related concept between photosynthesis and respiration in plant and interpret data of typical experiments which most basic level and a half of proficient level students could not solve. Advanced level students could understand most concepts and principles-Explaining the principal of gas exchange by partial press of gas during external respiration and internal respiration, setting up control variable factors which influence transpiration, reasoning the function of leaves in relation to photosynthesis and respiration just depending on the change of BTB solution *et al.* Also, they could solve the biology problems based on very small information and have various process skills to solve many biology problems.

4. Conclusion

The results of the study included the followings. First, it is necessary to organize teaching and learning method that can help basic level students understand more concepts and acquire more process skills, such as, presenting scaffold for helping the formation of concepts and principles. Hands-on activity and Experimental education should be reinforced to have a direct experience. Second, there are difficult concepts for proficient level students to master. They were respiration, excretory, the structure and function of neurons, the nervous system, the pathways of responses to stimuli, mitosis and meiosis in animal domain. And they felt more difficult to acquire concepts in plant and organism structure than animal domain. A special pedagogy is needed to promote the concepts in those domains. Third, a general features to solve the biology problems will be helpful to develop biology items suitable to standard achievement.

Reference

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