# SOURCES OF NAIVE THEORIES IN ASTRONOMICAL PHENOMENA

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## I. INTRODUCTION

### 1. Need for Study

Studies of naive theories in science education have identified a number of factors as potential sources of naive theories (Helm, 1980; Arons, 1976; Ivowi, 1984). These include lack of logical reasoning ability, ineffective teaching, poorly constructed textbooks, teachers, instructional television/general television programs, peers, other books, and common language usage.

Champagne and Klopfer (1983) suggest that one source of naive theories is the persistence of conceptions about natural phenomena formed through everyday experiences. Helm (1980) and Ivowi (1984) include everyday experience of the natural world, ineffective teaching, poorly constructed textbooks, and common language usage as contributors to the reinforcement of naive theories. Arons (1981) credits lack of logical reasoning ability as a factor and Ivowi and Oludotun (1987) suggest everyday experience, teachers, instructional television/general television programs, peers, textbooks, and other books as sources contributing to naive theories.

Naive theories about the natural world seem to be highly resistant to change or alteration (Champagne & Klopfer, 1983). The naive theories held by students and the sources of these naive theories need to be identified so that instructional strategies and materials can be developed to minimize their effects on science learning.

This study explores the existence of the naive theories in Astronomy and investigates the sources of these naive theories.

The research questions are: 1) What are 6th grade, 8th grade, and 10th grade students' naive theories about the day/night cycle?; 2) What are 6th grade, 8th grade, and 10th grade students' naive theories about the phases of the Moon?; 3) What are 6th grade, 8th grade, and 10th grade students' naive theories about the change in seasons?; 4) To what sources do Korean students attribute naive theories about the day/night cycle, the phases of Moon, and the change in season?

### 2. Controversy over naive theories terms

Many studies have investigated naive theories, which are a kind of misconceptions, resulting in a variety of new terms since the 1950's. The problem of selecting the most meaningful and useful terms to describe naive theories remains unresolved even after international conferences that have focused upon misconceptions in science and mathematics (Abimbola, 1988). Abimbola (1988) proposes that the different

terminologies for naive theories come from epistemological and philosophical positions, including empiricism and post-empiricism. The empiricist view considers that students' naive theories(misconceptions) are inferior to an expert's concepts and are wrong. Empiricists prefer terminology such as: "erroneous concepts" (Matteson & Kambly, 1940); "misconceptions" or "misunderstandings" (Barrass, 1984; Treagust & Smith, 1989); "mistakes" or "errors" (Barrass, 1984). Barrass (1984) uses the terms "mistakes" or "error", "misconceptions"(misleading ideas) or "misunderstandings" (misinterpretations) of facts in textbooks, saying that biologists should be concerned if textbooks contain mistakes(errors), misconceptions, misunderstandings, or misrepresentation of concepts (p. 201).

On the other hand, the post-empiricist, or constructivist view of misconceptions considers students' naive theories as efforts to make sense of the world through the students' everyday experiences and perspective. Constructivists use terms such as: "naive theories" (Champagne & Klopfer, 1983); "children's conceptions" (Cosgrove & Osborne, 1983); "prior conceptions" (Posner, Strike, Hewson & Gertzog, 1982);" alternative framework"(Driver & Easley, 1978); "alternative conceptions" (Hewson, 1981); "intuitive ideas" (Kim, 1989); and "children's science" (Gilbert, Osborne & Fensham, 1982).

In the case of students' conceptions related to natural phenomena, Champagne and Klopfer (1983) prefer to use the term naive theories. In their paper, "Naive Knowledge and Science Learning", Champagne and Klopfer (1983) mention that

> One of the most striking developments in understanding science learning had been the discovery of the extent and persistence of the naive conceptions about the natural world students bring with them to the classroom. Further investigation revealed that these students' failures were not due to an absence of theories, but rather to the persistence of naive theories that they brought with them to the science class, theories that stand in marked contrast to what students are expected to learn (p. 1).

All persons, young and old, are surrounded by the Earth. The Earth consists of the natural phenomena of rocks, rivers, animals, plants, and solar systems including planets. Meyer (1987) points out that people have their own ideas about the Earth, Sun, Moon, rivers, rain, and other earth science concepts whether they have been formally taught or not.

