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THE ACTIVITIES BASED ON CONCEPTUAL CHANGE STRATEGIES PREPARED BY SCIENCE TEACHER CANDIDATES

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Abstract

One of the main objectives of science education is to make students learn concepts meaningfully. It is known that students have some difficulties in understanding some concepts and they usually have misconceptions. In order to make meaningful learning possible, these misconceptions should be removed. Conceptual change strategies can be used for removing students' misconceptions in science education. Primary school science education is of great importance for meaningful science learning. Provided that science teachers teach scientific concepts correctly, students can be expected to learn meaningfully. Because of this, science teacher candidates should learn conceptual change strategies and how to apply them. This study contains science teacher candidates' activities related to conceptual change strategies, such as; conceptual change texts, analogies, models and concept cartoons. The study was conducted in 2009-2010 academic year, at Dokuz Eylül University, Buca Education Faculty. This 5-week study was carried out during Special Teaching Methods course. 28 students joined the study. This study was helpful in that the science teacher candidates involved in the study learned conceptual change strategies better and they prepared activities based on them.

Keywords: Science teacher candidates, conceptual change

INTRODUCTION

The core commitment of a constructivist position is that; knowledge is not transmitted directly from one source to another, but it is actively built up by the learner (Driver et al., 1994). As for the constructivist approach, learners actively construct new knowledge by making use of their existing knowledge and experiences (Windschilt, 2002). From a constructivist perspective, learning is an individual process that involves linking new ideas and experiences with what the learner already knows. A fundemental assumption of constructivism is that learners construct understanding through interactions with the

physical and/or social environment (Liang and Gabel, 2005). While constructivism is an approach on how knowledge is acquired, it is also quite successfull in comprehending and commenting on the learning-teaching experiences. The principles put forward by the constructivist learning approach give important clues on what can be done to develop more effective teaching methods and techniques.

Conceptual Change Texts

Conceptual change texts are used for enabling the conceptual change in students' minds. Possible misconceptions that the students might have are writtten down on conceptual change texts and the inadequacy and mistakes of their misconceptions are made clear to students. Based on his/her previous experience, the teacher can also add the texts examples of difficulties encountered that could be useful for the exact and correct comprehension of the subject studied if necessary. After convincing the students what they thought to be true was wrong, the exact and correct comprehension of concepts are taught to them with the necessary scientific proof and convenient explanations and examples. Then students study on the texts either on their own or in groups and compare their previous knowledge on the subject to the information given in the text and think of it. Thus, it is expected to remove students' misconceptions in their minds. Conceptual change texts are usually handed in to the students during the presentation of the subject and they are asked to analyze the texts either on their own or in groups. After making sure that students complete their reading and analysis of the text, they are expected to start a class discussion on the subject and have an exact and correct comprehension of the concepts (Ayas, Çepni and Ayvacı, 2005).

Concept Cartoons:

The concept cartoon is one of the useful tools that can be used to point out different viewpoints to students and motivate them to start a discussion with the use of scientific method (Naylor, Keogh and Downing, 2007; Balım, İnel and Evrekli 2008).

Concept cartoons were created by Brenda Keogh and Stuart Naylor in 1991. A typical concept cartoon should have the following features (Naylor, Keogh and Downing, 2007):

- visual representation of scientific ideas

- minimal text in dialogue form
- alternative viewpoints on the situation
- application of scientific ideas in everyday situations
- the rest of the options should also be relevant and include alternative concepts

Analogies

Scientist use analogies to concentrate attention on specific aspects in order to explain something unfamiliar by way of something familiar. Analogies could also be considered as models since they involve some similarities between two things. Analogical models are used very often by scientists in order to explain scientific concepts and clarify complexity of mental models (Coll, Franceand Taylor, 2005: 185).

While using analogies, students must be explained the points where the source and target intersect or differ (Durmuş and Kocakülah, 2006).

Models

A model is the name given to the supplementary teaching materials used in science teaching to make an object be better understood because the object is either too big or too small to perceive well by students.

