FACILITATING CONCEPTUAL CHANGE IN ATOM, MOLECULE, ION AND MATTER

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ABSTRACT

FACILITATING CONCEPTUAL CHANGE IN ATOM, MOLECULE, ION AND MATTER

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The main purpose of the study was to compare the effectiveness of the conceptual chance texts oriented instruction accompanied with analagoies over traditionally designed science instruction on 7^{th} grade students' understanding of atom, molecule, ion and matter concepts and their attitudes toward science as a school subject.

In this study 70 seventh grade students from two classes of science course instructed by the same teacher from Battalgazi Elementary School took part. The study was conducted during 2004-2005 fall semester.

This study included two groups which were selected randomly throughout five clasesses. One of the group was defined as control group in which students were taught by traditionally designed science instruction, while other group defined as experimental group in which students were instructed by conceptual chance texts oriented instruction accompanied with analogies (CCTI). Atom, Molecule, Ion and Matter Concepts Test (AMIMCT) was administered to both groups as a pre-test and post-test and Attitudes Scale toward Science were administered as post-test to asses the students understanding of atom, molecule, ion and matter concepts and students' attitudes toward science as a school subject, respectively.

The hypotheses were tested by using two-way analysis of variance (ANOVA). The results showed that CCTI caused significantly better acquisition of the scientific conceptions related to atom, molecule, ion and matter concepts than TDSI. The result showed that there was no significant difference between test mean scores of students taught with CCTI and those taught with TDSI with respect to their attitudes toward science as a school subject.

Keywords: Conceptual Change Texts, Analogy, Misconception, Attitudes Toward Science, Atom, Molecule, Ion and Matter.

ÖZ

ATOM, MOLEKÜL, İYON VE MADDE KAVRAMLARININ ÖĞRENİLMESİNDE KAVRAMSAL DEĞİŞİM METİNLERİNİN ETKİSİ

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Bu araştırmanın amacı benzetmelerle desteklenmiş kavramsal değişim metinlerine dayalı öğretimin 7. sınıf öğrencilerinin atom, molekül, iyon ve madde konusunu anlamalarına, kavram yanılgılarını azaltmalarına ve Fen Bilgisi dersine olan tutumlarına etkisini incelemektir.

Çalışmada aynı fen bilgisi öğretmenin eğitim verdiği 70 yedinci sınıf öğrencisi yer almıştır. Çalışma, Battalgazi İlköğretim okulunda 2004-2005 öğretim yılı sonbahar döneminde gerçekleştirilmiştir.

Çalışma için iki grup oluşturulmuştur. Deney grubunda atom, molekül, iyon ve madde konuları işlenirken benzetme destekli kavramsal değişim metinleri kullanılmıştır. Öğrencilerin atom, molekül, iyon ve madde konularındaki başarılarını belirlemek için atom, molekül, iyon ve madde kavramları testi uygulanmıştır. Öğrencilerin fen bilgisi dersine olan tutumlarını belirlemek için fen bilgisi dersi tutum ölçeği kullanılmıştır.

Çalışmanın hipotezlerini desteklemek için ANOVA istatiksel analiz yöntemleri kullanılmıştır. Analiz sonuçları benzetme destekli kavramsal değişim metinlerini

kullanan öğrencilerin atom, molekül, iyon ve madde konusundaki başarılarının, geleneksel fen bilgisi öğretim metodunu kullanan öğrencilere göre daha yüksek olduğunu göstermiştir. Ancak, benzetme destekli kavramsal değişim metinlerini kullanan öğrencilerin fen bilgisi dersine olan tutumlarında belirgin bir fark olmadığı gözlemlenmiştir.

Bu araştırma sonuçları ve geliştirilen yöntemler bakımından araştırmacılara ve fen bilgis öğretmenlerine katkı sağlayabilir.

Anahtar Sözcükler: Kavramsal Değişim Metinleri, Benzetme, Geleneksel Fen Bilgisi Öğretim Metodu, Kavram Yanılgısı, Fen Bilgisi Dersi Tutum Ölçeği, Atom, Molekül, İyon, Madde.

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LIST OF SYMBOLS

CCTI	:	Conceptual Change Text Instructıon
TDSI	:	Traditionally Designed Science Instruction
AMMICT	:	Atom, Molecule, Ion, Matter Concepts Test
ASTS	:	Attitude Scale Toward Science
DF	:	Degrees of Freedom
F	:	F Statistic
t	:	T Statistic
p	:	Significant Level
$\overline{X}$	:	Mean of Sample
n	:	Sample Size

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CHAPTER 1

INTRODUCTION

Learning is a process of conceptual change which it involves an interaction between new and existing conceptions with the outcome being dependent on the nature of interaction (Suchocki, 2004).

According to constructivist learning theory if the learners construct their own knowledge actively, their understanding will be better comperatively passively acquire (Posner et al. 1982) . In every part of the life learning occurs. Learners acquire some knowledge by means of experiences with the life. This knowledge is called existing knowledge. This knowledge may be true or wrong. But learners use their exsisting knowledge to interpret new information in ways which make sense to them. They build their own conceptual structure in which they incorporate emprical phenomena, they might have to change their minds in ways which may well require restructuring of their existing conceptions, rather than simply adding new knowledge (Hewson, 1981, Posner et al. 1982). Learners of interaction with their scholars, parents or member of the community effects the learning. Learning occurs with understanding and learners consruct and transform their own knowledge, so personal construction of knowledge is very important

Constructivism is one of the most effective theory among the learnings theories According to this philosophy, learners construct knowledge themselves. Students construct their own knowledge by experiencing their own ideas which are based on the their previous knowledge. They apply it to new situations and integrate the previous knowledge with the new knowledge (Hein, 1991; Taber & Watts, 1997).

Harrison and Treagust (1996, 2000) propose that developing modeling skills of students should be part of science instruction, and students' understanding of chemistry concepts may be enhanced, with this way. Information coming from students' experiences with the world can often lead to occur unintended concepts.

Students can interpret the concepts or ideas, incorrectly and they may not transform the new knowledge to their own meaning exactly (Gilbert, Osborne & Fenshman 1982). This concern has encouraged the researcher to investigate students' conceptual science knowledge in many content areas, such as particle theory of matter (Doran, 1972), lights and shadows (Neale, Smith and Johnson, 1990), dissolution (Blanco, 1997), chemichal misconceptions (Nakhleh, 1992), solution, gas and chemichal change (Çalık & Ayaz, 2004), periodic table and elements (Schmidt, Baumgartner & Eybe, 2002).

Most of the studies in science education show that students are unable to understand some basic science concepts. The concept of particles of matter, in other words atoms, molecules and ions are fundemental in study of chemistry. Students have trouble to understand advanced concepts due to not fully understand fundemental concepts such as atom, molecule, ion and matter. If the students have trouble in this topics, they cannot learn chemical reactions, solution, equlibrium, dissolving or changes in states, effectively. Atom and molecule are abstract topics. These are far removed from the daily experiences of junior high school students. Thus, many students have difficulty in understanding of these concepts.

If some misunderstandings occur on particles of the matter, these concepts may lead to unintended situation. In many research study like solubility (Ebenezer and Erickson, 1996) bonds and energetic of chemical reactions (Boo, 1997), chemical bonding and spontaneity (Teichert and Stacy,2001) showed that students' lack knowledge in atoms, molecules and ions arise problems in understanding of other basic chemical concepts. So it is very important to know students' pre-existing knowledge about particles of matter, thus misunderstanding of some chemical concepts may be prevented.

There has been many reports of studies relating to the explanation, identification, and students' difficulties in understanding science concepts. Studies indicated that students have misconceptions relating to matter, molecules, atoms and ions. Novick and Nussbaum (1978) and Keith S. Taber (1996) reported that most of their sample didin't distinct atom, molecule and ions. They thought that 'molecules was part of a atom and also ions were part of the atom like neutron, proton and electron'. Grifith and Peterson (1992) reported that some misconceptions about atom and molecule like 'atoms are live because they can move'. Dow, Auld, and Wilson (1978) reported that a popular misconceptions among 12 to 13 years old students was that molecular diameter decreases progressively from solid to liquid to a gas for a given substance.

There are a lot of reason why students have problem in understanding of characteristics of atoms, molecules and ions. Osborne and Cosgrove (1983) suggest that scientifics models of the atom, as typically thaught, can appear to be abstract, and hardly, if it all, relatable to everyday experiences. Ault, Novak, and Gowin (1985) describe the concept of molecule as having 'nearly limitless complexity'. They suggest that while students may be able to grasp the abstract meaning of molecules at some level, their conceptual patterns may be imaginative and unconventional. How students come to understand scientific knowledge is very important problem. Reseracher, designed models to provide this understanding. One of the model in constructivism theory is conceptual change model. According to conceptual change model when students have existing knowledge before the instruction they cannot link easily the new knowledge with their own meainings.

Conceptions that are inconsistent with the accepted scientific conceptions defined as misconceptions. Researchers have used various terms for misconceptions, such as alternative conceptions, alternative frameworks, preconceptions (Novick & Nussbaum, 1982; Nakleh, 1992). Misconceptions integrated into a student's cognitive structure and interfere with subsequent learning. Then the student is left to connect new information into a cognitive structure that already holds inappropriate knowledge. Thus the new information cannot be connected appropriately to their cognitive structure, and weak understanding or misunderstandings of the concepts will occur (Nakhleh, 1992).

One misconception can be created individually created by misinterpreting the previous concepts, or it can be supported by through daiy life experiences. Out of these accumulated experiences, students can develop rudimentary explanations or develop mental models of many natural phenomena including different topics such as life, astronomy, light, force, matter (Harrison Treagust, 1996).

