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Students' Perception of Continuous Change of the Nature

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Abstract: One of the prime objectives of school science is to help the children learn science concepts and conceptual schemes that will help them understand and interpret their environment. One of the basic scientific concepts is 'Change - everything existing in universe is changing always'. The purpose of this study was to investigate the characteristics of elementary and secondary students' conception of change. The subjects for this study were 489 students in Korea; 111 fourth graders, 95 sixth graders, 140 seventh graders and 143 ninth graders. Four items - mountain, river, ground, sea - were used for investigating students conception of change because representing the nature world in elementary and secondary level. The subjects were asked to check whether each item was changing and to explain each their check. Students' explanations were classified by whether they were sound understanding geologically, or not. The rate of responses that each item was changing was compared by grades and the rate of geological explanations was also compared by grades. Because students' conceptions of change might were effected by time scale, the additional questions that asked students whether the present status of four items were equivalent to the that of several points of time. As a result, the rate of scientific answers and patterns of explanations were similar by grade and the rate of geological understandings was relatively low. The frequencies of concept of change were more dropped as the point of time was closer to present.

Key words: concept, geology, elementary science, secondary science

INTRODUCTION

The core commitment of a constructivist position, that knowledge is not transmitted directly from one knower to another, but is actively built up by the learner, is shared by a wide range of different research traditions relating to science education (Driver *et al.*, 1994). By this position, students' conceptions being brought into classroom have been emphasized in science learning and many researches have dealt with and revealed the states and characteristics of them. in addition, various teaching and learning strategies for conceptual change were devised and tested in researches of science education (Wandersee *et al.*, 1994).

Scientific knowledge is divided into procedural and declarative knowledge and declarative knowledge includes several types of knowledge (Lawson, 1995). The declarative aspects of subject matter of the disciplines are composed of a series of concepts and conceptual systems. Concepts by apprehension are the first major type of concept, it include the terms, hunger, pain, cold etc. derived primarily through internal sensory impressions. The second type of concept is descriptive concepts including terms, interaction, environment, the meanings of these terms are constructed from external experience such as familiar actions, direct observations, and examples. The last type is theoretical concepts that must be understood as part of complex relationships with other concepts, functional relationships, or inferences from experience and idealizations, for example, gene,

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ideal gas, light wave and so on.

Although considerable amount of educational research were conducted to show students' conceptions in science domains, most of them focused on theoretical concepts and were not concerned about descriptive concepts.

Cognitive psychologists are accepting that certain concepts, such as time, space, number and mind, are so basic to our understanding of the world that their development is important in their own right. In fact, these concepts being classified in descriptive concepts have played central roles in the theories of philosophers such as Kant and Psychologists such as Piaget (Siegler, 1998). One reason of that these concepts have been considered importantly may because they are foundational knowledge in recognizing phenomena. Psychologists had to be interested in them In order to have students have a sound view about natural world and reasonable thought in everyday life,

Science education in elementary and secondary school may not only focus upon learner's thinking and individual knowledge. Feeling and acting with sound understanding of natural world is more important. Therefore, science educators of elementary and secondary schools should identify a limited number of important concepts and children's ideas in connection with the concepts (Helldn, 1997).

In fact, science educators also have established basic concepts of science for students and science curricula have been organized basing on them. The concepts are not theoretical concepts. For example, In the middle of the 1960's, NSTA (National Science Teachers Association) gave a recommendation of conceptual schema of science. It have set the several concepts, such as Energy, Matter, interaction, Motion, Life, Change as basic concepts of science. The recommendation influenced heavily on 3rd elementary science curriculum of Korea published in 1973 and the concepts became main domains in organizing of science content (Kang, 1985).

Although the reason for teaching science have been changed according to social and political situations such as economic development, public's health, production of scientists for national security and international prestige (Deboer, 1991), One of the prime objectives of elementary science is to help the children learn science concepts and conceptual schemes that will help them understand and interpret their environment. Children who have appropriate scientific knowledge can use to their thinking and future behavior (Victor, 1989). For students' sound understanding natural world by acquisition of science concepts, establishment of basic concepts of science must be precedent.

One of the basic concepts is Change - everything existing in universe change'. It is a important aim of science education that student can see the world with the sight of change. Although this viewpoint is emphasized especially in Earth Science education (Ministry of Education of Korea, 2000), there are few researches probing this issue. In this study, We investigated whether elementary students see the natural world with sight of 'Change' with some questions and its characteristics according to time scale with longitudinal study.

