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The effect of the conceptual change oriented instruction through cooperative learning on 4th grade students' understanding of earth and sky concepts

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Abstract
The purpose of this study was to compare the effectiveness of the conceptual change oriented instruction through cooperative learning (CCICL) and traditional science instruction (TI) on 4th grade students' understanding of earth and sky concepts and their attitudes toward earth and sky concepts. In this study, 56 fourth grade students from the same elementary school took part. This study included two groups which were taught by the same teacher and selected from six general science classes according to their equality – based characteristics such as size, gender, and the frequency distribution in the analysis of their pre-test results. One of the classes was assigned to the experimental group, which was exposed to conceptual change oriented instruction through cooperative learning; the other class was assigned to the control group, which was exposed to traditional science instruction over a period of eight weeks. In order to determine the effect of the study on dependent variables, achievement related to earth and science concepts was measured with an Earth and Sky Concepts Test and their attitude toward earth and sky concepts was measured with an Attitude Scale Toward Earth and Sky Concepts. The results showed that students who used conceptual change oriented instruction through cooperative learning had a significantly better acquisition of earth and sky concepts than the students who received traditional science instruction. Also, the results indicated that there was no significant difference between post-test mean scores of students taught with CCICL and those taught with TI with respect to their attitude toward earth and sky concepts.
Keywords: Misconception, Conceptual Change Text, Earth and Sky Concepts, Conceptual Change Approach, Cooperative Learning.

Introduction

Before receiving formal education, children have been shown to construct their own ideas and meanings for the natural events they observe (Anderson, 1986). Therefore, children's explanations and ideas about the natural world are commonly different from the views of scientists; students come to school classrooms with their own understanding of the world (Driver, Guesne & Tiberghien, 1985). In literature these different conceptions of students have been called "preconceptions" (Clement, 1982; Garnett & Treagust, 1992), "misconceptions" (Eryilmaz, 2002; Fisher, 1985; Helm, 1980; Marques & Thompson, 1997), "naive or intuitive ideas" (McCloskey, 1983; Osborne & Freyberg, 1985), "alternative frameworks" (Driver & Erickson, 1983), or "alternative conceptions" (Gilbert & Watts, 1983; Lin & Cheng, 2000). While taking into consideration that students' conceptions are formed before receiving formal instruction in class, this paper will use the term "misconception."

There is an extensive literature that students come to class with prior conceptions which are commonly different from the scientific facts, which influence further learning and which may be resistant to change. Misconceptions imply mistaken answers students give when confronted with a particular situation when their knowledge about how the world works differs from that of a scientist. After a student integrates misconceptions into his or her cognitive structure, these misconceptions interfere with subsequent learning (Nakhleh, 1992). The student is then left to connect new information into a cognitive structure that already holds inappropriate knowledge. Thus, the new information cannot be connected to his/her cognitive structure and misunderstanding of this new concept occurs. Across all areas of science and within all age groups misconceptions appear (Gomez, 2008). Empirical evidence has shown that children have qualitative differences in their understanding of science that is often inconsistent with what the teacher intended through instruction (Bar, 1989; Bar, Zinn, Goldmuntz & Sneider, 1994; Pine, Messer & John, 2001; Tao & Gunstone, 1999; Trend, 2001). Moreover, research findings show that misconceptions are deeply rooted and even after instruction misconceptions often remain (Eryilmaz, 2002).

Misconceptions and misunderstandings about a concept are not similar to each other; misconceptions are more than a misunderstanding about a concept. Misconceptions are part of a larger knowledge system that involves many interrelated concepts that students use to make sense of their experiences (Southerland, Abrams, Cummins & Anzelmo, 2001). Thus, since misconceptions are often integrated with other knowledge, they may include aspects of both expert and novice understandings and may be useful in constructing accurate scientific understandings. An important goal of science education is to help students develop an understanding of concepts and use them when solving a problem in a new situation. A major obstacle to solving science problems is the lack of understanding of science concepts (Osborne & Wittrock, 1983).

In recent years, many studies of students' conceptions of natural phenomena have been carried out in different disciplines, in different countries and at all educational levels from elementary school to college graduates. Their occurrence is widespread. Students of a wide range of ages, abilities, grade levels, and nationalities have been shown to hold alternative conceptions in most content areas in science (e.g. Bou Jaoude, 1991; Çetingül & Geban, 2005; Haidar & Abraham, 1991; Mayer, 2011). One of the areas in which misconceptions of students can easily be seen is linked to astronomy phenomena (e.g. Miller & Brewer, 2010; Mohapatra, 1991).