Accordingly, this study prefers to use the terminology naive theories, which are defined as students' intuitive ideas(thoughts) about natural phenomena through everyday experience, teachers, instructional television/general television programs, peers, textbooks, and other books.

### 3. Open-Ended Written Questions and Interviews

There has been much research on students' conceptions in science education since 1950. One issue which has emerged from this research concerns methodologies for identifying students' conceptions. Three types of research methods have traditionally been used to identify students' conceptions: 1) interviews (Cosgrove & Osborne, 1983; Nussbaum & Novak, 1976); 2) multiple choice tests (Wandersee, 1985); and 3) open-ended written questions (Bar, 1987; Bar & Travis, 1991).

Interviews have been used in many recent investigations of students' science conceptions. Gunstone, White, and Fensham (1988) point out that if we want to know how learners conceptualize the real world of natural phenomena and to investigate how or why individual learners differ in their ideas about the real world of natural phenomena, we need to use interviews. On the other hand, interviews are very time-consuming and require substantial training, and so it is not easy for teachers to identify every individuals' naive theories within large classroom settings (Treagust, 1987).

Multiple choice tests are easy to score at the beginning or upon completion of a specified science topic, so that any science teacher may easily obtain a measure of students' conceptions. One difficulty is to construct an instrument which will detect the many different conceptions that students have about the

natural world. Ridgeway(1988) indicates that students' conceptions vary from student to student and from year to year. Furthermore, multiple choice tests may be less valid because they may be read and interpreted in unintended ways.

Open-ended written questions can be applied to large classroom settings and elicit the variety of unique responses held by students. Bar(1987) suggests the use of open-ended written questions because of this capability. Bar(1987) conducted research comparing the effectiveness of interviews, multiple choice tests, and open-ended written questions for eliciting students' concepts. Bar (1987) found that open-ended written questions elicit responses similar to those of the interviews, while multiple choice tests show significantly different results. Bar and Travis (1991) investigated the effects of the formats of the testing on student responses. Bar and Travis(1991) confirmed that the open-ended written questions elicit responses similar to those of the interviews, but multiple choice tests elicit the different responses.

This study will use an open-ended written question format and an interview format.

## Ⅱ. Methodology

This study consists of 15 Korean students: 5 sixth grade students in one class from one elementary school; 5 eighth grade students in one class from one junior high school; and 5 tenth grade students in one class from one senior high school. These students were randomly selected from each grade. These schools are located in Kongju City, in the northwestern part of South Korea. In this study, the elementary and junior high schools are public schools, and the senior high school is a private school.

One instrument, called Identification of Naive Theories Test in Earth Science(INTTES) was developed for this study. The INTTES includes 3 items: one on the day/night cycle, one on the phases of the moon, and one on the change in seasons. In the INTTES, participants were asked to explain their answers with words and drawings by stating "drawing diagrams" and "explain your answer", and to indicate their sources of knowledge by stating "where did you first learn about this?".

After a lapse of one week, interviews began. The purpose of interviews in this study was to investigate students' naive theories which might be overlooked by the INTTES, clarify the nature of these naive theories, and to validate the INTTES. Interviews were also used to attempt to identify the sources of naive theories. Each interview was based on review of the student's responses to the items on the INTTES. An interview protocol was established. Two drafts of interview protocol were tested on a reference group of 2 seventh-grade students whom the researcher had known personally.

For the data analysis, the key phrases were grouped into the different categories: Scientific Model, Naive Model, or "No" Model. This procedure was based on criteria used by Vosniadou(1989) where each participant's ideas were classified as either Intuitive Model or Scientific (Copernican) Model and Anderson and Smith (1986) where each participant's ideas were classified as either naive propositions or scientific propositions. According to the criteria used by both Vosniadou and Anderson and Smith, the "Scientific Model" refers to student responses that are consistent with scientific theory, the "Naive Model" refers to student responses that are inconsistent with beliefs commonly accepted by scientists, and the "No" Model refers to questions or situations to which students have no respond.