Dykstra, Boyle, and Monorach (1992) summarized the meaning of alternative conceptions (misconceptions) as:

1) Students, who are confronted with a particular situation, give mistaken answers. These mistaken answers defined as misconceptions.
2) Students have ideas about particular situation and these ideas evoke the mistaken answers. These ideas called as misconceptions.
3) Students have some fundemental beliefs, which are used in variety of different situation, to explain how the world works. These fundemental beliefs defined as misconceptions.

Misconceptions or pre-existing knowledge that students have cannot be eradicated by simply presenting new information. The existing schemata are used to make sense of anything you present. That is, new information is most often assimilated into existing schemata without pronounced change in the way the knowledge is structured; new information is added on to what is already there. Misconceptions, naive theories, and ill-conceived schemata in science will be stubbornly held on to unless students are actively engaged in wrestling with phenomena, problems or questions. Students must willingly commit themselves to the cognitive struggle of restructuring. They must become motivated to confront actively the inconsistencies or contradictions between their misconceptions and the phenomena. If students perceive an inconsistency and accept the intellectual challenge of resolving it, the teacher may be able to provoke the cognitive restructuring to more sophisticated conceptual understanding (Hyde and Bizar, 1989).

Posner at al. (1982) proposed conceptual change strategies, which was based on the assumption that many difficulties in science learning have their origin in the knowledge students have acquired before the instruction and in the ignorance of this knowledge by teachers. Posner suggest four criteria for changing students' misconceptions:

- They must become dissatisfied with their existing conceptions.
- They must achieve a minimal initial understanding of the scientific conceptions.
- The scientific conceptions must appera plausible.
- They must see that the scientific conception is useful in understanding other examples of phenomena.

Teacher can provide these criteria using conceptual change model. Conceptual change cannot be obtain through regular instruction. In order to elicit it, teacher should use some instructional strategies. One of them is conceptual change text model. In this model; teacher asks to students to predict what would happen in a given situations related to science concepts, before being presented with information that demostrates the inconsistency between common misconceptions and scientific conceptions (Chamber & Andre, 1997).

Using analogies is another way to prevent misconceptions. Analogies are valuable tools in learning difficult scientific concept. Analogy refers to comparisons of structures between two domains. It is possible to classify the analogies according to their usage method. It can be as a story as a game analogy, and it can be written or illustrated analogy (Mirzalar & Kabapınar, 1998). Analogies have important role in learning process. Duit (1991) stated that analogies may make new information more concrete and easier to imagine. His studies confirm that analogies are common tools for explaining scientific issues. Analogies may facilitate the learning and understanding of the abstract issues. They give opportunity to students to construct their own knowledge by forcing them to view the new knowledge within framework of analogy.

Students have a lot of misconceptions on atom, molecule, ion and the matter concepts. These concepts are the central of the chemistry concepts. There is a need for effective instructional strategy to prevent students' misconceptions. Because of this reason the present study mainly was designed to compare the effectiveness of conceptual change text instruction accompanied with analogies over traditionally designed science instruction in 7^{th} grade students' understanding of atom, molecule, ion and matter concepts.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Previous studies that have produced therotical and emprical backround for this study are presented in this chapter.

Science is an organized body of the knowledge about nature. It is the product of obsevations, commonsense, rational thinking. In this aspect science education is very important. It helps students to develop an understanding of concepts and use them as solving a problem. Most of the students find chemistry concepts difficult. They are unable to understand the abstract chemistry concepts. Chemistry teachers would generally agree that understanding the concept of matter, atom and molecule are fundemental in the learning of chemistry. They are the basic concepts and understanding of them is essential to the learning of other concepts such as chemical bonding, chemical reactions. According to Osborne and Cosgrove (1983); students find atom and molecule abstract, and hardly, relatable to everyday experiences. Choosen instructional strategy should provide meaningful understanding of these concepts and students' thinking ability should be enhanced by this way. Therefore this study is focused on students' misconceptions and new instructional strategies, which are conceptual change text and anology, to develop their chemistry success related to matter, atom, molecule, and ion concepts.

We examined the existing relevant literature concerning with the same problem in this study (misconceptions, conceptual change, analogy).

2.1 Misconceptions

Misunderstandings which do not agree with accepted scientific view refer misconceptions (Nussbaum & Novick, 1982; Nakleh, 1992; Grifith, 1994). Students have a lot of ideas either prior to instructions or following and after instruction. Students construct these ideas through their experiences with their environment. Students hold their pre-knowledge in spite of the given instruction. Their pre-knowledge conflict with new knowledge and they may not construct a relation between them. So the conceptions may be misunderstood by the students. These alternative students' views have been characterized as preconceptions (Anderson and Smith, 1983), intiuitive beliefs (McCloskey, 1983), children's science (Osborne, Bell, & Gilbert, 1983), naive beliefs (Caramazza, McCloskey, & Green, 1981). These terms describe an idea that a student holds before general chemistry instruction (Bodner, 1986). Students' ideas may be change quite different from expected.

Misconceptions are created by different sources. Cho et. al., (1985) stated that misconeptions may arise from textbooks, may arise from prior to formal instruction (Griffiths and Preston, 1992), or as a result of interaction with teachers, physical and social world (Gilbert & Zylberstajn, 1985; Valanides, 2000). Gill-Perez and Carrauca (1990) stated that the resemblance between students' intuitive ideas and preclassical conceptions cannot be accidential, but must be consequence of the same way of approaching problems. Absence of students' doubts may lead to alternative frameworks, and trying to find possible alternative solutions to the problems also may lead to these intiutive ideas.

A review of the research relating to students' misconceptions of science concepts reveals that misconceptions have many common features. They are often strongly resistant to traditional teaching method and students are generally reluctant to transform these misconceptions(Driver & Easley, 1978; SungUr, Tekkay, and Geban, 2001). Various studies focused on students' misconceptions in science education. There has been an increasing interest in science misconceptions. There are some investigations that explore students' ideas on science issues; Particle Theory of Matter (Doran, 1972), Gasses (Stavy, 1988), Lights and Shadows (Neale, Smith and Johnson, 1990), Dissolution (Blanco, 1997), Chemical bonds and energetics (Boo, 1997), Solution, gas and chemichal change (Çalık and Ayaz, 2004), Periodic table and elements (Schmidt, Baumgartner & Eybe, 2002).

Mary B. Nakleh (1992) studied students' misconceptions on chemistry education and investigated the students' conceptual chemistry knowledge. He interviewed grade 11 chemistry students who were in the last quarter of the academic year. These students had recently completed a unit on acids and bases. In this study, it appeared that 20% of the students still held a simplistic, undifferentiated view of matter. When asked how a solution of an acid or a base would appear under a very powerful magnifying glass, these students drew waves, bubles, or shiny patches.

R. F. Peterson and D. F. Treagust (1989) examined to identify grade 11 and 12 students' misconceptions and misunderstanding of chemistry topic covalent bonding and structure , in Australia. Students understanding of the topic was identified from the interviews, student- drawn concept maps, and free response questions. These data were used to produce multiple-choice items. The diagnostic instrument consists of 15 items, each of which refer specificially to the conceptual areas of bond polarity , molecular shape, polarity of molecules, lattice, inter molecular forces, and the octet rule. Most items were based on problem-centered situations and each item was analyzed to find out students understandingof and identify misconceptions related to the concepts and propositional statements underlying covalent bonding and structure. Some of the misconceptios that the researchers found are:
-The shape of a molecule is due to equal repulsion between the bonds.
-Bond polarity determines the shape of the molecule.
-Ionic charge determines the polarity of the bond.

H. K. Boo (1997) investigated grade 12 students' understanding of the nature of the chemical bonds and energetics elicited across five familiar chemical reactions following a course of instruction. Based on the chemist's analayses of the conceptual area, a list of relevant concepts involved was identified and five chemichal reaction was choosen. They were used as the framework for drawing up a semistructured interview protocol and were administered to 48 students. Interview-about-events technique was used as data collection method. Students' understaning of chemichal bonds and energetics were elicited on four aspects across five events. These were:

1. hot copper in air;
2. the burning candle;

3. the Bunsen flame;

4. addition of addition of magnesium to dilute hydrchloric asid;

5 addition of aqueous lead nitrate to aqueous sodium chloride.

The four aspects were:

1. the type of change predicted in terms of reactants and products involved.

2. the overall enery predicted.

3. how the process of change is conceived or imagined.

4. the driving force for the change.

As a result of the study he found several misconceptions on ionic and covalent bond, electronegativity and electron transfer. Some of them are:

Ionic bond was broken during the dissolving process.

Metals such as magnesium and copper could orm covalent bonds with nonmetals such as chlorine and oxygen.

Ionic bond is sharing of electrons.

Chiu, Chou and Liu (2002) examined how students learned and constructed their mental models of chemichal equilibrium in a cognitive apprenticeship contex. 30 students participated to the study and they are seperated into two groups. Students in the treatment group were instructed based on the main features of cognitive apprenticeship, such as coaching, modelling, scaffolding, articulation, reflection, and exploration. Students in control group were instructed. But, both groups were presented with a series of hands-on chemichal experiments. Students in the first group were capable of constructing the mental models of chemichal equilibrium, whereas students in second group failed to construct similar correct mental models of chemichal equilibrium.

Harrison and Treagust (2000) examined students' intellectual models on atoms, molecules and chemical bonding. They identified that students have eight different intellectual model on atom. According to them, text book and models that teachers used are the reason of the students' models.

Schmidt, Baumgartner and Eybe (2002) studied to identify students' alternative concepts of isotopes and allatropes and how they link these concepts with the

Periodic Table of Elements. 300-74 students from garde 11 and 13 participated in the study. Quantitative (written test) and qualitative (interviews) methodology was used. 12 items were used in the written test. Some of the misconceptions that the reearchers found that:

1. The numbers of protons and neutrons are the same in atom.
2. Atoms in graphite and diamond do not contain protons and neutrons in equal number
3. If neutrons were absent, the nucleus would contain charged particles only.Because of that the protons are positively charged, protons repeal each other.