Models and modelling are quite effective techniques in animating the abstract concepts in a more concrete manner in students' minds (Gülçiçek, 2005).

Duit and Glynn (1996) handles the models in two main groups; as mental and conceptual models (Durmuş and Kocakülah, 2006). Mental models are personal and show students' own knowledge and what they have in their minds. Conceptual models are scientifically correct models and accepted true by everyone.

Learning difficulties appear if there is a conflict between the students' mental models and the conceptual models that are to be learnt. Learning is the process of reaching the scientifically correct conceptual models from the students' previous mental models by making use of similarities.

If used appropriately, models can lead students to the correct conceptual models that are accepted by scientists. Encouraging and enabling the students to make their own models and criticize them provide conceptual progress in learning.

METHOD

This is a descriptive study in that it embodies information regarding the constructivist approach and the conceptual change texts, concept cartoons, analogies and models that are in compliance with the constructivist approach. Besides, the study includes conceptual change activities prepared by the science teacher candidates. The study was conducted in 2009-2010 academic year, at Dokuz Eylül University, Buca Education Faculty, Izmir, Turkey. This 5-week study was carried out during Special Teaching Methods course. 28 students joined the study. On the first week, students were explained what misconceptions were and how to remove them by using conceptual change strategies, such as; conceptual change texts, analogies, models and concept cartoons. Also different kinds of activities based on conceptual change strategies were presented to the science teacher candidates. After that, 28 students were divided into 7 groups with 4 students each and they were asked to prepare activities based on conceptual change strategies related to a unit in science and technology curriculum of primary schools. Each group chose a unit and made preparations, and for two weeks in classroom environment all groups presented their activities in compliance with the aims and acquisitions in the science and technology program. These activities were prepared by taking the acquisitions of the unit "Heat and Temperature" in the 8th grade into consideration. The activities were prepared by focusing on the inclusion of the basic concepts within the content of the subject, taking the students' constructing the concepts better as the basis. Following are the examples of a conceptual change text, concept cartoon, analogy and model respectively as to the subject “Heat and Temperature” prepared by the science teacher candidates.

Grade: 8

Subject: Heat and Temperature

Conceptual Change Text

Activity: Why I Felt Chily?

The Purpose of the Activity: To remove misconceptions by explaining why we perceive some substances a bit colder.

Acquisitions:

- show the transmission of heat in solids with an experiment.
- define and call the solids that can transmit heat as the heat conductors.
- define and call the solids that do not conduct heat as the heat insulators.

- infer from observsation and daily experience that heat transmission can occur without direct contact.

Misconceptions:

-In a cold place, metal materials are colder than wooden materials though being in the same environment.

-Temperature is transferred.

-Heat is measured with a thermometer.

-The heat follows from the hot system to cold system.

Activity and Questions

- Which one would you choose to sit on while waiting at the bus stop, the wooden bench or metal bench?
- Why do people prefer wooden spoons while cooking at home?
- Why does the glass part of a window feels colder than the wooden frame of it though being in the same environment? Or do our senses misguide us?

-Heat Transmission, Heat Exchange:

When you connect two materials of different heat to each other, the heat exchange occurs. As the hot substance becomes cold by giving away the heat, the cold substance increases its temperature by absorbing the heat and it goes on until the temperature is equal. In this case, the heat taken is equal to the heat given.

Solids emit heat by means of transmission. Atoms of the substance transmit heat to one other, thus heat transmission occurs. Metal substances transmit heat much faster than wooden substances as the space among the metal atoms are relatively smaller than those of wooden substances. So we call the metals as conductive and wooden substances as nonconductive. Because of the faster heat transmission, one can mistakenly think that metal substances are much colder than wooden substances though they are in the same environment. It is not the flow of heat but it is the exchange of heat and heat is the energy which is measured by units of calories.

If a pair of tongs are exposed to fire, the other end of the tongs, namely the part handled gets heated soon after. Metals are good conductors of heat. Heat goes through the substance and this type of heat transmission is called “conduction”. The molecules of the heated substance gets faster and collides with the molecules nearby and gives away some of their energy to the nearby molecules, thus the energy transmission occurs from molecule to another molecule.