The study of the behavior of astronomy concepts has been a traditional part of elementary school science courses. These concepts are often seen as problematic by students, because astronomy is an abstract subject area that is not easy to understand and even pre-service teachers (Dai & Capie, 1990; Kalkan & Kıroğlu, 2007; Trumper, 2001), and university students (Trumper, 2000) hold misconceptions related to astronomy concepts. A number of suggestions have been put forward to explain why students encounter difficulty explaining astronomical events. A common problem is one of reconciling everyday experiences, such as observing the rising and setting sun, with abstract models which attempt to explain why this occurs (Vosniadou, 1991). Another widespread difficulty is that of interpreting two-dimensional diagrams which attempt to represent three-dimensional space (Parker & Heywood, 1998). Misleading diagrams also can encourage alternative views (Ojala, 1997). Similarly, books where text and diagrams do not correspond may be a source of confusion (Vosniadou, 1991). And finally, ambiguous terminology may also cause difficulties (Parker & Heywood, 1998). Students' misconceptions related to earth, sun, moon and solar system reported in Baxter's (1989) and Sharp et al.'s (1999) studies are summarized in Table 1.

Table 1. Students' Misconceptions of Earth and Sky Concepts

Earth and sky concepts	Misconceptions
Earth	Earth shaped more like a saucer. The shape of the earth is sphere and people only live on upper half. The shape of the earth is sphere and people live all over the surface.
Day and night	Night occurs because sun goes behind hill. Night occurs because clouds cover the sun. Night occurs because moon covers the sun. Night occurs because sun goes around the earth once a day. Night occurs because earth goes around the sun once a day.
Earth and sky concepts	Misconceptions
The phases of the moon	The moon has different phases because clouds cover part of the moon. The moon has different phases because planets cast a shadow on the moon. The moon has different phases because the shadow of the sun falls on the moon. The moon has different phases because the shadow of the earth falls on the moon.
The Seasons	In winter the weather is cold because cold planets take heat from sun. In winter the weather is cold because heavy winter clouds stop heat from the sun. In winter the weather is cold because sun is further away from the earth in the winter. In winter the weather is cold because sun moves to the other side of the Earth to give them their summer. Changes in the plants cause the season.

Students' misconceptions in science are often resistant to change (Fisher, 1985). The construction of meaning by learners requires that they actively seek with knowledge already in their cognitive structure (Novak, 2002). Meaningful learning involves students in constructing integrated knowledge structures, which contain their prior knowledge, experiences and new concepts (Tsai, 2000). Constructivism stresses the role of prior knowledge in learning. Students interpret tasks and instructional activities involving new concepts in terms of their prior knowledge. Constructivism assumes that humans are knowing, active, purposive, adaptive, self-aware beings whose knowledge and purposes have consequences for their actions (Von Glasersfeld, 1993). They construct their own knowledge by using their existing knowledge. Even when information is explicitly presented by teachers or textbooks, meaningful knowledge acquisition involves interpretation and integration guided by the learners' own prior knowledge. The constructivist perspective leads to an interpretation of many of the observed regularities and consistencies in students' responses as misconceptions which students hold about the natural world and how it works (Champagne, Klopfer & Anderson, 1980).

Several teaching approaches or strategies such as the conceptual change (Posner at al., 1982) are based on the constructivist view of learning. These were developed to overcome students' misconceptions in science education. The conceptual change model claims that learning is a process of personal construction of knowledge (Cobern, 1996). Posner, Strike, Hewson, and Gerzog (1982) stated that four conditions are necessary: (1) There must be dissatisfaction with existing conceptions. The individual must first encounter difficulties with an existing conception to consider a new one. (2) A new conception must be intelligible. Intelligibility requires constructing a coherent representation of a theory or a passage. When the student can construct a meaningful representation of a theory, it can become a tool of thought. (3) A new conception must be plausible. A new conception must have the capacity to solve the problems generated by its predecessors. (4) A new concept must be fruitful. It must have potential to open up new areas of inquiry. It leads to new insights and discoveries. Therefore, teachers should develop strategies to create cognitive conflict in students, organize instruction to diagnose errors in students' thinking, and help students translate from one mode of representation to another.