In order to investigate 6th, 8th, and 10th grade students' naive theories(Models) about natural phenomena in Astronomy, the naive theories (Models) were grouped into categories and totals determined.

Sources of naive theories as perceived by the students were categorized as everyday experience, teachers, textbooks, instructional/general television programs, and other books as suggested by Ivowi and Oludotun (1987).

## Ⅲ. RESULTS

1. What are Korean 6th, 8th, and 10th Grade Students' Naive Theories(Models) about the Day/Night Cycle?

Question: It is dark at night and light during the day. What causes the day and night cycle? You can explain the answer to this question using diagrams and words.

Percentages of 6th, 8th, and 10th student responses to the question about the day/night cycle are shown in Table 1. Student responses were categorized into 2 response groups.

Table 1 Numbers of Student Responses to the Question about the Day/Night Cycle by Grade

| Response Group | Grade 6 | 8 | 10 | Remarks |
|---|---|---|---|---|
| 1. The Earth spins once per day and one half of the Earth is lighted | 4 | 5 | 5 | * |
| 2. The Earth revolves around the Sun | 1 | | | ** |

*: Scientific Model **: Naive Model ***: "No" Model

Response group 1, four 6th grade, five 8th grade, and five 10th grade students, believed that the change in the day/night cycle is due to the Earth's rotation. The students in this response group explained that the Earth rotates once per day and one half of the Earth is always lighted (Scientific Model).

Response group 2, consisting of one 6th grade student, stated that the change in the day/night cycle is due to the Earth's revolution. These students explained that when the Earth revolves around the Sun once in a year, on half of the Earth it is day time and on the other half of the Earth it is night (Naive Model). A portion of the interview with one student (6th grade) in response group 2 who claimed that the change in the day/night cycle is due to the Earth's revolution(R:Researcher S:Student) follows:

R: Is it day or night now?
S: Day.
R: Later?
S: Night.
R: What causes day and night?
S: The Earth's revolution.
R: What do you mean by the Earth's revolution. Can you explain this using a diagram?
S: (drawing a diagram). Here is the Sun, the Moon, and the Earth. The Earth revolves around the Sun. (hesitating) The shadow of the Earth.
R: Can you explain this using a diagram again?
S: I am not sure.

2. What are Korean 6th, 8th, and 10th Grade Students' Naive Theories (Models) about the Phases of the Moon?

Question: From one day to the next, the Moon has different phases. Why do the phases of the Moon seem to change? You can explain the answer to this question using diagrams and words.

Percentages of 6th, 8th, and 10th grade student responses to the question about the phases of the Moon are shown in Table 2. Student responses were categorized into 6 response groups.

Table 2 Numbers of Student Responses to the Question about the Phases of the Moon by Grade

| Response Group | Grade 6 | 8 | 10 | Remarks |
|---|---|---|---|---|
| 1. The Moon revolves | 1 | 1 | 2 | * |
| 2. Differences in the sizes of the Earth's shadow | 2 | 1 | 1 | ** |
| 3. Different amounts of light reflected by the Moon | 1 | 1 | 2 | ** |
| 4. The Earth revolves | | 1 | | ** |
| 5. The Earth rotates and revolves | 1 | | | ** |
| 6. I don't know | | 1 | | *** |

*: Scientific Model **: Naive Model ***: "No" Model

Response group 1, consisting of one 6th grade, one 8th grade, and two 10th grade students, believed that the phases of the Moon are due to the Moon's revolution. The students in this response group

answered correctly that the Moon's revolution allows us to see different amounts of the lighted part of the Moon at different times (Scientific Model).

Response group 2 includes two 6th grade, one 8th grade, and one 10th grade students who reasoned that different amounts of the Earth's shadow cause the phases of the Moon at different times (Naive Model). A portion of the interview with one student (6th grade) in response group 2 who claimed that different amounts of the Earth's shadow cause the phases of the Moon at different times(R:Researcher S: Student) follows:

R: Do the phases of the Moon seems to change at night?
S: Yes.
R: What phases of the Moon do you see?
S: (hesitating) a full Moon, a half Moon.....
R: Why do you think that the phases of the Moon seem to change at night? Can you explain this using a diagram?
S: (drawing a diagram). The Moon has phases because of the Earth's shadow.
R: (pointing to the diagram) What is the location of a full Moon and a half Moon with respect to the Earth?
S: (hesitating) If the shadow of the Earth is small, the Moon is a half Moon.
R: Can you explain this again?
S: I am not sure.
R: Why do the phases of the Moon seem to change at night?
S: (hesitating) I am not sure.