Concept Cartoon

Activity: An example of a Concept Cartoon related to the subject Temperature

-Three friends are discussing about what the temperature unit is.

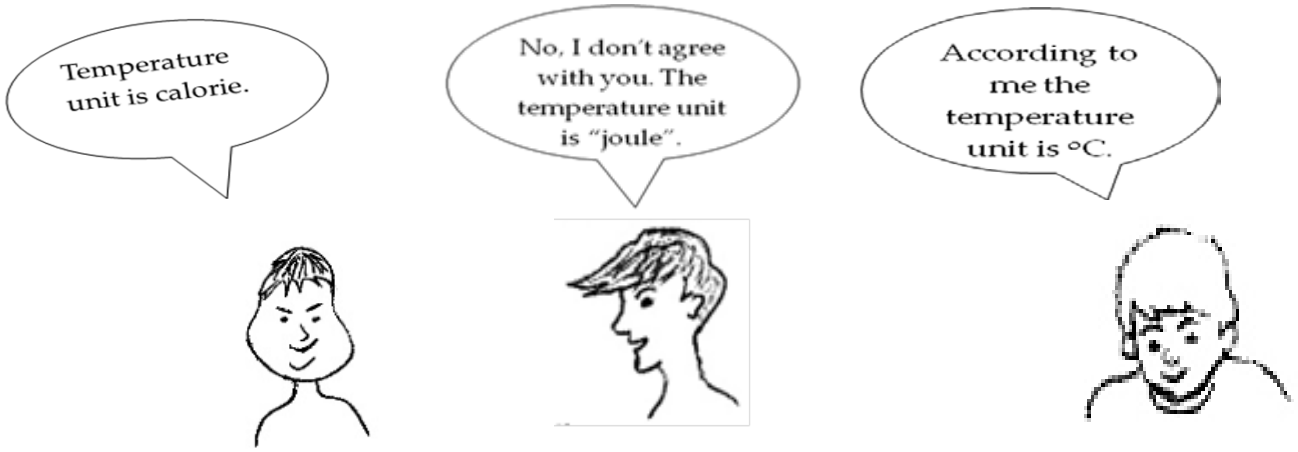
Acquisition:

Learning the unit of heat and temperature

Misconceptions:

-The temperature unit is calorie.

-The temperature unit is joule.



Who do you think is correct? You can indicate by marking one of the following boxes.

☐ Hasan ☐ Nuri ☐ Mert

Please tell the reasons why you think like that

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Analogy

Activity: Let's be particles and transmit heat.

The Purpose of the Activity:

Heat transmission in solids, liquids and gas is both a difficult and abstract subject. So, the objective of the activity is to provide permanent learning by helping the students concretize concepts and relate them with the concepts that they already know by using analogies.

Acquisitions:

The students are expected to:

- Infer that heat transmission is inversely proportional to the space among the particles.
- Infer that solids transmit heat the fastest and heat transmission in liquids is slower than solids and the gas is the slowest in heat transmission.

Misconceptions:

- Confusing the heat transfer with the phase change.
- Heat transmission occurs immediately at all points of the substance.
- Hard substances transmit heat more slowly.
- Heat is transmitted the most rapidly in air.

Doing the Activity:

The students are separated into 3 groups with 10 students for each, and the groups were named as; Solid, Liquid and Gas. The solid group students gather closely side by side without having any space in between, the students in the liquid group gather by leaving some space in between, and finally the students in the gas group gather by leaving much bigger space in between. So, the students in three groups symbolize and illustrate the solid, liquid and gas substances. The students are given instructions on how to play "ear to ear". Students line in and only the first student hears the correct word and s/he is required to whisper this word into the ear of his/her friend beside and the last student in the line says the word whispered into his/her ear aloud. In this play, the heat is considered like the word that is said to the students' ears. Finally groups are lined up as the 1st, 2nd and 3rd according to the order of their

finishing the game and they are asked to infer that solids transmit heat the fastest and heat transmission in liquids is slower than solids and the gas is the slowest in heat transmission.