In this study, teaching strategies based on a conceptual change approach, such as assigning conceptual change texts to read, discussing the texts through questions, scientifically correct explanations of concepts in the context of prediction questions and applying the correct conception in different settings, were constructed so that they were directed towards the building of conceptual change. The instruction using these strategies enabled students to change their mental models. The instruction identified students' ideas and views, created opportunities for students to explore their ideas, provided stimuli for students to develop, modify, and change their ideas and views. In addition, concept map activities allowed students to organize their learning by constructing interrelationships among concepts, which enhance meaningful learning. Therefore, concept map activities provided evidence for a conceptual change.

There is continued interest in improving learning activities in science education. In the present study, conceptual change oriented instruction through cooperative learning was used to provide an alternative for teaching science concepts in the classroom.

Sample

The participants of this study were enrolled in a general science course in an urban elementary school. In this school, there were 6 fourth grade classes, and a total of 339 fourth grade students. Most of the students' socio- economic status, including the educational level of their parents and their family income were in the middle-range. Furthermore, the ages of the students ranged from 10 to 11. The participating students were placed in two classes and instructed by the same teacher. The two instruction methods used in this study were randomly assigned to each group. Both the experimental group who received CCICL and the control group who received TI consisted of 28 students. All of the 56 fourth grade students, 26 boys and 30 girls, returned signed parental consent forms for participation in this study.

Instruments

Instruments used in this study were: Earth and Sky Concepts Test (ESCT); Attitude Scale toward Earth and Sky Concepts (ASTES) and Reading Comprehension Skills Test (RCST).

Earth and Sky Concepts Test (ESCT)

The ESCT consisted of 15 multiple choice questions, five of which were taken from the literature (Baxter, 1989) and the rest developed by the researcher. There were four alternatives for each multiple-choice question in the test. These items were related to basic earth and sky concepts: Day and night, seasons, moon's phases, and earth, moon and sun as three celestial bodies.

These questions were developed from the literature related to students' misconceptions with respect to earth and sky (Baxter, 1989) and a set of pilot interviews with classroom teachers to determine their observations about topics in which their students had difficulty and about examination results and students' misconceptions. See Table 2 for an example of one of these items.

Table 2. The Question Sample of Earth and Sky Concept Test

In Turkey, the period of night is longer than the period of day in winter, and this is opposite in summer. Which one of the following is the reason for this fact?
a) The earth is spherical.
b) The earth rotates on its own axis.
c) The earth has a rotating axis.
d) The rotating axis of the earth is not perpendicular to the orbital plane.

The pilot of the Earth and Sky Concepts Test (ESCT) was trialed on 4th grade students, who were not students in either the experimental or control group. The reliability of the test was found to be 0.812. For every item in the test, the distracters were prepared based on the students' misconceptions about earth and sky. The classification of these misconceptions in the test is given in Table 3. Findings after the analysis of the students' responses, show results from this study were in agreement with the research literature (Baxter, 1989; Sharp, Bowker, Mooney, Grace & Jeans, 1999) in terms of students' misconceptions of astronomy concepts.

Attitude Scale toward Earth and Sky Concepts (ASTES)

The ASTES scale was developed by the researchers and was prepared so as to identify to what extent and specifically to which concepts students indicated an interest. This was given to both groups as a post-test to support the measurement of the effectiveness of each instructional method. The scale consisted of 17 items, five of which were in the first part, seven in the second part and five in the third part. In the first part, sentences based on students' earth and sky observations were prepared. In the second part, questions were included to determine students' interest in earth and sky concepts. In the third part, students' opinions about the earth and sky concepts were determined. The piloting of the ASTES was undertaken with 4th grade students. The reliability of the test was found to be 0.72.

Table 3. Misconceptions about Earth and Sky in ESCT

Misconceptions
Axis
The shape of the earth is geode because the earth has an axis or this axis has an angle to the plane of the orbit
In every part of the earth, day or night do not occur at the same time because the earth has an axis and this axis makes an angle with the plane of the orbit
In Turkey, night time is longer than day time in winter and vice versa in summer because the earth moves around its axis, or has an axis
If the earth's axis were perpendicular to the orbit, the earth could not move around the sun, or there would be no day and night
Properties of the Sun
The sun is a star because it is so far from the earth, or the planets move around the sun, or it is bigger than the planets and satellites
The earth is greater than the sun
The moon is greater than the sun
Orientation
From the earth, always the same face of the moon is seen because the moon together with the earth moves around the sun, or the moon moves around itself, or the moon moves around the earth
The earth always sees the same face of the moon. When this face does not take any light from the sun to

reflect to the earth, the resulting phase is called whole moon, or it is called first quarter, or it is called last quarter
In every part of the earth, day or night do not occur at the same time because the earth is far away from the sun
The moon is not seen in the sky every time, because it may send its own light to other places instead of earth, or it cannot show its own light to the earth when it enters through the clouds, or the sun may cover the moon
The moon has different phases because while moving the shadow of a planet, or the earth prevents the reflection of light from the moon to the earth, or the sun moves the moon and covers it
The moon has different phases because the sun moves toward the moon and covers it