Response group 3 includes one 6th grade, one 8th grade, two 10th grade students who mentioned that different amounts of light are reflected by the Moon at different times (Naive Model). A portion of the interview with one student ( 6th grade) in response group 3 who claimed that different amounts of light reflected by the Moon at different times cause the phases of the Moon (R: Researcher S: Student) follows:

R: Do the phases of the Moon seem to change at night?
S: Yes.
R: What phases of the Moon do you see?
S: A full Moon, a half Moon.
R: Why do you think that the phases of the Moon seem to change at night? Can you explain this using a diagram?
S: (drawing a diagram) Here is the Sun, the Earth, and the Moon. As far as I know, the Moon has the ability to reflect light. If the Moon reflects light too much, it is a full Moon...
R: (pointing to the diagram) What is the location of a full Moon with respect to the Earth?
S: Here.
R: And a half Moon?
S: Here
R: You mean that the phases of the Moon result from the different amount of light reflected by the Moon?
S: Yes
R: Where did you first learn this?
S: From teachers and science textbooks.
R: Do you mean teachers or science textbooks?
S: Teachers

Response group 4, which includes one 8th grade students, believed that the phases of the Moon are due to the the Earth's revolution (Naive Model). A portion of the interview with one student (8th grade) in response group 4 who claimed that the Earth's revolution causes the phases of the Moon (R: Researcher S: Student) follows:

R: We see the different phases of the Moon at night?
S: Yes.
R: Did you observe them?
S: Yes.
R: Why do the phases of the Moon seem to change at night?
S: (drawing a diagram and explaining) The Earth revolves around the Sun.
R: Where does the observer stand in your diagram?
S: At the center of the Earth.
R: At the center of the Earth?

S: I am not sure.
R: Are you confused about this question?
S: Yes.

Response group 5, one 6th grade student, believed that the phases of the Moon are due to the the Earth's rotation and revolution (Naive Model). A portion of the interview with one student (6th grade) in response group 5 who claimed that the Earth's rotation and revolution cause the phases of the Moon (R: Researcher S: Student) follows:

R: Do the phases of the Moon seem to change at night?
S: Yes.
R: Can you show me what phases of the Moon you see?
S: (hesitating).
R: I mean, What phases of the Moon do you see?
S: From a full Moon to a half Moon.
R: Why do you think that the phases of the Moon seem to change?
S: (hesitating).
R: Can you explain this using a diagram?
S: (drawing a diagram).
R: (pointing to the diagram) Where is the Sun?
S: Here.
R: (pointing to the diagram) If the Moon stays here, what kind of phase does the Moon have?
S: I am not sure. A full Moon.
R: Where is the observer?
S: Here
R: Why do you think that the phases of the Moon seem to change at night?
S: The Earth rotates and revolves around the Sun.
R: The Earth rotates and revolves around the Sun?
S: Yes
R: Are you sure?
S: I am not sure.

Response group 6 includes one 8th grade student, who did not provide any responses to this question ("No" Model).

3. What are Korean 6th, 8th, and 10th Grade Students' Naive Theories (Models) about the Change in Seasons?

Question: We have summer, autumn, winter, and spring. What causes the change in seasons? You can explain the answer to this question using diagrams and words.

Percentages of 6th, 8th, and 10th grade student responses to the question about the change in seasons are shown in Table 3. Student responses were categorized into 6 response groups.