Concept of change in school science

Geological studies show that the enormous power of weathering and erosion on surface of the earth. Weathering refers to the breaking down of rocks into smaller parts through the action of agents such as plants, chemicals, frost, and changes of temperature. Erosion includes weathering plus the process of transporting weathered material from one location to another, as in the action of running water, wind, and glaciers (Gega, 1990). Everything in universe as well as surface of the earth is changing or circulating. This concept is the center of earth science education (Ministry of Education of Korea, 2000).

Concept of change have emphasized in school science. The National Research Council (1996) published the National Science Education Standards after several steps to develop a standards of K-12 science education on national level. The standards have set standards about various aspects of science

education named Science teaching standards, Standards for professional development for teachers of science, Assessment in science education, Science content standards, Science education program standards, and Science education system standards.

Among those standards, Science content standards have eight categories: Unifying concepts and processes in science, Science as inquiry, Physical science, Life science, Earth and space science, Science and technology, Science in personal and social perspectives, and History and nature of science. Unifying concepts and processes standards is providing students with powerful ideas to help them understanding the natural world. Unifying concepts and processes include;

□ Systems, order, and organization.
□ Evidence, models, and explanation.
□ Change, constancy, and measurement.
□ Evolution and equilibrium.
□ Form and function.

Students may have a sound point of view on natural world with these concepts and processes. The establishment of this viewpoint on natural world may be more important in science education than other each theoretical concept. Concept of change is the one of unifying concept and emphasized as essential to have a sound viewpoint.

Korean 3rd science curriculum was affected by science curriculum reform of United states (Kim, 1993) that was the development of an approach to science education that was focused on the logical structure of the disciplines and on the processes of science (Deboer, 1991). Since 3rd science curriculum of Korea, science contents were organized focusing on basic concepts such as matter, energy, interaction, life, and change. In the case of 1st science curriculum published in 1954 and 2nd science curriculum published in 1963, Although the science contents were not organized basing on, It was also sure that concept of change was important concept of science education because the concept of change was presented as one of the aims of science subject matter (Kim, 1992)

New curriculum of Japan implemented from 2000 also shows the importance of the concept of change. Astronomical change concept is presented in the aims of 3rd grade and geological change concept in 6th grade (Munbusyou, 1998).

METHOD

Subjects

The subjects for this study were 489 students: 111 fourth graders, 95 sixth graders, 140 seventh graders, and 143 ninth graders. Fourth and sixth graders were sampled from an elementary school in Daegu city, Korea. Male students of seventh graders and ninth graders came from a boys middle school in Sungnam city, Korea and female students were from a girls middle school in the same city. The achievement of science subject of these school students may be on average of Korea. The elementary school sampled was a public school being located on residential street and the achievement of science subject was on average of elementary school of Daegu city, a megalopolis. The boys' and girls' middle schools from Sungnam city were also public schools being situated on residential street. The city is in the Capital area so that dwellers of the city have an attention to education as highly as any megalopolis in Korea. This study was conducted on February, 2000. The 6th science curriculum, therefore, was being applied to subjects and students already had finished the learning on the contents of their grade for a school year is closed at the end of February. The number of male and female students by grader is presented in Table 1.

Questions

Parmer (1998) used different types of living things

Table 1. The number of samples by grader and sex

	Fourth grader	Sixth grader	Seventh grader	Ninth grader	Total
Male	66	39	65	74	283
Female	45	56	75	69	301
Total	111	95	140	143	584

to investigate students' biological-role concept. He supposed that the living things represent different contexts for students when they are applying their ideas of biology. Even if we don't agree on his and prior researchers' idea that each item represents different context, Using items to which a concept can be applied is available in order to survey a concept students have.

This study used 4 items; Mountain, River, Ground, and Sea because these represent the nature world well on elementary and secondary school level. We asked students to check whether each item change and to explain each their check to identify their responses were appropriate to geological respect. The students' conceptions of change might be various according to time scales because change is related to time scale, so another questionnaire asking whether each item change by five time scales (100 years, 10 years, 1 year, 10 days, 1 day) was used. The time scales were determined through a pilot test with students of each grade. For the pilot test, un-structural interview on change of the nature were conducted for about 10 minutes per one student. The results of pilot interview showed that students might have thought in which 10 years became border between change and un-change of the nature. 10 years, therefore, were set as a fiducial point and the shorter time scales than 10 years were more emphasized. An instance in connection with an item Mountain was presented in Table 2.

