Analysis of Primary School Students’ Mental Models Relating to The Structure of Atom

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SYNOPSIS

INTRODUCTION

One of the most important concepts of science is atom. Since ancient times, people have used different metaphors to describe atom. Parallel to the development of technology, those metaphors have become more systematic, based on scientific facts and transformed into modelling (Güneş et al., 2004).

Since its discovery, atom has been explained with models, and thus teachers have described the structure of the atom to their students and have tried to facilitate to understand the subject by using these models (Güneş et al., 2004). The usage of more than one models (Thomson, Rutherford, Bohr) related with the structure of the atom may cause confusion of students (Harrison & Treagust, 1996; Podolefsky & Finkelstein, 2006). Therefore, it is important to analyze students’ perception of grip about atom models.

It is possible to define how and how much of the subject that students understand by using their mental models (Vosniadou & Brewer, 1992). Besides, mental models of students are very important for evaluating students and teaching (Podolefsky & Finkelstein, 2006).

PURPOSE OF THE STUDY

The main problem of this study is how the students give meaning to atom concept, which can only be explained through models. Related with this problem, the aim of the study is to determine the mental models of 7th grade primary school students about the concept of atom, and accordingly, their perception of this concept.

METHODOLOGY

This study was carried out by means of a case study method, since it is a descriptive study that aims defining and describing the studied situation thoroughly.
a) Sample
The sampling of the study consists of 45 students ($N_{\text{Female}} = 24; N_{\text{Male}} = 21$) at 7th grade in a primary school in Istanbul during the 2009-2010 academic year.

b) Instrument
Under the research, a success test that consists of six open-ended questions was developed for the purpose of collecting data. While developing this test, the education programs utilized in primary education were reviewed, and the achievements related with the subject “Structure of the Atom” in the unit “Structure and Properties of the Matter” of the 7th grade course of Science and Technology at primary school were analyzed.

c) Data Analysis
The data were analyzed in two ways. Firstly, the data were analyzed by using the placement scale of five, developed by the researchers in order to reveal the overall success of students. At the second stage, the answers given by any students to the questions in the data collection vehicle were co-analyzed, and the mental models of the students were determined according to the general specifications that come out.

FINDINGS

a) Students’ Status of the Overall Success
When the answers given to the first three questions of the placement scale of five were reviewed, all the students showed the atom as a nucleus with protons and neutrons at the center and particles of electrons revolving around it. However, some students showed electrons as particles moving at certain orbits and some of them as particles moving at a single orbit. As stated in Harrison and Treagust (1996)’s study, this shows that students have misunderstandings in showing the orbits of electrons. In addition, it was determined that students have many different definitions about showing the place of the nucleus of the atom (such as, at the center of the sphere, in the middle of the circle). According to the developed scale, it was seen that a major ratio of the answers given by the students could be classified at level [2], [3], and [4].

b) Mental Models of Students
The holistic analysis of the answers given to the questions in the data collection vehicle determined that the students had 4 different mental models about the atom, in general as the Solar System, Granular Food, Earth, and Ferris Wheel Model. When the general specifications of these models are reviewed from the analytical point of view, it is found that the students resemble the atom to a concrete structure that is suitable with their level. It was found that a great majority of students as 63% had the model of granular food as to the structure of the atom. Accordingly, it can be said that Thomson’s “raisin cake” model and Rutherford’s granular structure where there is the nucleus at the center and electrons revolving around the nucleus, which take place in course books, have influence on the analogy of students. In addition, it was seen that all the students stated correctly that the atom consists of protons, neutrons, and electrons; however they had varying perceptions about their movements and positions.

DISCUSSION and SUGGESTIONS
By the results in mind, it is advisable to research for the reasons of existence of varying mental models related with the structure of the atom. Determination and removal of the reasons of students for creating variable and mostly non-scientific mental models will both
have a positive impact on the academic lives of students and facilitate teachers’ work. Because making accurate and efficient modeling demonstrate to improve teaching (Vosniadou & Brewer, 1992; Podolefsky & Finkelstein, 2006). Furthermore such studies are needed for overcoming the problems about being understood models and using models that are in the course books. Researching the models that are in course books and are used by teachers and students, will give the opportunity to be evaluated the problems about using models and modeling comprehensively by researchers (Güneş vd., 2004; Jong, 2009).

REFERENCES