Table 3 Numbers of Student Responses to the Question about the Change in Seasons by Grade

| Response Group | Grade 6 | 8 | 10 | Remarks |
|---|---|---|---|---|
| 1. The Earth's axis tilts | | | 2 | * |
| 2. The Earth revolves | | 4 | 2 | ** |
| 3 The relative distance between the Sun and the Earth | 1 | 1 | 1 | ** |
| 4. The relative difference in solar radiation | 1 | | | ** |
| 5. The Earth rotates | 1 | | | ** |
| 6. I don't know | 2 | | | *** |

*: Scientific Model **: Naive Model ***: "No" Model

Response group 1 includes two 10th grade students who responded correctly, indicating that the change in seasons is due to the tilt of the Earth's axis (Scientific Model).

Response group 2 includes four 8th grade, and two 10th grade students who believed that the change in seasons is caused by the Earth's revolution (Naive Model). A portion of the interview with one student (10th grade) in response group 2 who claimed that the change in seasons is caused by the Earth's revolution (R: Researcher S: Student) follows:

R: What causes the change in seasons?
S: The Earth revolves around the Sun.
R: Why do you think so?
S: The Earth revolves around the Sun.

R: The Earth revolves around the Sun?
S: Yes.
R: Can you show me that?
S: (The student did not respond).

Response group 3 includes one 6th grade, one 8th grade, and one 10th grade students who believed that the relative distance between the Sun and the Earth causes the change in seasons; that is, if the Earth is closer to the Sun, it is hotter and it is summer, and if the Earth is farther from the Sun, it is cooler and it is winter (Naive Model). A portion of the interview with one student (10th grade) in response group 3 who claimed that the relative distance between the Sun and the Earth causes the change in seasons (R: Researcher S: Student) follows:

R: What kinds of seasons do we have?
S: Spring, summer, autumn, and winter.
R: What season is it?
S: Summer.
R: Summer. Is summer hot?
S: Yes.
R: How about winter?
S: It is very cold.
R: What causes the change in seasons?
S: The Earth revolves once a year around the Sun. The Earth revolves in a circular orbit. If the Earth is closer to the Sun, it is hot. That is summer. If the Earth is farther from the Sun, the Earth is cold. That is winter.
R: You mean that when the Earth is closer to the Sun, the Earth receives more heat, and when the Earth is farther from the Sun, the Earth receives less heat?
S: Yes. I am not sure.
R: Where did you learn first about this?
S: From reference books and textbooks.

Response group 4, two 6th grade students, stated that the change in seasons is due to the relative difference in solar radiation; that is, solar radiation is stronger in summer and it is weaker in winter (Naive Model). A portion of the interview with one student (6th grade) in response group 4 who claimed that the change in seasons is due to the relative difference in solar radiation (R: Researcher, S: Student) follows:

R: We have four seasons; spring, summer, autumn, and winter.
R: What season is it?
S: Summer.
R: After summer?
S: Autumn.
R: What causes the change in seasons?
S: I think that it is the difference in the amounts of solar radiation. In summer, the Earth receives the largest amount of solar radiation. In winter, it receives the smallest amount of solar radiation.
R: What about autumn and spring?
S: The amounts of solar radiation are not less or greater. Just in between.
R: Can you explain this using a diagram?
S: (drawing a diagram) In summer, the Earth receives the largest amount of solar radiation. In winter, it receives the smallest amount of solar radiation.
R: You mean that the change in seasons results from the difference in the amount of solar radiation.
S: Yes.
R: Where did you learn first about this?
S: From science textbooks.

Response group 5 containing one 6th grade student, reasoned that the Earth's rotation causes the change in seasons (Naive Model). A portion of the interview with one student (6th grade) in response group 5 who claimed that the Earth's rotation causes the change in seasons (R: Researcher S: Student) follows:

R: What season is it?
S: Summer.
R: After summer.
S: Autumn.
R: What causes the change in seasons?
S: The Earth's rotation.
R: The Earth's rotation? Can you explain this using a diagram.
S: (drawing a diagram). Here is the Sun. (hesitating)
R: How does the Earth's rotation cause the change in

seasons?
S: I am not sure.

Response group 6 includes two 6th grade student who did not provide any responses to this question ("No" Model).

4. To what Sources do Korean Students attribute Naive Theories (Models) about the Day/Night Cycle, the Phases of Moon, and the Change in Season?