Geography
The earth is not spherical, but planar
The line thought to pass through the poles of the earth is called the equator, or it is called semi-sphere, or it is called orbit
The line followed by the earth during its movement around the sun is called the equator, or is called the axis, or is called the pole

Night
In Turkey, night time is longer than day time in winter, and vice versa in summer because the earth moves around its axis, or the earth has an axis, or the earth is spherical
Night occurs because the movement of the moon is towards the sun and it covers the sun, or the sun moves around the earth

Seasons
In winter the weather is cold because in winter cold planets take the heat coming from the sun, or the distance between the earth and the sun is getting longer, or the sun moves around the earth

Reading Comprehension Skills Test (RCST)

This test was originally developed by Müjgan Özçelikel, who is a teacher at the same elementary school in which this study was conducted. It consists of 20 multiple-choice items witht each item measuring to what extent 4th grade students comprehend what they read and what they understood to be the main idea. The reason for administering the RCST is to determine whether there is a correlation between students' reading comprehension skills and their understanding of earth and sky concepts. The test was given to both groups after the study. The reliability of this test was found to be 0.83.

The Study

This study was conducted over 8 weeks. As stated, 56 fourth grade students in two science classes with the same teacher volunteered to be in the study. There were two groups in the study. The experimental group was instructed by conceptual change oriented instruction through cooperative learning while the control group was instructed by traditional science instruction. During the study, the earth and sky topics were covered as part of the regular classroom curriculum in their general science course. The classroom instruction was for three 40-minute sessions per week.

Prior to the study, the Earth and Sky Concept Test (ESCT) and the Attitude Scale toward Earth and Sky Concepts (ASTES) were administered to both the experimental and the control groups. One hour of class was utilized for each administration. The concepts studied were: (1) The earth concept which includes the shape of the earth, the rotating motions of the earth, day and night, and seasons; and (2) the sky concept which includes the phases of the moon, and the relative sizes of moon, earth and sun.

In the traditional science instruction, the teacher used lecture and discussion methods. The concepts in both parts (earth and sky) were covered in six traditional texts, four of which were related to earth concepts and two of which were related to sky concepts. These texts were selected from the science textbook chosen by the school. The teacher gave each text to the students at the beginning of the class hour. She asked the students to read the text silently and then after reading, she started her lecture. The students were instructed with respect to teaching strategies that relied on the teacher's explanation and texts. The main underlying principle was that it was the teacher's responsibility to transfer the necessary knowledge to the students. After the teacher's explanations of the concepts, a discussion was directed by the teacher's questions.

In the conceptual change oriented instruction through cooperative learning, which the experimental group received, six conceptual change texts were given to the students, which included earth and sky concepts similar to those in the traditional texts. Conceptual change texts were designed to make the students aware of the inadequacy of their intuitive ideas. In the conceptual change texts, students were asked explicitly to predict what would happen in a situation before being presented with information that demonstrates the inconsistency between common misconceptions and the scientific conceptions. These texts activated students' misconceptions by presenting evidence and simple qualitative examples that challenged the misconceptions used to make a prediction about the situation. The students' misconceptions were also challenged by dis-equilibrating their preconceptions with scientific phenomena through questions. Then, the text presented evidence that illustrated how each of the common misconceptions would lead to an incorrect prediction. These texts facilitated conceptual conflict, meaning students became dissatisfied with their existing conceptions. These texts provided evidence that students' existing knowledge was insufficient and only supported partial understanding. The explanatory phase involved an explanation of the scientifically correct concept in the content of evidence or prediction questions. Moreover, examples and figures were used in order to help students reach a more acceptable scientific explanation of the concepts. The final phase provided opportunities to apply the correct conception in different settings. The students, in small groups, discussed the statements in the text with each other. Also, the teacher discussed the statements in the text with the whole class.