Data analysis

Data gathered from two questionnaires was analyzed with two points of view. One is to investigate whether there is a difference by grade in the rate of response indicating an item change geologically and the other is to survey how sound responses become different according to several time scales.

Students' answers were divided into two groups (change or not) firstly and then the responses in which an item might change were classified two categories by whether they implied the geological sound concept. The rates of responses included in each category were compared by grade and the tendency depending on grades was investigated. The patterns of variations of responses by time scale were also compared throughout the subject and by grade.

RESULTS

Students' perception of geological change

Four items (Mountain, River, Ground, Sea) selected in this study were provided to subjects and students were asked to check whether each item was changing. Students also explain the reason after checking. The rate and tendency of response that each item was changing was presented in Table 3 and Fig. 1.

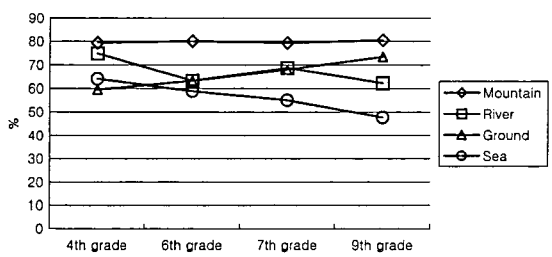

Fig. 1. The tendency of response that each item is changing by grade.

Table 3. The rate of response that each item was changing (%)

	Mountain	River	Ground	Sea
4th Grade (N=111)	79.3	74.8	59.5	64.0
6th Grade (N= 95)	80.0	63.2	63.2	58.9
7th Grade (N=140)	79.3	68.6	67.9	55.0
9th Grade (N=143)	80.4	62.2	73.4	47.6
Total (N=489)	79.8	67.1	66.7	55.6

Table 2. The questionnaire asking whether mountain change by time scale

	Yes	No	No idea
The present status of mountain is equivalent to the status of 100 years ago.	-----	-----	-----
The present status of mountain is equivalent to the status of 10 years ago.	-----	-----	-----
The present status of mountain is equivalent to the status of 1 years ago.	-----	-----	-----
The present status of mountain is equivalent to the status of 10 days ago.	-----	-----	-----
The present status of mountain is equivalent to the status of yesterday.	-----	-----	-----

About 80% of students showed responses of change in question about Mountain and relative frequency of each items was made appearance in order of Mountain, River, Ground, and Sea. The difference by items and, above of all, the difference by grades was small. It, ,regardless of the reasons they gave, can be implied that about 50-80% of subjects have perception that the nature change. For more significant determination, the investigation of the reasons they described was needed. Their reasons were classified into two groups. One was 'Geological reasons' and the other was 'Non-geological reasons'. The representative instances of those were as follows.

· Geological reasons

Change by erosion, transportation and deposition.

Change by volcanic eruption, earthquake, orogenic and epeirogenic movement.

· Non-geological reasons

Activity, ecology of living things

Change of season

Change of climate, weather, the world is getting warmer

Pollution and development by human

The nature was made and has changed all by itself.

How many students have a geological reason was focused in this study and the frequency of the reason geologically acceptable was compared by grade. Table 3 and Fig. 2 present the frequency of geological responses according to grades.

On the whole, the rate of geological reasons was very low and although the rate on seventh grade was little higher than others, there was not a wide difference among grades. Two former results that

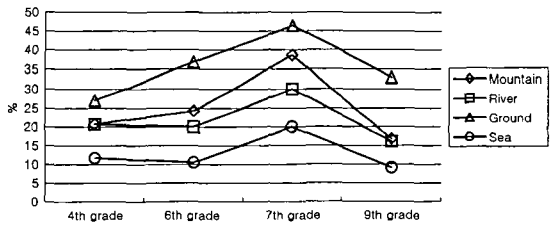

Fig. 2. The tendency of response that each item is changing for geological reasons.

there was little difference among grades were not coincided with general expectation. The values on seventh grade were higher than those in other grades and geological reason increase gradually from fourth grade to seventh grade. One considerable cause can be in science curriculum of Korea. In Korean science curriculum, the change of the surface of the earth including erosion, transporting and deposition is dealt with on third and fourth grade and orogenic and epeirogenic movement including volcanic eruption, earthquake are learned on grade sixth and seventh grade. This result, therefore, imply that the effect of learning geological concepts decrease after learning and geological viewpoint grow fainter and fainter.