Identification of possible sources of naive theories comes from student responses to the Identification of Naive Theories Test in Earth Science (INTTES) and from interviews. In the INTTES and during the interview, the students were asked to indicate their sources of knowledge (Where did you first learn about this?). After identifying the students' naive theories, their sources of knowledge were categorized as everyday experience, teachers, textbooks, instructional/general television programs, and other books as suggested by Ivowi and Oludotun (1987).

The sources of naive theories as identified by the students are shown in Table 4.

The Table 4 shows that for on the day/night cycle, the source of naive theories identified by the students is teachers (B). For the questions on the phases of the Moon and the change in seasons, the prevalent sources of naive theories are teachers (B) followed by textbooks (C), personal experiences (A), other books (D), and instructional television (E). In summary, the most frequently cited sources are teachers across all the questions.

## IV. DISCUSSION

This study explores the existence of the naive theories in Astronomy and investigates the sources of these naive theories. In Table 4, the most possible source of naive theories in Astronomy is teachers. Sadler (1987) supports these findings in a study on students' naive theories in astronomy, indicating that students overwhelmingly attribute their sources to

**Table 4. Sources of naive theories as identified by students**

| Item No. | Grade | Naive theories | Sources |
|---|---|---|---|
| 1 | 6 | The change in the day/night cycle is due to the Earth's revolution | B |
| 2 | 6 | The phases of the Moon are due to the different amounts of light reflected by the Moon | B |
| 2 | 6 | The phases of the Moon are due to the different sizes of the Earth's shadow | B |
| 2 | 6 | The phases of the Moon are due to the Earth's rotation and revolution | B |
| 2 | 6 | The phases of the Moon are due to the different sizes of the Earth's shadow | B |
| 2 | 8 | The phases of the Moon are due to the different sizes of the Earth's shadow | D |
| 2 | 8 | The phases of the Moon are due to the different amounts of light reflected by the Moon | B |
| 2 | 8 | The phases of the Moon are due to the Earth's revolution | B |
| 2 | 10 | The phases of the Moon are due to the different amounts of light reflected by the Moon | C |
| 2 | 10 | The phases of the Moon are due to the the different amounts of light reflected by the Moon | B |
| 2 | 10 | The phases of the Moon are due to the different sizes of the Earth's shadow | B |
| 3 | 6 | The change in seasons is due to the different amounts of solar radiation | C & E |
| 3 | 6 | The change in seasons is due to the relative distance between the Sun and the Earth | A |
| 3 | 6 | The change in seasons is due to the Earth's rotation | B |
| 3 | 6 | The change in seasons is due to the relative distance between the Sun and the Earth | A |
| 3 | 6 | The change in seasons is due to the different amounts of solar radiation | C |
| 3 | 8 | The change in seasons is due to the Earth's revolution | B |
| 3 | 8 | The change in seasons is due to the relative distance between the Sun and the Earth | B |
| 3 | 8 | The change in seasons is due to the Earth's revolution | B |
| 3 | 8 | The change in seasons is due to the Earth's revolution | B |
| 3 | 8 | The change in seasons is due to the Earth's revolution | B |
| 3 | 10 | The change in seasons is due to the relative distance between the Sun and the Earth | B & C |
| 3 | 10 | The change in seasons is due to the Earth's revolution | B |
| 3 | 10 | The change in seasons is due to the Earth's revolution | B |

A: personal experiences B: teachers C: textbooks
D: other books E: instructional television

their teachers. Preservice elementary teachers have been found to hold naive theories about conceptions of heat transfer and temperature (Tilgner, 1990). Generally, teachers who hold naive theories in science are not able to recognize the naive theories held by their students. Tilgner(1990) suggests that alternative methods should be used in teaching science to future science teachers. The methods especially include making them aware of their current conceptions before instruction.

The second source of naive theories is textbooks. Textbooks are materials and resources from which students construct knowledge. Textbooks are considered one of the most important sources in the construction of students' knowledge. This is consistent with the findings of this study, that some students attributed the sources of their knowledge to textbooks. Cho, Kahle, and Nordland (1985) claim that textbooks may be a source of naive theories. In light of this importance, Korean science textbook publishers and curriculum developers should consider ways to overcome students' naive theories. Taking a close look at the sequence of the Korean textbooks (Ministry of Education, 1989a.b.c), topics investigated in this study are unconnected in the elementary, junior, and high school level. This topical, unconnected sequence may contribute naive theories. In connection with this, the researcher suggests that in the elementary Korean science textbook (Integrated Science Textbook, 1988a), the day/night cycle concept in the 2nd grade, the phases of the Moon in the 5th grade, and changes in seasons concept in the 6th grade should be placed in one unit or at least connected systematically.