The analysis of the research showed that students actively tried to make sense of what they had experienced.

Ayas and Çalık (2004) tried to identify the alternaive ideas and understanding of eight grade students and students teachers in their final year in science education department related to concepts of solution, gas and chemichal change. Opeended questions and group discussion methods were used for data collection. 50 students in 8th grade and 50 students teachers in the science education department. 6 students and 6 students teacher participated to the group discussions. The study depicted that both 8th grade students and students teachers had some similar alternative conceptions. The data provided from the test analaysed and it was found that some 8th grade students and students teachers referred to homogenous mixture, or invisibility to the naked eye, but they claimed that this process was melting. Although they had some ideas about dissolution, they were unable to explain their mental models. Furthermore some claimed that sugar mixes in water y melting or melts rapidly. Some eight graders beleived that sugar includes acids or evaporates to mix with air.

In order to probe students understanding of the science concepts various methods have been developed. Most of these methods involve general or deep interview (Osborne & Wittrock, 1983). To identify the misconceptions paper and pencil test, concept map (Ault, Novak & Gowin,1984), questionaire and short test also were used. Especially most of the researchers have choosen to use interviewing.

2.2 Research on Misconception in Atom, Molecule, Ion and Matter

The concepts of atom, molecule, ion and the matter have been fundemental parts of the learning science courses. Understanding of these concepts has an important role on learning other concepts of the science. Meanwhile students have many difficulties to understand properties of matter, atom or molecule. Many students are not able to relate their existing knowledge with new knowledge. Consequently, they hold a lot of misconceptions about atom, molecule, ion and the matter concepts. Many researchers investigated students' understanding of these concepts and their misconceptions. Here are the sumary of these studies:

Hibbard M. K. and Novak D. J. (1975) had an attempt to examine the degree of differentiation of the uninstructed child's cognitive structure with respect to smells and states of matter, and the cognitive differentiation which occurs when the child's knowledge and new information interact in audio-tutorial lessons. 84 children who received audio-tutorial instruction and 38 'uninstructed' children who received only an introductory set of A-T lessons participated to the study. Most uninstructed children involved in this study recognized a casual relationship between a smell and its source, but they did not understand that the smell was once physically part of the source. They could not understand the relevance of the particulate model presented to their knowledge of solids, liquids and air. This study showed that instructed children use a particulate model to explain the nature of smells much more effectively than uninstructed children , and they also use somewhat better explanatory models for comparing solids, liquids and air.

Novick and Nussbaum (1978) studied on grade 8^{th} students' misconceptions about particulate nature of the matter. They emphasise the importance of transition from primitive continious to a particulate conception matter as a major change a student's outlook on the physical world. So they explored wheter such a transition is really achieved by the students.

In this study the sample consisted of 154 grade-8 students in Israil. Researcher inteviewed with these students about gasseous phase. They expected the students to realize the criterions they determined. These criterions are:

1. Gas consist of too tiny particles to be seen.
2. There is a gap between the particles of the gas.
3. Particles of the gas diffuse equally in the space
4. Particles of the gas can move.
5. If two particle of the different matter interact with eachother, third matter will be formed.

They found the following students' conceptions:

- After the evacuation gases do not distrubute uniformly in an enclosed space.
- Students couldn't realize the empty space. They thought that as liquid, dust or germs.
- Students genreally used continious model instead of particle model.
- Space-filling property of gases are not attributed to the instrict motion of particles
- The particles weigh very little and they rise

Researchers stated that students' misconceptions on particulate conception of matter will effect the learning of other science issues negatively.

In 1981, Novick and Nussbaum made a smiliar study which they had done in 1978. They made cross age study and their sample consisted of 576 students. The sample was divided into four groups: 5 th and 6 th grade (EL);7 th ,8 th , and 9 th grades (JHS); 10 th ,11 th , and 12th grades (SHS); and university students (UNIV). They investigated whether students' conceptions change as they are exposed to additional information relevant to the model in the progressively higher graders. They used paper-and-pencil instrument. When they asked to students after evacuation of air in flask what will happen to particles. Most students drew the remaining particles concentrated in the bottom of the container. Some students drew the remaining particles in the upper part of the flask. Altough this proportion is %30 in elementary and secondary students, it is %10 in university students. Students explained the distribution of the gas orally but, when the drawings are examined it was seen that they couldn't realize it. Related to space between particles, students thought that ' there are other particles between air particles', 'air keeps the particles from falling', 'there are repulsive force between particles' and 'the particles have very small density'. The research showed that at all levels students have misconceptions on particulate nature of the matter.

Gilbert, Osborne and Fensham (1982) reported that students' preknowledge about some science concepts have an important role in realizing and interpretation of the knowledge. For instance, students use the 'particle' word synonmy with atom and molecule, students also think that particles are pieces of a matter. Researchers emphasised that in order to prevent misconceptions, teachers should consider students' preknowledge in instruction.

Osborne and Cosgrove (1983) studied students' misconceptions on matter and particulate nature of the matter. In order to identify misconceptions, they interviewed 725 students in 12-17 age. They focused on students' interpretation on structure of water and transtition. They administered questions to students about melt of ice, evaporation and, boiling of water. In this study researchers found out these misconceptions:

- Bubles in boiling water are H_2 and O_2 or heat or vapor or air.
- When the water evaporate, water seperated into compenents.
- When the ice melt, number of the O_2 molecules increase.
- When the water evaporate, water molecules are transformed into air molecules.

Researchers reported that students have lack of understanding the conception of evaporation, boling, condensation and transtition. They emphasised that teachers should be aware of the students misconceptions and in order to eliminate them effective teaching methods should be used by the teachers.

Ben-Zvi, Eylon and Silberstein (1986) studied to find out students' views about matter and particulate nature of the matter. Researchers focused on students' misconceptions on atom, molecule and ion. This study consisted of three stage:

1.Diagnostic investigation of students' views about the atom
2.Development and implementation of a program which is designed to prevent some of the misconceptions identified in the diagnostic investigation.

3.Evaluation of the program.The sample is consisted of 300 students which attending 10^{th} grade, in Israil. Students have been exposed to chemistry study for half of the academic year. They administered a questionaire to identify misconceptions that students have. It was asked to students to compare the properties of two atoms: one taken from a piece of copper wire, and one that has been isolated from the gas that formed when the copper wire vaporized. They observed that most of the students confused the properties of substances and properties of atom. In the second stage of their study, they developed and implemented a new technique which emphasised the development of the atomic model. The sample consisted 1078 students which attending 10^{th} grade, in Israil and 540 of them were in experimental group; 538 of them were in control group. They used constructivist approach in the experimental group and they used traditional method in the other. As a result of this study, researchers observed that students in experimental group had less misconceptions than the others. So they stated that this technique is effective in preventing some of the misconceptions. They found the following students' misconceptions related to concepts being investigated:

- Gaseous atom is larger than the solid atom.
- Solid atom conduct electiricity because the atom has electrons and electrons provide electrical conductivity.
- Atoms of gas can be compressed and when they are heated, they can be expanded.
- The difference between states of matter is due to the changes whithin the atom.
- Atom of gas and the atom of a solid have different properties.

de Vos and Verdonk (1987) studied on students own corpuscular ideas. They interviewed 14 and 15 year old students. They record their conversation to the audiotape equipment. They analaysied the collected material and they found that students have different expressed views about molecules comparatively views normally held by the scientists.

Students ideas about molecules:

- Molecules in living creature are alive.
- A soft substance can not be made up of hard molecules.
- When the object expand, individual molecules expand also.

- Molecules of liquids cannot be solid objects but must be tiny little droplets.
- Opaque substances have opaque molecules.

Nurrenberg and Pickering (1987) stated that conceptual learning is more important than the solving problem. Because chemistry consist of many abstract concepts, and learning these concepts is essential for the other issues in chemistry. According to them in schools, chemistry is given as a mathematical process. So, students think that chemistry is part of the mathematic lesson. Researchers verified that their ideas with their investigation and they figure out students are unable to reply conceptual questions.

Stavy (1988) made an investigation to identify students' views and students' misconceptions on gas conception. In this study he found out students' view about gas is considerably different from the views normally held by scientists. The sample is 9 to 15 year old 72 students, in Israil. He interviewed with the students. Researcher asked students the mass of the CO_2 and mass of the CO_2 after used in the soda water. Then he asked the mass of the soda water after and before spread of CO_2. Most of the students in every level think that air has no mass and babbles which spread out from the soda water are gas or air. Also, students think that when gas spread out from the water, the mass of the water will increase and some of the students beleive that gas have no mass. Stavy observed three types of interpretation which students have about gas. These are :

- Gas can not be seen with the naked eye.
- Gas is only the phase of the matter.
- Gas has particulate nature.

Stavy analysed the data and he saw that conception of gas are not understood completly by the students. They integrated the gas with the air, gas in the drinks and vapour of meal. Students in 7^{th} and 8^{th}grade explained the gas as a phase of the matter and they identified that it has not colour and smell ; it has volume and it can be spread out. Students in 9^{th} and 10^{th} grade explained the gas with the particulate nature of the gas. He observed that students in every level used particle model of matter for gas but they didnot use it for solids and liquids. So, Stavy stated that while teaching matter and particulate nature of the matter, teachers should consider factors which are below:

When the matter transmute;

- Mass can not change.
- Particulate nature of the matter can not change.
- Kinetic energy will change .
- Motion of the particles will change.
- Attractive force between the particles will change.
- Space between the particles will change.

Sawrey (1990) and Gabel (1993) stated that chemistry education in most chemistry class are not given in macro and micro level and chemistry education is given in sembolic level. They identified that micro or conceptual concepts in chemistry should not be ignored and new teaching strategies should be developed.