Perception of change according to time scales

An important purpose of geology education is to have student perceive continuous change of nature. The present state of nature is differ from that a little while ago. The concept that the change occurs in succession is most important. So, in this study, whether students perceive this property in a short time scale as well as long time scale. Subjects were presented five time scales (100 years, 10 years, 1 year, 10 days, 1 day) per an item and asked to check whether the present state of an item is equivalent to

Table 4. The rate of response that each item is changing for geological reason (%)

	Mountain	River	Ground	Sea
4th Grade (N=111)	20.7	20.7	27.0	11.7
6th Grade (N=95)	24.2	20.0	36.8	10.5
7th Grade (N=140)	38.6	30.0	46.4	20.0
9th Grade (N=143)	16.8	16.1	32.9	9.1
Total (N=489)	25.4	21.9	36.2	13.1

Table 5. The rate of response that Mountain changes by time scale (%)

	100 years	10 years	1 year	1 day	1 hour
4th Grade (N= 88)	88.6	75.0	3.3	21.6	10.2
6th Grade (N= 77)	85.5	84.2	56.6	36.8	27.6
7th Grade (N=111)	90.1	81.1	61.3	46.8	37.8
9th Grade (N=115)	92.2	93.0	73.0	53.9	45.2
Total (N=390)	92.2	83.8	57.4	41.3	31.8

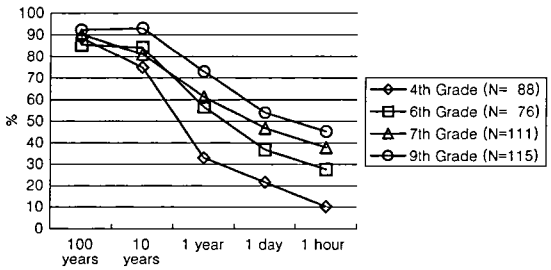

Fig. 3. The tendency of response that Mountain changes by time scale.

state of each time scale ago. Data analysis was done to the subject answered an item change in first question. The result is presented in from Table 5 to Table 8 and from Fig. 3 to Fig. 6. Each percentage was set on the basis of students responded the item change.

As the result of analysis data, two patterns were found. First, the closer a point of time was to present, the lower the percentage of response that the states was different from those of present. The values dropped rapidly at question related to 10 years.

Second, another common patterns found on four graphs was that the shorter time interval was, the wider the difference among the grades was and, although the percentage of response that an item change for geological reason was highest on seventh grade (Table 4, Fig. 2), relative rate was higher on ninth grade when concrete time intervals were presented. This result may implies that although geology of school science was learned intensively on sixth and seventh grade, further mature is need for more perception of continuous change of the nature and, judging by the result that 20-30% of subjects who gave answers that an item change mentioned geological reasons, it may be near the truth to say that the concept of change should be taught as basic and important concept of geology in school science.

Table 6. The rate of response that River changes by time scale (%)

	100 years	10 years	1 year	1 day	1 hour
4th Grade (N= 83)	83.1	78.3	47.0	26.5	13.3
6th Grade (N= 60)	91.7	85.0	63.3	43.3	31.7
7th Grade (N= 96)	92.7	84.4	60.4	46.9	38.5
9th Grade (N= 89)	89.9	89.9	78.7	55.1	45.2
Total (N=328)	89.3	83.8	57.4	41.3	31.8

Table 7. The rate of response that Ground changes by time scale (%)

	100 years	10 years	1 years	1 day	1 hour
4th Grade (N= 66)	89.4	75.8	39.4	16.7	6.1
6th Grade (N= 60)	95.0	91.7	71.7	53.3	33.3
7th Grade (N= 95)	87.4	81.1	64.2	51.6	42.1
9th Grade (N=105)	91.4	88.6	78.1	50.5	44.8
Total (N=326)	90.5	84.4	65.0	44.5	34.0

Table 8. The rate of response that Sea changes by time scale (%)

	100 years	10 years	1 years	1 day	1 hour
4th Grade (N=71)	74.6	80.3	43.7	33.8	18.3
6th Grade (N=56)	83.9	80.4	57.1	35.7	28.6
7th Grade (N=77)	83.1	75.3	59.7	44.2	36.4
9th Grade (N=68)	89.7	91.2	86.8	64.7	54.4
Total (N=272)	89.7	81.6	61.8	44.9	34.6

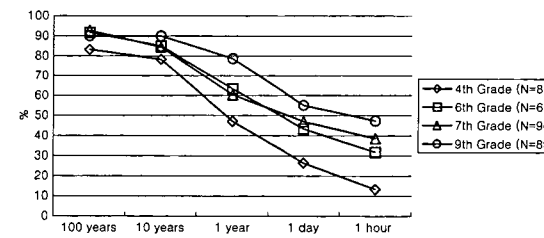

Fig. 4. The tendency of response that River changes by time scale.