In a Korean senior high textbook (Separate Earth Science Textbook, 1988c, p. 174), the elliptical diagram of the Earth's orbit around the Sun, which is used to illustrate Kepler's second law, is possibly contributing to students' naive theories related to the change in seasons because the diagram depicts the distance between the Earth and Sun as variable. Korean curriculum developers should consider these kinds of naive theories and then make changes to attempt to move students from a Naive Model to a Scientific Model.

The other sources of naive theories are personal experiences (A), other books (D), and instructional television (E). These findings are supported by Champagne and Klopfer (1983) who stated that naive theories come from the students' everyday experience and observations. Also, Sadler (1983) indicated that these naive theories are reinforced by trade books. Some Korean trade books often show the incorrect scale size and distance of models of the Earth, Moon, Sun, and planets. Other trade books are emphasized on eclipse of the Earth, Moon, Sun, and planets. This eclipse may also contributes to students' naive theories related to the change in seasons because the eclipse depicts the distance between the Earth and Sun.

## V. CONCLUSUION

This study identifies the sources of naive theories in Astronomy and explores the existence of the naive theories. The prevalent sources of naive theories are teachers (B) followed by textbooks (C), personal experiences (A), other books (D), and instructional television (E). These findings suggest that teachers should keep in mind making them aware of their current conceptions before instruction. This study also finds that a higher percentage of students holds naive theories for questions on the phases of the Moon and the change in seasons.

## REFERENCES

Abimbola, I. O. (1988). The problem of terminology in the study of student conceptions in science. Science Education, 72(2), 175- 184.

Anderson, C. W., & Smith, E. L. (1986). Children's conceptions of light and color: Understanding the role of unseen rays. (Research Series No. 166). East Lansing: Michigan State University, Institute for Research on Teaching.

Arons, A. (1981, March). Thinking, reasoning and understanding in introductory physics courses. The Physics Teacher, pp. 166-172.

Ausubel, D. P. (1968). Educational psychology: A cognitive view. New York: Holt, Rinehart and Winston.

Bar, V. (1987). The effect of the testing format on the distribution of results. In Novak, J. D. (ed.), Proceeding of the Second International Seminar on Misconceptions and Educational Strategies in Science and Mathematics, Volume I (pp. 26-31). Ithaca, NY: Cornell University, New York.

Bar, V., & Travis, A. (1991). Children's views concerning phase changes. Journal of Research in Science Teaching, 28(4), 363-382.

Barrass, R. (1984). Some misconceptions and misunderstandings perpetuated by teachers and textbooks of biology. Journal of Biological Education, 18(3), 201-205.

Brumby, M. (1979). Problems in learning the concept of natural selection. Journal of Biological Education, 13(2), 119-122.

Champagne, A. B. , & Klopfer, L. E. (1983). Naive theories and science learning. Paper presented at the annual meeting of the American Association of Physics Teachers, New York. (ERIC Document Reproduction Service No. ED 225 825).

Cho, H., Kahle, J. B., & Nordland, F. H. (1985). An investigation of high school biology textbooks as sources of misconceptions and difficulties in genetics and some suggestions for teaching genetics. Science Education, 69(5), 707-719.

Cosgrove, M. M., & Osborne, R. J. (1983). Children's conceptions of changes of state of water. Journal of Research in Science Teaching, 20(9), 825-838.

Driver, R., & Easley, J. (1978). Pupils and paradigms: A review of literature related to concept development in adolescent science students. Studies in Science Education, 5, 61-84.

Gilbert, J. K., Osborne, R. J., & Fensham, P. J. (1982). Children's science and its consequences for teaching. Science Education, 66(4), 623-633.