Renstrom L., Anderson B. and Morton F. (1990) worked to identifiy misconceptions that 13-16 age students have about the matter, particulate nature of the matter, empty space between the particles and motion of the particles in the matter. They interviewed with 20 students in Sweeden. Then, they analysied the results and they reported that students used continious model and they didnot understand the particle model, excatly. Some of the students compare location of the particles in the matter with grapes in the cake. In spite of that some of the students explained atom, molecule and ion concepts, they hadnot any imagition about these concepts.

Stavy (1991) tried to understand students' intuitive perceptual knowledge that matter is conserved on evaporation. Stavy suggested that the use of an analogical relation between the known and the unknown can help students learn new information and discard or modify misconceptions. In the study reported, students from grades 5 and 6 were divided into two groups. One group completed a task involving iodine evaporation where the gaseous iodine is visible as a coloured gas before attempting a similar task using acetone, an invisible gas. The second group used acetone first, followed by iodine. It was found that performance in the acetone task was significantly higher when it followed the iodine task. The intuitively under-stood, perceptually supported iodine task apparently served as an analogical example for the misunderstood acetone case.

Griffiths and Preston (1992) made a prepilot study. They interviewed 10 high school students who were taking courses in chemistry in order to probe their undertanding of the concepts of atom and molecule. Researchers identified several misconceptions:

Electrons have no mass.

All the atoms in the molecule are the same.

There is only one kind of atom.

Protons have a mass of one gram.

After this investigation, they studied 30 grade-12 students drawn from high schools in Canada. The sample was devided into three sub-groups of 10 students each. They interviewed with the students. Questions were asked about the structure, composition, size, shape, weight, bonding and energy of molecules. they found 52 misconceptions relating to these terms and they classified the misconceptions in categories.

Questions were asked in order to identify students' misconcepitons relating to the structure and shape of atoms. Some of the misconceptions that they found:
An atom resembles a sphere with components inside; an atom resembles a solid sphere; an atom resembles several dots or circles; electrons move in orbits; matter exists between atoms; there are air between the atoms.

Questions were asked in order to identify students' misconceptions relating to size of an atom, comparision size of an atom with a molecule. Some of the misconceptions that they found:

Atoms are large enough to be seen under a microscope; atoms are large then molecules; all atoms are the same size; heat may result in a change of atomistic size; collision between atoms may result in change of atomic size; size of atoms is determined primarily by the number of protons.

The questions were asked to identify if the students thought all atoms weight the same or not. Only one misconceptions was found.

Atoms of different elements may have different weight.
Questions were asked in order to find out if students beleive that atoms are alive. Misconceptions that students had: All atoms are alive; organic atoms are alive; atoms are alive because they move.

Questions were asked in order to reveal students' misconceptions about the shape and the size of the molecules, using water molecules as reference. Some of the misconceptions that students had: The size of a water molecule depends on its tempeture; water molecules from the gas phase are the largest/ smallest; water molecules from the solid phase are the largest/ smallest; water molecules have different shapes depending on what phase they are in; tempature may affect the shape of a molecule; pressure may affect the shape of a molecule.

Questions were asked to find out students' misconceptions about the energy and weight of molecules. some of the misconceptions that students had: Water molecules within a phase may weigh differently; the size of a water molecule affects its weight; heat causes molecules to expand; the speed of the molecule is determined by its size.

Lee Eichinger, Anderson, Berkheimer and Blakeslee (1993) studied to understand the conceptual frameworks that 6^{th} grade students use to explain the nature of the matter and molecules and they tried to assess the effectiveness of two alternative curriculum units in promoting students' scientific understanding. This study was conducted to 15 students in 6^{th} grade. Science classes taught by 12 teachers in each of two successive years. Data were collected through paper and pencil tests and clinical interviews. The results indicated that students had a great difficulty understanding of matter and molecules and some of the students had misconceptions about these concepts. Researchers stated that students' entering conceptions differed from scientific conceptions concerning the nature of the matter and its physical changes. Researchers classified the students' misconceptions related to concept being investigated in macroscopic and molecular level.

Nature of Matter

At the macroscopic level, students incorrectly classified gases and forms of energy. Classification of matter and nonmatter is based on irrelevant properties.(e.g. something you can see or feel)

At the molecular level, no molecular motion initially. In learning about molecules, nonmatteer is described as molecular (e.g. heat molecules). molecules are in substances. Molecules may be comperable in size to dust specks, cells, germs etc. Molecules may sometimes be still (especially in solids) or move by external forces.

States of Matter

At the macroscopic level, gases move from one place to another when compressed or expanded, and are unevenly distrubuted.

At the molecular level,states of matter based on observable properties only (e.g. solids are heavy). Obsevable properties of the states are attributed to the molecules themselves (e.g. molecules are hard in solids), or molecules share in observable properties (e.g. molecules move in gases and liquids but not in solids)

Thermal Expansion

At the macroscopic level, substances (especially solids) ‘shrivel up’ when heated; expansion of gases is explained in terms of movement of air (e.g. hot air rises).

At the molecular level, molecules themselves are chenged by heating (e.g. molecules become hot, or molecules expand).

Change of States of Matter

At the macroscopic level, no recognition of water vapor in air, or liquid water changes into air.

At the molecular level, heatin and cooling make molecules themselves change (e.g. molecules ‘boil’, ‘eveporate’) or molecules share in observable properties of substances (molecules begin to move when heated)

Most students did not understand the word matter, and their misunderstanding could not be resolved by a simple definition nad they confused the matter with the energy. Students had great difficulty understanding the molecular constitution of matter.

They thought that molecules are in substances and that there is something between the molecules. They tend to describe molecules as having the same properties as obsevable substances and they tend to describe molecules undergoing the same changes as visible changes in substances.

Benson, Wittrock and Baur (1993) studied to find out students' misconceptions on matter and particulate nature of the matter. The sample consisted of 1098 students in different age. 103 of them were in primary school; 197 of them were in elementary school; 191 of them were in secondary school and 607 of them were at university in chemistry education. All of the students were evaluated according to their school level. Before the test, researchers made a demostration to the elementary students. They used two airproof bottles. They evacuated some of the air from the first bottle by using an enjector. Then, they asked 'If you look these bottles with a magnifying device, what will you see in them?' and they wanted students to draw the pictures of the particles in the first and in the second bottle. Some of the students used particulate nature of the matter in their drawings and some of them drew pictures which have shown distribution of gas and some students didnot draw any empty space between the partilcles of the gas.

This study proved that in spite of that the students say 'gas are in particulate nature and they can distrubute in the atmosphere.', their orginal views are not appropriate with it. After the analysing of the test results, researchers reported that 80% of the elementary students made continious model drawings; 85% of the university students made particle model drawings but, 37% of them didnot explain the empty space between the particles; 25% of the secondary students made particle model drawings and made correct drawings about the distribution of the gas.

Researchers stated that univesity students didnot even realize the empty space between the particles of the matter and motion of the particles. It is hard to change students' misconceptions with the scientific conceptions because they are insistent on their ideas. Researchers emphasised that before the instruction, teachers and the students should know the misconceptions about the concepts and teachers should develop new teaching techniquie. Thus, misconceptions that students have may be decreased.

Haidar (1996) investigated the quality and extent of understanding of certain well-known theoretical concepts (conservation of atoms and mass, mole and atomic mass, balancing chemical equations) which prospective teachers of chemistry in Yemen possess 173 junior and senior prospective chemistry teachers were administered to the study. The result showed that their understandings of most the concepts ranged from a partial understanding which specific misconceptions to no understanding. It is also found that prospective teachers' knowledge about the concepts was fragmented and not correlated. For instance, some of the prospective teachers did not have an appreciation of the small size of the atoms and they thought that mass of one atom of hydrogen is equal to 1g. Therefore, they did not understand the conservation of the atoms and mass.

Harrison and Treagust (1996) studied to find out students' mental models of atoms and molecules. They interviewed 48 students from grade 8,9 and 10. Students interview were analysed and researchers reported their misconceptions about atom and molecule. Some of the misconceptions that the researchers found:

Atoms are visible under a microscope.
Some substances made of other objects.
Atoms are alive, grow and divide.
Atoms are like a ball or sphere.
Atoms are hard.
Atom's nucleus controls the atom's activities.
Atoms are protected by a outer shell.

Researchers concluded that language used in the classroom and discussion during instruction are the major source of the alternative conceptions.

Albanase A. and Vicentini M. (1997) reported their reflections about the teaching of the particle model. They used a research results which was done by Lee at al. (1993) and De Posada Aparico (1993). In order to verify these research results with Italian students they interviewed 30 secondary-school students (age 14-16). The kind of questions in the questionnare were smiliar with those asked in other research but, the question about the colour of an atom was different. Researchers analysed the results and they reported that students seem to consider atoms not as the elements of a model which tries to explain macroscopic propertiesas emergent proporties of the collection of the elements but as the smallest part in which a macroscopic object may be subdivided while retaining its characteristics. The question of about the colour of atom was particularly effective in revealing the beleif of the students that atoms behave like macroscopic matter and it was found that 80% of the sample attributed a colour to the atom. Students were used to thinking of the terms ‘atoms’ and ‘molecules’ as simple names or unsubstantiated assertions. Researchers stated that it is necessary to convey the atomistic model to the students by consideration of an adequate number of phenomena and their interpretation in terms of discrete particles and they proposed pictorial visualized models (obtained by up-to-date microscopic techniques) to the instructors.

Harrison and Treagust (2000) explored students’ mental models of particle phenomena and examined student interactions with the analogical models used to teach about atoms, molecules and chemical bonds. This study qualitatively observed ten students’ modelling experiences, intellectual development, and conceptual status throughout grade 11 as they learned about these concepts. Students’ preconceptions on atom and molecule contained a number of incongruities. The researchers suggested that when analogical models are presented in a systematic way and capable students are given ample opportunity to explore model meaning and use, their understanding of abstract concepts is enhanced.