Conceptual change texts were given to the students at the beginning of the lesson. All lessons were given to the experimental group in the science laboratory. There were six five-member groups of students and each group sat around pentagon shaped tables. Each group gave a name to itself and there was a different group leader responsible for coordinating his or her group each class hour. Before the instruction, the teacher gave a brief information session about how this study would be carried out, defined misconceptions and gave simple examples about some misconceptions. Group leaders distributed conceptual change texts to the students in their own group. All students read the text silently for five minutes. After reading, the teacher asked the group leaders to list misconceptions in the text and write down the misconceptions of their group members. Then the group leaders gave the misconception lists to the teacher and the teacher recorded the misconceptions highlighted by all groups on the chalkboard. The teacher told the groups that they would perform an activity related to the concepts to be learnt. She wrote new vocabulary and the title of the activity on the chalkboard and asked the students to write them down their notebooks. Then the teacher explained how the groups would carry out the activity. This activity could be an experiment, a game, or a drama, which was designed to encourage the students to be aware of their misconceptions. Group leaders then organized their own group and started the activity. These activities lasted approximately 10 minutes. After all groups had finished, the teacher asked some questions about the aim of the activity and what they learned.

A variety of activities were part of the experimental group, for example the "day and night" activity which used materials like the earth map, the earth model and a light source along with instructional methods of drama, a game and question-answer. In this activity, the teacher asks the students in peer groups to think of themselves as people living on earth. Groups held their hands together while turning their backs and formed a circle facing outwards. Students were asked to sing a song. While they were singing and walking round in a circle, the teacher turned the light source on and held it towards the students. When the teacher tells them to stop, the students stop and answer the questions such as: "Who is waking now?", "Who is having his/her lunch now?", "Who is going to bed now?" The game continued until the circle completed one rotation around itself. After the completion of the rotation, the teacher asked: "How long does the earth take to complete its rotation?"

Conceptual change oriented instruction through cooperative learning was supported with concept maps after all the texts were studied. The teacher told the students what a concept map was and described the construction of it using an exemplar concept map. Then the teacher reviewed the concepts covered in the classes to all groups and asked them to construct their own maps.

Results

The pre-test results showed that there was no significant difference between the conceptual change oriented instruction through cooperative (CCICL) group and the traditional science instruction (TI) group in terms of earth and sky concept achievement ($t=1.164$, $p>0.05$); their attitudes toward earth and sky concepts as a school subject ($t=1.204$, $p>0.05$); and their reading comprehension skills ($t=1.855$, $p>0.05$).

ANCOVA was used to determine the effect of type of instruction and gender differences on students' understanding of sky and earth concepts after instruction while students' reading comprehension skills were taken as a covariate. The results showed that there was a significant difference between the post-test mean scores of the students taught by CCICL and those taught by TI with respect to understanding of sky and earth concepts when reading comprehension skills was controlled. ($F=6.04$, $p<0.05$). The CCICL group scored significantly higher than the TI group ($\overline{x}_{(CCICL)}=9.65$, $\overline{x}_{(TI)}=8.17$). The proportions of correct responses and misconceptions were examined by using item analysis for the experimental and control group. For example, one of the items related to the earth's shape. In this item students were asked to distinguish the drawings which represent the shape of earth, the place of people living on earth, the place of clouds and the way that rain falls from the clouds as realistic as possible. Before the study, 57% of students of both groups had the misconception that, "the earth is flat." After the study only 26% of the CCICL group held this misconception while it only decreased to 50% in the control group. Another item which reflected the striking difference between students in the two groups related to the reason for the occurrence of day and night. In this item, students were asked to distinguish the drawing which represented how night occurs as realistic as possible. Before the study, 60.7% of students in the experimental group had the misconception that "day and night occurs because the sun turns around the earth," and 64.2% of students in the control group held the same misconception. After the study 33.3% of students in the experimental group retained this misconception, compared to 53.5% of students in the TI group.

The results seem to indicate that there is no significant post-test mean difference between male and female students in terms of understanding earth and sky concepts ($F=1.67$, $p>0.05$). There was no significant interaction effect between gender difference and the study on students' understanding of earth and sky concepts ($F=3.65$, $p>0.05$). On the other hand, reading comprehension skills were a statistically significant predictor for understanding earth and sky concepts ($F=11.03$, $p<0.05$). t-test result showed that there was no significant difference between post-test mean scores of the students taught with CCICL and those taught with TI with respect to their attitudes toward earth and sky concepts as a school subject ($t=0.85$, $p>0.05$).

Participant Interviews

In this study student interviews were used in order to gather information about the misconceptions of 4th grade students on earth and sky concepts. The interviews were conducted with eight 4th grade students, four of whom were from the experimental groups and four from the control group. Students 1, 2, 3, and 4 were selected from the experimental group and students 5, 6, 7 and 8 were selected from the control group.