Gunstone, R. F., White, R. T., & Fensham, P. J. (1988). Developments in style and purpose of research on the learning of science. Journal of Research in Science Teaching, 25(7), 513-530.

Helm, H. (1980). Misconceptions in physics amongst South African students. Physics Education, 15(2), 92-97.

Hewson, P. W. (1981). A conceptual change approach to learning science. European Journal of Science Education, 3(4), 383-396.

Ivowi, U. M. O. (1984). Misconceptions in physics amongst Nigerian secondary school students. Physics Education, 19(6), 279-285.

Ivowi, U. M. O., & Oludotun, J. S. O. (1987). An investigation of sources of misconceptions in physics. Proceedings of the Second International Seminar Misconceptions and Educational Strategies in Science and Mathematics. Ithaca, NY: Cornell University. (ERIC Document Reproduction Service No. ED 293 686).

Kim, C. (1989). Students' intuitive ideas about "water in the atmosphere": A cross age study. Unpublished, doctoral dissertation, The University of Texas at Austin.

Matteson, H. D., & Kambly, P. E. (1940). Knowledge of science possessed by pupils entering seventh grade. School Science and Mathematics, 40(346), 244-247.

Meyer, W. B. (1987). Vernacular American theories of earth science. Journal of Geological Education, 35(4), 193-196.

Ministry of Education. (1988a). Science for Elementary School, Seoul: Ministry of Education, Korea.

Ministry of Education. (1988b). Science for Junior High School, Seoul: Ministry of Education, Korea.

Ministry of Education. (1988c). Science for Senior High School, Seoul: Keumsung, Korea.

Nussbaum, J., & Novak, J. D. (1976). An assessment of children's concepts of the earth utilizing structured interviews. Science Education,

60(4), 535-550.

Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. Science Education, 66(2), 211-227.

Ridgeway, D. (1988). Misconceptions and the qualitative method. The Science Teacher, 55(6), 68-71.

Sadler, P. M. (1987). Misconceptions in astronomy. Proceedings of the Second International Seminar on Misconceptions and Educational Strategies in Science and Mathematics, Volume III (pp. 422-425). Ithaca, NY: Cornell University.

Tilgner, P. J. (1990). A qualitative analysis of preservice elementary teachers' conceptions of heat transfer and temperature. Unpublished, doctoral dissertation, University of Nebraska.

Treagust, D. F. (1987). An approach for helping students and teachers diagnose misconceptions in specific science content areas. In J. D. Novak (Ed. ), Proceedings of the Second International Seminar Misconceptions and Educational Strategies in Science and Mathematics. Ithaca, NY: Cornell University. (ERIC Document Reproduction Service No. ED 293 686).

Treagust, D. F., & Smith, C. L. (1989). Secondary students' understanding of gravity and the motion of planets. School Science and Mathematics, 89(5), 380-391.

Vosniadou, S. (1989). Knowledge acquisition in observational astronomy (Technical Report No. 468). (ERIC Document Processing Service No. ED 316 408).

Wandersee, J. H. (1985). Can the history of science help science educators anticipate students' misconceptions? Journal of Research in Science Teaching, 23(7), 581-597.

(국문요약)

# 천문학적 현상의 유년적 사고 근원에 관한 연구

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1980년 이래로 자연현상에 관한 유년적 사고에 관한 연구가 국내,외에 활발히 보고되어 왔지만, 그 근원에 관한 연구는 다소 소홀히 다루어져 왔다.

본 연구는 천문학에 관한 학생들의 유년적 사고와 그 사고의 근원을 조사한 것이다. 이의 대상은 국민학교 6학년 5명, 중학교 2학년 5명, 고등학교 1학년 5명으로 하였다. 연구방법으로는 질문지법(Open-ended Written Questions)과 면접법(Interview)을 이용하였다.

이 연구에서는 계절 변화, 달 위상 변화의 원인에 관하여, 국민학생에서 고등학생에 이르기까지 대다수의 학생들이 유년적 사고를 지니고 있는 것으로 밝혀졌고, 이들 유년적 사고의 근원으로는 '학교 교사'와 '교과서'라고 대답하는 학생이 대부분으로 나타났다.