Yeğnidemir (2000) studied to identify misconceptions that 8th grade students have to explain matter and particulate nature of the matter and she proposed a teaching technique in preventing misconceptions. Sample of the study consisted of 84 students drawn from 8th grade classes. Before and after the instruction, researcher made pre-test and post-test. She interviewed with the students and analysied the results. Then she reported these misconceptions:

1. The weather is not matter because it has not volume and mass.
2. Shape of a atom resembles coin.
3. Size of a atom can be half of the chalk dust and atoms of the iron can be bigger the air atoms.
4. If the water freeze, molecules of the water can not move

5. If the water freeze, atoms of the water will freeze.
6. Molecules of the water in ice are heavier than the water molecules but after a while, their mass will decrease. Because when the water freeze, some of the atoms will die.
7. Atoms are alive. Because they can move.
If the iron rust, iron atoms will decay or they will die or they will mix the air.

Nieswandt (2001) investigated students' learning processes in an introductory chemistry courses. The smaple of the study consisted of 81 ninth grade students. The study focesed on four common everyday conceptions about changes of substances and particle model of matter. Introductory chemistry course contained six teaching units and they were developed based on conceptual change perspective. Before and after the instructions, a questionnaire was conducted to the students. Results showed that students confused everyday description with scientific explanation. Their understanding of changes of properties of a substance as an indication that a new substance had been created. Researcher stated chemical concepts needs to be taught in different contexts. Each new context gives students different opportunities to practice the new concept on similar tasks as well as to apply it to everyday phenomena.

Güdüz (2001) conducted a study to find out the misconceptions of atom and molecule and to evaluate effects of the education that base on activities among 5^{th}, 6^{th}, 7^{th}, 8^{th} class of primary school and 9^{th}, 10^{th}, 11^{th} class of high school students. A test about atom and molecule was administered to 923 students. The result of the test showed that %91 of this 923 students have misconceptions.The lessons with the activities base on modelling was presented to 120 students among 923 students. The misconception percentage for this 120 students was dropped from %100 to %40.

Pideci (2002) investigated secondary students alternative ideas concerning atoms and molecules. She tried to evaluate the teaching strategies in terms of its contrubutions to students' understanding. Pre and the post-test were directed to the students. Results of the pre-test showed that even though they received informal teaching, students still had some alternative ideas on the structure, movement and mass of the atoms/molecules. results of the post-test indicated that some of the teaching strategies like constructivism were very succesful in remedying misconceptions.

Kikas (2004) studied to find out conceptions of trainee, primary and subject teachers about three phenomena: aggregate change of matter, the motion of objects and seasonal changes. A questionnaire was directed to the 198 teachers in Estonia. Teachers evaluated the adequacy of a given explanation as compared to their knowledge of the contemporary scientific explanation. Researcher asked the following question to identify views about aggregate change of matter:
"Water in a glass taken out into the cold. The water freezes. The level of ice in the glass is higher than the previous level of the water. We say that the ice expands in the process of freezing. Please explain why ice expands during freezing? "When iron is heated until it starts to melt, what will happen to atoms in it?"

The findings showed that teachers had various misconceptions relating to this concept. Some of the teachers thought that the molecules of water expand during freezing and the molecules of ice is bigger than those of water. They explained that when iron is heated until it starts to melt, atoms do not change but molecules expand and some of them said that atoms do not change, but the air between atoms expand.

Pallant and Tinker (2004) explored the applicability of computational models in introductory science learning. Two instructionals methods were described that use a molecular dynamics model embedded in a set of online learning activities with middle and high school students in 10 classroom. Pre and post-test were conducted to the students. Pre-test results showed that students have many misconceptions about states of matter, atoms and molecules. After the instructions, middle and high school students acquired robust mental models of the states of matter throught guided explorations of computational models of matter based on molecular dynamics. Researchers stated that students accurately recalled arrangements of different states of matter and they understood the atomic interactions.

2.3 Conceptual Change and Conceptual Change Texts

Students have an active role in learning process. They construct their knowledge through their existing ideas, knowledge or experiences. Meanwhile, students create their own personal meanings by using their ideas. Hence, it is possible to misinterpret the new concepts and to construct misconceptions by using their existing knowledge, experiences. In order to eliminate these miscoceptions or alternative ideas, instructors need to use conceptual change activities.

However, learning involve changing a learner's conceptions and adding new knowledge to what is already there. This view was develop into a model of learning as a conceptual change or constructivism by Posner, Strike, Hewson, and Gertzog (1982) and explained by Hewson (1982). Students can only make sense of new information on their own terms. The conceptual change model describes the conditions under which a student will change one explanation for another. These conditions, in turn, point to the significance of the epistemological bases which underlie students response, and to those, such as generalizability and internal consistency, which are necessary to guide changes to scientifically acceptable conceptions (Hewson & Hewson, 1988, 1992).

Conceptual analyses of the concept of teaching have been carried out by Hirst (1971) and Fenstermacher (1986). The Hirst and Fenstermacher framework can be summarized as follows:

1. Teaching consist of activities and tasks.
2. The tasks of teaching are characterized by their intention or purpose to bring about learning.
3. The tasks of teaching are performed by a teacher.
4. Learning consist of activities and tasks.
5. The tasks of learning are characterized by their intention.
6. The tasks of learning are performed by a learner who has the intention in 5. above.
7. The endstate of achievement of learning has the object of some particular content.
8. The learner is characterized by his/her present state which does not include the content.

9. The tasks of teaching must be “indicative” of the particular content in 7.
10. The tasks of teaching must be related to the present state of the learner in such a way that is possible for the learner to the learn the content referred to in 7.

Posner at al. (1982) and Hewson (1981) claim that learning involves an interaction between new ang existing conceptions with the outcome being dependent on the nature of the interaction. If these conceptions cannot be reconciled, learning requires that existing conceptions be restructured or even exchanged for the new.

Posner at al. (1982) suggest four criteria for changing students’ misconceptions:

1. Students must become dissatisfied with their existing conceptions. When the discrepant event is presented, there must be a dissatisfaction with the existing conceptions.
2. Students must achieve a minimal initial understanding of the scientific conceptions. Students are not going to adopt a new conception unless they can first represent it to themselves. In other words, they must find it intelligible.
3. A new conception must appear initially plausible. It must precisely connected with the current cognitive framework of the concept and related ideas and they must be believable
4. Students must see that the scientific conception is useful in understanding other examples of phenomena. A new concept should suggest the possibility of the fruitful research program.

These cognitive criterias do not define what the teachers or students do in the science classroom. But students must be acitively engaged in wrestling with phenomena, problems or questions. Students must willingly commit themselves to the cognitive struggle of restructuring. They must become motivated to confront actively the inconsistencies or contradictions between their misconceptions and the phenomena. If students percieve an inconsistency and accept the intellectual challenge of resolving it, the teacher may be able to provoke the cognitive restructuring to more spohisticated conceptual understanding (Hyde at al., 1989).

On the other hand conceptual change involves some techniques such as accomodation, reconstructing, replacing a concept (Taylor, 2001). Different models have been developed for conceptual change. Scott, Asoko and Driver (1991) have identified two main groupings of strategies to promote conceptual change. The first grouping was of strategies which are based upon cognitive conflict and the resolution of conflicting perspectives. The second grouping was of strategies which build on learners' existing ideas and extend them, through, for example, metaphor or analogy, to a new domain. Underlying these two groupings were different emphases on where the balance of responsibility for promoting conceptual change in learners may lie. Strategies which emphasise conceptual conflict and the resolution of that conflict by the learner may be seen to derive from a Piagetian view of learning in which the learner's active part in reorganising their knowledge was central. The strategies which build on learners' existing knowledge schemes, extending them to new domains, may be seen to place less emphasis on the role of accommodation by the learner and instead focus on the design of appropriate interventions by the teachers to provide "scaffolding" for new ways of thinking.

Dykstra, Boyle, and Monarch (1992) bring different perspectives to conceptual change process. They suggested that conceptual change is a prograssive process of refinement of students' conceptions and propose a taxonomy of conceptual change including differetiation, class extension and reconceptualization.

Hyde at al. (1989) claimed that the best way for students to acquire the rich conceptual structures of scientfic knowledge is by engaging in those very processes that created it. They must experience the process of creating meaning that will lead to restructuring schemata. Students can become more proficient in these cognitive process by practicing them.

Schott (1992) made a outline of teaching the particle model by using constructivist teaching sequence. It was identified in figure 1. In this study, researcher gave many opportunities to students in order to make their own experiences and to construct their own meaning of the phenomena observed. Students played a simple rule guessing game here. The teacher wrote a number of names at the blackboard following a certain rule (e.g. only names with four letters). Students tried to find out the rule by checking their ideas against evidences. The metaphor of a scientist as a detective was employed in another game in which students were provided with facts of a murder case. They worked in groups in order to find out who the murder is. They checked their hypotheses against the evidence provided. In much the same way they were invited later to check their theories of how matter was composed of particles against the evidences as provided in their experiments. Schott made a constructivist scheme of teaching the particle model.

A.Orientation and elicitation of Pupil ideas	Pupils are asked to describe and explain some simple phenomena related to properties of matter. In thisway their own ideas are made explict and open for inspection.
B.The nature of scientific Theory and theory making	Pupils are introduced to nature of the scientific theory and theory making through simulations and discussionshis being in preperation for section D of the scheme.
C.A pattern of properties of Solid, liquid and gases	Pupils work to identify and develop a pattern of properties in the behaviour of solids, liquids and gases
D. Pupil theory making	Pupils develop their own theories as the nature of solids, liquids and gases. They are encouraged to base their theory making upon the pattern of properties identified in section C.
E.Rewiev reflection and movement towards accepted theory	Pupil theories are complate and evaluated by members of the class. The teacher introduces activities to help pupils towards the accepted science point of view
F.Application of accepted theory	Pupils are given opportunities to apply the accepted theory about the nature of the matter in familiar and novel situations.