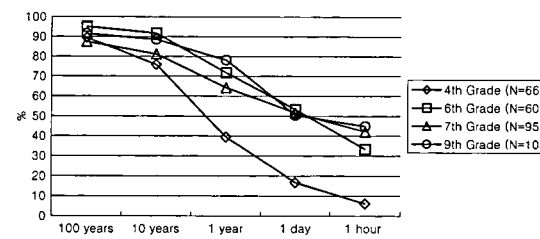

Fig. 5. The tendency of response that ground change by time scale.

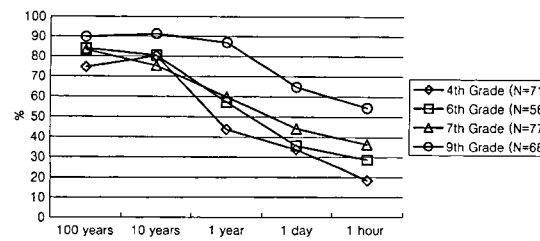

Fig. 6. The tendency of response that Sea changes by time scale.

CONCLUSION

For the sound understanding of the nature and organic relationship between the nature and human, there are basic concepts should be treated importantly in school science, for example, Energy, Matter, Interaction, Life, and Change. Among them, in this study, students' perceptions of change that is the core of geology unit were investigated. Students were asked to check whether four items, such as Mountain, River, Ground and Sea seemed to represent well the nature on elementary and secondary school level, were changing and asked to explain the reason.

The result of those questions showed that the difference by grade was very small, although the rate of geological reasons on seventh grade was higher than other grades. Reviewing the content of school science focusing on 6th curriculum of Korea (Ministry of education, 1994), although the concept of change of the nature is emphasized on whole grade levels, the learning on the change of environment surrounding us is performed from third grade science course. In the grade, observation and investigation of the properties of rock, sand, soil was learned for the establishment of foundation for further studies on this area. In 4th grade, the continuous change of environment is studied in earnest. Students in the grade learn erosion, transportation, and deposition by water in River and Sea unit. In addition, the process of formation of strata and the rocks constructing were also dealt in Strata and fossils unit in 4th grade. In 6th grade that are the last grade of elementary school, students learn about volcanoes and earthquake in Moving ground unit. At the secondary school, 7th graders who are first grade in middle school learn matters composing earth crust and their change, alteration of crust, and environment in geologic eras. In 8th grade, then, the contents of earth science focus on the atmosphere and the hydrosphere of the Earth. In the last grade of middle school, 9th grade, the contents are organized with the Sun, the moon, other stars, and galaxies.

In that, until 7th grade, students learn the change of environment surrounding us on and, on 8th and 9th grade, they learn about beyond the limit of the Earth. Therefore, the result that 7th graders showed higher frequency than other graders in geological response might depend on this curriculum arrangement and, Seeing that their frequencies went down rapidly on 9th grade, it can be said that higher frequencies on 7th grade is temporary and students can not join what they learned to consistent perception of change of the nature.

It implies that students perceptions of continuous change of the nature are not developed by school science. If this result has the fundamental cause that many fourth graders already have the conception of change of the nature, reconstruction of science curriculum may be considerable.

More manifest evidence showing science education do not grow up students' perception on the changing nature appeared in questions asking students whether the state of each item have changed for several time intervals, such as 100 years, 10 years, 1 year, 1 day, 1 hour. In those questions, the rate of answer implying the perception of the concept of change became low suddenly as a point of time was closer to present. If this result is on account of unconcern about concept of change as the basis of geology, the focus of teaching should be altered to more emphasizing the concept of change.

For scientific literacy noticed in science education and appropriate attitude toward science, school science should give more attention to the basic and comprehensive concepts, not to the individual knowledge derived from concrete theories of science.

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