Interview questions were prepared in the light of the related literature about students' misconceptions on earth and sky concepts. Interviews consisted of the following areas: (1) the shape of the earth, (2) day and night, (3) seasons, and (4) the moon's phases. All interview data was recorded on audiotape and was used to support the comparison of the effectiveness of conceptual change approach versus traditional approach by taking into account students' reasoning on target concepts. There were 8 interview questions asked to the students and one of the interview exchanges is summarized below as an example.

How do students explain the reason for the occurrence of day and night?
Interviewer: Can you explain the reason for the occurrence of day and night?
Student 1, Student 2: The earth's movement around the sun leads to the occurrence of day and night.
Student 3, Student 4: We know that it moves around the sun. During this movement, the places toward the sun take the sun light. That is why in these places day occurs. In the places where the sun light is not reached, night occurs.
Student 5: When sun moves around the earth, day and night occur.
Student 6: The shape of the earth is like a circle. That is why day occurs in the places towards the sun.
Student 7, Student 8: I think that when the moon covers the sun, night occurs. When the moon does not cover the sun, day occurs.
The answers of Students 3 and 4 can be classified as a correct scientific explanation. The answers of Students 1, 2, 5, 6, 7, and 8 correspond to alternative explanations.

Discussion and Implications

After the instruction, the average percentage of correct responses by theCCICL group was 73% while that of the TI group was 62%. The results indicate that CCICL led to better understanding by the participating students of the earth and sky concepts than TI. The conceptual change instruction allowed the students to process information actively. Learning is an active process, therefore learners need to process information actively to comprehend it. The conceptual change texts were written in order to cause students to consider their knowledge and scientific knowledge; that is to create conceptual conflict necessary for conceptual change (Posner et al., 1982). They activated students' prior knowledge and refuted misconceptions. The conceptual change texts, which consider students' misconceptions, were used as a way of conceptual change to promote the acquisition of new conceptions as a consequence of the exchange and differentiation of the existing concepts and the integration of new concepts with existing conceptions. Reading the text and then discussing in their groups allowed the students to revise their knowledge. There is growing evidence that students who talk through the material with peers learn in a more effective way because students who work in cooperative relationships are more likely to have a conscious strategy about how they got to the answer (ref). The students in the experimental group were involved in activities in small groups such as the discussion of descriptive evidence presented in statements and qualitative questions provided by the researchers. The discussion of the concepts could facilitate students' understanding as well as encourage their conceptual restricting. This type of instruction appears to provide students opportunities for greater involvement.

In the concept map application, the students who could not construct appropriate links realized the gap in their understanding. The students in the experimental group were involved in activities supporting the conceptual change approach, were encouraged to discuss the results of the activities and were provided opportunities to summarize their conceptual understanding by constructing concept maps. The conceptual change approach provided special learning environments such as identifying common misconception about the sky and the earth, activating students' misconceptions by presenting simple qualitative examples, presenting descriptive evidence in the text that the typical misconceptions were incorrect, providing a scientific explanation of the situation, and providing students the opportunity to practice the correct explanation by utilizing questions.

As reported in the research literature, there is a significant relationship between reading comprehension and science achievement. Reading comprehension is strongly associated with academic achievement, including science achievement (Cromley, 2009; Cromley, Synder-Hogan & Luciw-Dubas, 2010). This study concurred that reading comprehension was a significant predictor of understanding of earth and sky concepts. Texts were required to be read and hence students' reading comprehension played an important role in understanding these texts.

Well-designed conceptual change texts used in cooperative learning help to increase students' achievement in science. This may occur because students using these techniques have active and reinforced practice. To be most effective, it appears that these activities should be integrated with curriculum objectives. Teachers should be informed about the usage and importance of conceptual change oriented instruction. The course content should be designed in such a way that teachers are able to spend more time on developing instructional methods to dispel students' misconception. Curriculum designs based on conceptual change approach can be used for meaningful understanding of the concepts by taking students' preconceptions into consideration. For meaningful learning to occur, it appears to be better to include questions on topics that explicitly probe for misconceptions. In this way, teachers can be better aware of students' conceptions. Reading comprehension skills is a strong predictor of science achievement. The use of language determines students' understanding of what they read and this affects their science achievement. For that reason, students should be given exercises on developing their reading comprehension skills.

Limitations of the study

1. Number of students involved in the study
2. Number of teachers involved.

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