Figure 2.1 Constructivist Scheme of Teaching the Particle Model.

There are many other researches that investigate the effect of the conceptual change different science courses. Eryılmaz (2002) investigated the effects of conceptual assigments and conceptual change discussions on students' achievment and misconceptions about force and motion. Test were administered to the 396 high school physics students. It was administered Force Misconceptions and Force Achievement Test to the students as a pre-test. It was assigned five conceptual assignments about force and motion and sudents assigned to the discussion method participated in conceptual change discussion. After the treatment period, the same test administered to the students. The results of the study showed that conceptual change discussion is an effective means of reducing the number of misconceptions that students held.

Mei-Hung Chiu and at al. (2002) investigated students' mental models of chemical equilibrum using main features of cognitive apprenticeship, such as coaching, modeling, scaffolding, articulation, reflection, and explanation in their study. 30 tenth grade students participated to the study. Students divided into control and treatment groups. both groups were presented with hand-on chemical experiments. Students in treatment group were instructed based on the main features of cognitive apprenticeship. However, students in control group were instructed without explict cognitive apprenticeship support. The result supported that the students were instructured based on the main features of cognitive apprenticeship are capable of constructing the mental models of chemical equilibrum.

Conceptual change text is the text that identifies and analyses misconceptions, and it refutes these misconceptions that students have in their mind. It is designed according to conceptual change process. Because, it illustrates inconsistencies between the misconceptions and scientific knowledge (Kim and Van Dunsen, 1998). Many studies have been done to explore effects of conceptual change text on students' conceptions in science courses.

Ünlü (2000) investigated the effects of conceptual change texts in 8^{th} grade students' achivement of atom, molecule, matter concepts. Sample of the study assigned two groups which are control and experimental groups. The experimental group received conceptual change texts through instructor lecture and the control group received traditionally designed science instruction. The results of the study showed that the conceptual change texts instruction group had a significantly higher scores with achievement related to atom, molecule and matter concepts than the traditionally designed science instructional group.

Çakır, Uzuntiryaki and Geban (2002) studied the effects of concept mapping and conceptulal change texts instruction over the traditional instruction on 10^{th} grade students' understanding of acid and base concepts. 110 students from six classes were administered to the study. Two of the classes were instructed with conceptual change text instruction, other two of them were instructed with concept mapping instruction and the two of the classes were instructed traditionally. Pre-test and post-test related with acid-base concepts were conducted to the all students in study. The results of the study depicted that conceptual change and concept mapping instruction provided significantly better understanding of acids-bases concepts than the tradional instruction.

Ceylan (2004) conducted a research to compare the effectiveness of the conceptual change oriented instruction through demostration and traditionally designed chemistry instruction on tenth grade students' understanding of chemichal reactions and energy. 61 tenth grade students adminstered to the tudy. The study included two groups. One of them was control group in which students were taught by traditionally designed chemistry instruction and other of them was experimental group in which students were taught by conceptual change oriented instruction through demostration. The result of the study showed that there was a significant difference between the two groups. Students' understanding of the scientific concepts related to chemichal reactions and energy in experimental group were better than the control group.

Günay (2005) investigated effects of the conceptual change oriented instruction accompanied with analogies and traditionally designed chemistry instruction on tenth grade students' understanding of atoms and molecules concepts. Also, the researcher searched the students' misconceptions related to atoms and molecules. 45 students participated to the study. Pre-test and post-test was adminstered to the students in experimental and control group. Students in experimental group was instructed with conceptual change oriented instruction accompanied with analogies and students in control group was instructed with traditionally designed chemistry instruction. The study showed that conceptual change oriented instruction accompanied with analogies was more effective significantly grasp the scientific knowledge, to understand conceptually the natural phenomena than traditionally designed chemistry instruction.

Chamber and Andre (1997) used conceptual change texts in their study. They investigated the relationship between gender, interest and experience in electricity, and conceptual change text manipulations on learning fundemental direct current concept. The findings support that the conceptual change text manipulations lead to better conceptual understanding of electrical concepts than traditional didactic text.

2.4 Analogies

Analogies express comparison of structures between two domain and identify similarities. Analogies may be valuable tools in teaching and learning difficult scientific concepts. The constructivistic view has become the leading theoretical perspective of science education research on learning process. There are two basic ideas of this view: Learning is an active process and learning is possible only on the basis of previously acquired knowledge. Learning has to do with constructing similarities between the new and existing knowledge. Thus, Analogies are significant in constructivistic learning approach. Duit (1991) explored the role of analogies in the learning process and he stated that analogies are common tools for explaining and trying to make sense of the unknown. Analogies help students to learn and they are helpful because they allow to students to construct their own knowledge by forcing them to view the new knowledge within framework of the analogy. Analogies support learning only specific areas of a target domain. They facilitate the learners' construction process on the grounds of concepts that are already available.

Gabel and Samuel (1986) investigated the use of analogy tasks for detemining difficulties that high school chemistry students might encounter in solving molarity problems. Students completed three test given throughout the school year. These tests were: Analog tests, molarity tests contain problems typically used to determine students' understanding of molarity. The analog test were constructed using lemonade powder as the analog. Pretest-posttest design was used in the study. Results of the study showed that achievement for certain types of problems might be substantially improved through the use of analogs if students saw the connection between the analog and the chemistry problems.

Yanowitz (2001) conducted a study to determine the effects of analogies in the text . Two experiments was used in the study. In first experiment analogical text was used and in second one expository text was used. The texts were related to cells and components. Students were asked to recall the text and answer the inferential questions. The second experiment was performed with different students who read an analogical text once and non analogical text was read twice . ın both of the experiments of the study, students who instructed analogical text were able to demostrate a better inferential reasoning. The result of the study depicted that the analogies in the text seemed to help even the younger elementary school students develop a deeper understanding of the domain than they would have gained without the analogy.

Orgill and Bodner (2003) examined biochemistry students' perceptions of analogies and theri use in biochemistry classes. They interviewed 43 students from two introductory biochemistry classes and one upper level chemistry class. They asked to students if they like analogies, what the advantages and disadvantages are of analogies, how students use analogies, and how analogies should be used to be effective in classes and what the students understood about these analogies. After the analayzing the results they stated that most of the students like analogies and remember the analogies their instructors provide. They use these analogies to understand, visualize, and recall information from class.

Sarantopoulos and Tsaparlis (2004) conducted a research to investigate the use of chemical analogies and their effect on cognitive and affective factors of 10th and 11th grade Greek students in a naturalistic setting. 148 students paricapated to the study. They were randomly divided into expeimental and control group. They taught to students units of modern atomic theory, periodic table of elements, chemical bonds, solutions, acids, bases and salts. In the control group , units were instructed with traditionally designed science instruciton. In experimental group, units were instructed with analogies. The result of the study proved that analogies can be more effective for lower cognitive development students and also for other students. Both developmental level and motivational trait play a definitive role, with the concrete students on the one hand, and the curious students on the other found to be more favourably disposed to this teaching strategy.

Based on implications in the literature, the methodology of teaching is a important factor that influences understanding of science. Conceptual change texts and analogies seem to be satisfactory approaches that can be used to enhance students' understanding of science concepts. The present study tried to compare the effects of conceptual chance texts oriented instruction accompanied with analagoies. Futhermore, a multiple choice test was applied to students in order to identify the students' misconceptions and misunderstandings about atom, molecule, ion and matter concepts in science.

CHAPTER 3

PROBLEM AND HYPOTHESIS

The main problem, sub-problems and hypotheses are presented in this chapter.

3.1 THE MAIN PROBLEMS AND SUB-PROBLEMS

3.1.1 The Main Problem

The purpose of the study was to explore the effects of conceptual chance texts oriented instruction accompanied with analagoies over traditionally designed science instruction on 7^{th} grade students' understanding of atom, molecule, ion and matter concepts and their attitudes toward science as a school subject.

The second purpose of this study is to identify the role of gender, treatment and the interaction between gender and treatment on 7^{th} grade students' understanding of atom, molecule, ion and matter concepts.

3.1.2 Sub-Problems

1. Is there a significant difference between the effects of conceptual chance texts oriented instruction accompanied with analagoies over traditionally designed science instruction on students' understanding of atom, molecule, ion and matter concepts?

2. Is there a significant difference between the performance of boys and girls with respect to students' of traditionally designed science instruction and conceptual chance and analogy instruction on students' understanding of atom, molecule, ion and matter concepts?

3. Is there a significant effect of interaction between gender and treatment on students' understanding of atom, molecule, ion and matter concepts?

4. Is there a significant difference between the effects of conceptual chance texts oriented instruction accompanied with analagoies over traditionally designed science instruction with respect to attitudes towards science as a school subject?

5. Is there a significant difference between the performance of boys and girls with respect to students' of traditionally designed science instruction and conceptual chance and analogy instruction with respect to attitudes towards science as a school subject?

6. Is there a significant effect of interaction between gender and treatment on students' attitudes towards science as a school subject?

3.2 Hypotheses

Hypotheses which are related to problems were developed. These are:

H_o1: There is no significant difference between the post test mean scores of students taught with conceptual chance texts oriented instruction accompanied with analagoies and those taught with traditionally designed science instruction with respect to students' understanding of atom, molecule, ion and matter concepts.

H_o2: There is no significant difference between post-test mean scores of girls and boys with respect to students' understanding of atom, molecule, ion and matter concepts.

H_o3: There is no significant effect of interaction between gender and treatment on students' understanding of atom, molecule, ion and matter concepts.

H_o4: There is no significant difference between the post test mean scores of students taught with conceptual chance texts oriented instruction accompanied with analagoies and those taught with traditionally designed science instruction with respect to attitudes towards science as a school subject.