Model

Activity: Let's Make A Thermos

The Purpose of the Activity: To remove and correct the misconceptions on heat and temperature subject which students usually confuse and show how thermal insulation is embedded in daily life.

Acquisition:

The students are expected to guess when insulation would be necessary.

Misconceptions

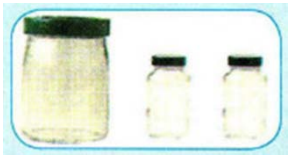
-Temperature is measured with calorimeter.

-Heat is measured with thermometer.

Materials:

A large jar, two small jars, aluminium foil, strafor foam or a bottle cork and some hot water.

Doing the Activity:



We must wrap one of the small jars with the aluminium foil. Make sure the foil's shiny surface looks inside and mat surface outside and then place the strafor foam or bottle cork to the bottom of the large jar.

Put the small wrapped jar into the large jar that was prepared

Our thermos is ready.

What is the intended use of thermos bottle? How do you think the thermos can keep materials hot or cold?

DISCUSSION AND CONCLUSION

Teaching concepts meaningfully is of great importance for science education. As Science and Technology courses include many subjects, concepts and their relations among each other, students are so likely to have misconceptions, which makes it harder for them to learn new subjects. It is necessary for meaningful learning to identify and remove students' misconceptions. This study helped the science teacher candidates learn conceptual change strategies aiming at removing misconceptions and they prepared and presented conceptual change texts, concept cartoons, analogies and models.

Science and Technology teachers and science teacher candidates should prepare to use such activities based on conceptual change activities to remove students' misconceptions in different subjects in their lessons as well.

REFERENCES

Ayas, A., Çepni, S. & Ayvacı, H. Ş. (2005). *Kuramdan Uygulamaya Fen ve Teknoloji Öğretimi*, S. Çepni (Ed.) Fen ve Teknoloji Derslerinde Öğrencileri Aktif Kılan Yöntem, Teknik ve Modellemeler (116-134). Ankara: Pegem A Yayıncılık.

Balım, A. G., İnel, D. & Evrekli, E. (2008). Fen Öğretiminde Kavram Karikatürü Kullanımının Öğrencilerin Akademik Başarılarına ve Sorgulayıcı Öğrenme Becerileri Algılarına Etkisi. *İlköğretim Online*, 7 (1), 188-202.

Coll, R. K., France,B. & Taylor, I. (2005). The Role of Models/and Analogies in Science Education: Implications from Research. *International Journal of Science Education*, 27 (2), 183-198.

Driver, R., Asoko, H., Leach, J., Mortimer, E. & Scott, P. (1994). Constructing Scientific Knowledge in the Classroom. *Educational Researcher*, 23 (7), 5-12.

Durmuş, S. & Kocakülah, S. (2006). *Fen ve Teknoloji Öğretimi,* M. Bahar (Ed.). Fen ve Matematik Öğretiminde Modelleme. Ankara: Pegem A Yayıncılık, 299-317.

Gülçiçek, Ç. (2005). *Konu Alanı Ders Kitabı İnceleme Kılavuzu (Fizik)*, R. Yağbasan, B. Güneş, İ. E. Özdemir, K. Temiz, Ç. Gülçiçek, U. Kanlı, Y. Ünsal, T. Tunç (Ed.) Bilimsel Modeller ve Modelleme (117-139). Ankara: Gazi Kitabevi.

Liang, L. L. & Gabel, D. (2005). Effectiveness of a Constructivist Approach to Science Instruction for Prospective Elementary Teachers. *International Journal of Science Education*, 27 (10), 1143-1162.

Naylor, S., Keogh, B. & Downing, B. (2007). Argumentation and Primary Science. *Research in Science Education*, 37, 17-39.

Windschitl, M. (2002). Framing Constructivism in Practise as the Negotiation of Dilemmas: An Analysis of Conceptual, Pedagogical, Cultural and Political Challenges Facing Teachers. Review of Educational Research.