H_o5: There is no significant difference between post-test mean scores of girls and boys with respect to attitudes towards science as a school subject.

H_o6: There is no significant effect of interaction between gender and treatment on students' attitudes towards science as a school subject.

CHAPTER 4

DESIGN OF THE STUDY

4.1 The Experimental Design

In order to prove the efficiencies of using conceptual chance texts oriented instruction accompanied with analagoies nonequivalent pre-post test control group design was used.

Table 4.1: Research Design of the Study

Groups	Pretest	Treatment	Posttest
GE	AMMICT	CCTI	AMMICT ASTS
GC	AMMICT	TDSI	AMMICT ASTS

EG: Experimental Group Instructed Conceptual Change Text Oriented Instruction Accompanied with Analogies.
CG: Control Group Instructed by Traditionally Designed Instruction
CCTI: Conceptual Chance Texts Oriented Instruction Accompanied with Analagoies Instruction
TDSI: Traditionally Designed Science Instruction
AMIMCT: Atom, Molecule, Ion, Matter Conceptions Test
ASTS: Attitude Scale Toward Science as a school subject.

CG represents the Control Group Using Traditionally designed science instruction. EG represents the Experimental Group instructed by conceptual change text oriented ınstruction accompanied with analogies. Atom, molecule, ion, matter conception achievement test was given to examine the effect of the treatment on the students and it was given to control students previous learning in atom, molecule, ion and matter concepts. In order to determine the students attitudes toward science, attitude scale toward science as a school subject was given to the students.

4.2 Subjects

This study consisted of 70 7th grade students from two classes of a General Science Courses taught by the same teacher in Battalgazi Elementary School in Ankara in 2004-2005 fall semester. Two instruction methods of the study were randomly assigned to the groups. Data for this research was obtained from 35 students participating in conceptual change text oriented ınstruction accompanied with analogies and 35 students participating in traditionally designed science classroom instruction. Number of the boys and the girls in groups are shown in table 4.2.

Table 4.2 Subjects of the Study

	TDSI GROUP	**CCTI GROUP**
GIRLS	21	14
BOYS	14	21
TOTAL	35	35

4.3 Variables

In this study, the variables are classified as dependent and independent variables.

4.3.1 Independent Variables

The treatment that included two different types of teaching methods was independent variable**.** Also, gender differences was taken as another independent variable.

4.3.2 Dependent Variables

Students' understansding of atom, molecule, ion and the matter concepts measured by AMIMCT and students' attitudes toward science as a school subject measured by ASTS were dependent variables of this study. Types of variables are shown in table 4.3.

Table 4.3 Types of Variables

Variables	**Type**
AMIMCT Scores	Dependent
ASTS	Dependent
CCTI and TDSI	Independent
Gender	Independent

4.4 Instruments

In this study, two written test were used. These tests were Atom, Molecule, Ion, Matter Conceptions Test and Attitude Scale Toward Science as a school subject. During the development stage of the test, the alternative conceptions of the students about atom, molecule, ion and matter concepts were determined from the related literature atom, molecule, ion and matter. Therefore it can be expected to be determined misconceptions about atom, molecule, ion and matter concepts fot the students who give the wrong answer. The test were administered to students under standart condition.

4.4.1 Atom, Molecule, Ion, Matter Concepts Test

This test was developed by the researcher and for the content validity the test was examined by a group of expert in science education for appropriateness of the items. The test consists 19 multiple choice items. Each question had one correct answer and the other choices are distracters. Questions were asked to students make a conceptual prediction about a situation. Distracters of items involves the misconceptions and it is possibily to choose the distracters in the test. Misconceptions in the test were given in Appendix B.

The test items in AMIMCT icluded:
Distinction of matter and nonmatter (at macroscopic level)
The particulate nature of matter (at microscopic level)
The nature of particles of the matter
The meaning of number of proton, electron and neutron

The items 1 and 4 in the test were related to distinction of matter and nonmatter. Each question was asked to students in different type. In the first question it was asked that which is matter. In the fourth question it was asked that which are have atoms (See Appendix B).

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The items 3, 6, 7, 8, 9, 10, 11, 14, 15 in the test were related to particle theory of matter.

- Distribution of the particles in the matter was tested by item 3 in the test.
- Heating and cooling cause changes in particle motion. Item 6 and 14 in the test were related to this aspect.
- Gas particles are not pushed externally. Item 8 in the test was related to this aspect.
- When the gas molecules are squashed, distance between the molecules are decreased. Item 7 in the test was related to this aspect.
- Proporties of the particles in atom were tested by items 9, 10, 11 and 15 in the test.

The items 2, 5, 12, 13 in the test were related to shape, size and structure of the particles.
The items 16, 17, 18, 19 in the test were related to atomic number, mass number, number of electron, neutron and proton, cation and anion.

The achievment test that was used in the present study was developed by the researcher according to following procedure.

1) Instructional objectives of the unit 'Atom, Molecule, Ion and Matter' in the curriculum was followed and they were stated in appendix A.
2) The literature related to students' misconceptions on atom, molecule, ion and matter was examined.
3) Students' misconceptions on atom, molecule, ion and matter concepts were classified and they were stated in table 4.4.
4) Every items in the test were constructed interms of the instructional objectives and misconceptions related to atom, molecule, ion and matter concept.

The test was examined by a group of science teachers in Battalgazi Elementary School and experts in science education. Reliability of the questions in this test was found 0,72.

Table 4.4 Classification of Students Misconceptions About The Aspects Of Atom, Molecule, Ion And Matter.

Matter and nonmatter are incorrectly classified.	1A, 1C, 1D, 4A, 4B, 4D
An atom looks like several dots.	2C
An atom resembles a sphere with components inside	2B
An atom looks like ball.	2A
Particles of liquid have no distance	
Particles of liquid have a little distance	3C
Particles of liquid have a lot of distance	3B
Atoms are large enough to be seen under a microscope.	5B, 5C, 5D
When the water evaporate, molecules change.	6A
When the water evaporate, a new matter occurs.	6C
When the water evaporate, molecules seperate to H_2 and O_2.	6D
When the oxygen gas squash, the shape of the molecules change.	7A, 7D
When the oxygen gas squashed, the volume of the gas change and then the mass of the gas will change.	7B, 7D
Gas molecules are continuous.	8A, 8B, 8C
Protons have a mass of one gram.	9B
Electron doesn't play any role in chemical reactions but proton and neutron have roles.	10B, 10C, 10D
The source of gravitational force of the nucleus in atom is proton.	11B
Atoms can be squashed.	12A
Atoms can be squashed and their shape can be change.	12B
When the atom squash they transform another atom.	12D
Molecules of water have no shape.	13A, 13C
Atoms in molecules of water are liquid.	13D
When the gas molecules are heated, they will expand	14C
When the gas molecules are heated, they will transform to different molecules.	14D
If an atom takes or gives an electron, number of proton and neutron in nucleus change.	15A
If an atom takes an electron; it is called that cation,catode or anode	16B, 16C, 16D
Number of proton in different two atoms are not different but mass number and number of neurtons are absolutely different.	18B, 18C, 18D

4.4.2 Attitude Scale Toward Science

This scale was developed by Geban and Ertepınar (Geban et al., 1994) to measure students' attitudes toward science as a school subject. This instrument contains 15 items in a point likert type scale (fully agree, agree, undecided, partially agree, and fully disagree) in Turkish. The scale is 5 point and there are positive and negative statements. The reliability coefficient of this scale was found to be O,82. It was given to the all students in this study (see Appendix D).

4.5 Treatment (CCTI and TDSI)

This study was conducted over 4 weeks during the 2004-2005 fall semester. A total of 70 students in a elementary school were participated in two science classes of the same teacher. Two different treatments were used in this study. Traditionally designed science instruction was utilized to the students in control group and conceptual change text oriented ınstruction accompanied with analogies was utilized in experimental group.

During the treatment the topics related to atom, molecule, ion and matter were covered as a part of the regular classroom curriculum in the science course. The course of the regular schedules is three 40 minutes periods per a week and this study was conducted four week.

Lecture and discussion methods were used in the traditionally designed science instruction courses. Teaching methods was based on explanations, textbooks and questioning. Hence, the misconceptions that students had were not took into account. Definition, explanation and concepts were presented on the blackboard. Also, teacher solved quantitative problems which are based on Ortaokul Kurumlar Sınavı.

However, the conceptual change texts and texts accompanied with analogies were given to 35 students in experimental group. Texts was prepared by the researcher by searching for the related literature. Conceptual change texts identified the misconceptions about atom, molecule, ion and matter concepts and corrected them by giving analogies, examples, figures and scientific explanation. Scientific knowledge and explanation in the texts are intelligible and plausable. Thus, students were expected to be dissatisfied with their previous knowledge, then they were corrected by using analogies, examples, figures and scientific explanation. Students activated to make a prediction about the situation. It was given some evidence that the misconceptions are incorrect. Thus, it was provided to reach the scientifically correct explanation.

The teacher started the lecture with an inquiry questions to activate students'exisiting knowledge and misconceptions. Teacher attempted to provide a discussion environment and also she tried to find out students misconceptions about atom, molecule, ion and matter concepts. During the treatment, each conceptual change text was showed to the students by using projector. Teacher acted as a guide in the discussion.

Conceptual change text were given in the class hour. Analogies were used in some conceptual change texts. The concepts used in the conceptual change text to search the misconceptions can be underlined the following content outline:

1. Classification of matter and nonmatter
2. Particulate nature of matter (analogy was used in this conceptual change te)

- motion of the particles in solid, liquid and gas
- composition of the matter
- speed of the particles in solid, liquid and gas
- space between the particles solid, liquid and gas

3. Structure of the matter

- structure of the atom (analogy was used in this conceptual change text)
  - movement of electron
  - movement of proton
  - movement of neutron
- structure of the molecule
- structure of ion (cation and anion)
- size and shape of an atom
- size and shape of a molecule

4. Atomic number and mass number

Conceptual change texts were prepared according to students common misconceptions on atom, molecule, ion and matter concepts in the literature.

4.6 Analyses of Data

ANOVA was used to determine the effectiveness of the two different instructional methods and gender differences in students' understanding of atom, molecule, ion and the matter concepts. In addition, it was used to determine the differences between the post test mean scores of the students in CCTI group and TDSI group with respect to their attitudes toward science as school subject.

4.7 Assumptions and Limitations

4.7.1 Asumptions

1-There was no interaction between students in control group and experimental group.
2- The teacher was not biased during treatment.
3- All subjects in both groups were accurate and sincere in answering the questions in test.

4.7.2 Limitations

1-The subject of the study limited to 70 students in two classrooms.
2- The subject of the study were limited to 7^{th} grade students.
3- The study was limited to matter, molecule, atom and ion.

CHAPTER 5

RESULTS AND CONCLUSIONS

In this chapter, the results obtained from the treatment is presented according to the hypothesis stated in Chapter 3. the hypothesis are tested at a siginificance level of 0.05, ANOVA model was used to test hypothesis. Statistical analyses were caried out by SPSS (Statistical Package for Social Sciences for Personal Computers).

5.1 Results

In order to find out students' prior knowledge about atom, molecule, ion and matter concepts, an achievment test were given to students before the treatment. The analyses showed that there was no significant differences between CCTI group and TDSI group in terms of atom, molecule, ion and matter concepts achievement ($t=0.000$, $p>0.05$).

5.1.2.Hypothesises

Hypothesis 1

To answer the question posed by hypothesis 1 stating that there is no significant difference between the post test score of the students taught by CCTI and those taught by TDSI with respect to understanding of atom, molecule, ion and matter concepts analysis of variance was used. The analysises of data is summarized in Table 5.1.

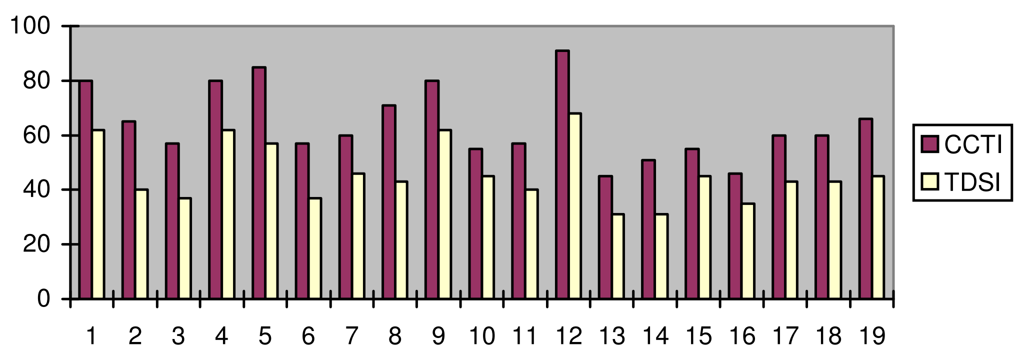
Table 5.1 ANOVA Summary

Source	Sum of square	DF	Mean Square	F	Sig.
Corrected Model	82,346 [a]	3	27,446	3,637	0,017
Intercept	6617,053	1	6617,053	876,851	0,000
Group	79,230	1	79,230	10,499	0,002
Gender	4,053	1	4,053	0,537	0,466
Interaction	2,170	1	2,170	0,288	0,594
Error	513,154	68	7,546		

The analyses result showed that the post test mean scores of CCTI group and TDSI group with respect to understanding of atom, molecule, ion and matter were significantly different ($F=10.49$, $p<0.05$). CCTI group scored significantly higher than the TDSI group ($\bar{X}$ (CCTI) = 10.78; $\bar{X}$ (TDSI) = 8.72).

Correct

Proportion



Number of Items

Figure 5.1 The Correct Responses to The Questions in The Posttest.

As seen in figure 5.1 there is a difference between CCTIgroup and TDSI group achievement. The avarage percentage of correct responses of CCTI group was %67 while that of TDSI group was %47. The differences was easily seen questions 3, 5, 8, 12 .

As it was examined the proportion of misconceptions of two groups, it was seen that some of the misconceptions were used much than the others. It was given proportion of misconceptions in some questions:

For the first question students had to distinguish examples of matter (door, human body, cloud) and nonmatter (heat). Most of the students responded this question correctly (%80 of students in CCTI and %62 of students in TDSI). However in both groups, %50 of the students taught that 'cloud' is not a matter and %15 of them taught 'door'; %35 of them taught the 'human body' is nonmatter.

The students were asked about structure and shape of the atoms in question two. %65 of the students in CCTI group and %40 of the student in TDSI group responded this question correctly. Howerer in both groups, %20 of the students taught that an atom resembles a solid sphere with components; %50 of them taught that an atom look like several dots around nucleus.

Feature of fourth question was that it adressed a misconception which was related particulate nature of matter. Students distinguished heat, light and perfume according to their particulate nature. %66 of the students in CCTI group and %43 of the student in TDSI group responded this question correctly and they choosed perfume. Howerer in both groups, %50 of the students responded the question wrongly and %21 of them choosed perfume and heat; %29 of them choosed light.

It was asked to identify the correct size of an oxygen molecule in question 5. %85 of the students in CCTI group and %57 of the student in TDSI group responded this question correctly. Howerer in both groups, %43 of the students taught that the molecule is as big as a speck of dust; %33 of them taught that the molecule is as big as a germ; %24 of them taught that it is as big as the size the point on pencil.

Feature of the sixth question was that it asked to students the correct statement about the variation of water molecules during the evaporation process. %57 of the students in CCTI group and %37 of the student in TDSI group responded this question correctly. Howerer in both groups, %41 of the students taught that when the water evaporate, it seperates to oxygen and hydrogen .%35 of them taught that a new matter occurs. %24 of them are taught that atoms in the water molecules change.

The students were asked what happens to atoms in a flower when squashed by a car in question12. %91 of the students in CCTI group and %68 of the student in TDSI group responded this question correctly. Howerer in both groups, %50 of the students taught that atoms in the flower change to another atoms. %35 of them taught that shape of the atoms will change; %15 of them taught that atoms will disappear.

Hypothesis 2

To answer the question posed by hypothesis 2 stating that there is no significant difference between post test mean scores of the girl and boy with respect to students understanding of atom, molecule, ion and matter concepts, analysis of variance was used. The results are shown in the table 5.1. Gender didn't make a significant contribution to the variation in understanding ($F=0.534$, $p>0.05$). there was no statistically significant difference between boys and girls with repect to understanding of atom, molecule, ion and matter concepts.

Hypothesis 3

To answer the question posed by hypothesis 3 stating that there is no significant effect of interaction between gender and treatment in students' understanding of atom, molecule, ion and matter concepts, analysis of variance was used. The results are shown in the table 5.1. Interaction between gender and treatment didn't make significant contribution to the variation in understanding ($F=0.288$, $p>0.05$).

Hypothesis 4

To answer the questions posed by hypothesis 4 stating that there is no significant difference between the post test score of the students taught by CCTI and those taught by TDSI with respect to attitudes towards science as a school subject, analysis of variance was used. The analysises of data is summarized in Table 5.2.

Table5.2 ASTS Result

Source	Sum of square	DF	Mean Square	F	Sig.
Corrected Model	105,483 [a]	3	35,161	0,514	0,674
Intercept	6617,053	1	257053,776	3756,326	0,000
Group	79,230	1	0,557	0,008	0,927
Gender	4,053	1	13,337	0,195	0,660
Interaction	2,170	1	89,786	1,312	0,256
Error	513,154	68	68,432		

The analyses result showed that the post test mean scores of CCTI group and TDSI group with respect to attitudes towards science as a school subject were not significantly different (F=0,008 p>0.05).

Hypothesis 5

To answer the question posed by hypothesis 5 stating that there is no significant difference between post test mean scores of the girl and boy with respect to attitudes towards science as a school subject , analysis of variance was used. The results are shown in the table 5.2. Gender didn't make a significant contribution to the variation in understanding (F=0.195, p>0.05). there was no statistically significant difference between boys and girls with respect to attitudes towards science as a school subject

Hypothesis 6

To answer the question posed by hypothesis 6 stating that there is no significant effect of interaction between gender and treatment on students' attitudes towards science as a school subject, analysis of variance was used. The results are shown in the table 5.2. Interaction between gender and treatment didn't make significant contribution to the variation on students' attitudes towards science as a school subject ($F=1.312$, $p>0.05$)

5.2.Conclusion

It can be deduced the following conclusions from the results of the study:

- Acquisition of scientific conceptions related to atom, molecule, ion and matter concepts were significantly better in CCTI than TDSI.
- Elimination of misconceptions related to atom, molecule, ion and matter concepts were significantly better in CCTI than TDSI.
- Gender was not a strong predictor for the understanding of atom, molecule, ion and matter concepts.
- Interaction between gender and treatment was not a strong predictor for the understanding of atom, molecule, ion and matter concepts.
- Gender was not a strong predictor for attitudes towards science as a school subject
- Both CCTI and TDSI caused statistically the similar attitudes towards science as a school subject.
- Interaction between gender and treatment was not a strong predictor for the attitudes towards science as a school subject

CHAPTER 6

DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

In the previous chapter the results are stated, in this chapter these results will be discussed and they will be interpreted. For the further research, the implications and recommendations will be presented for the further researches.

6.1 Discussion

The main purpose of this study was to compare the effectiveness of the Conceptual Change Texts Oriented Instruction accompanied with analogies instruction and Traditionally Designed Science Instruction in 7^{th} grade students' understanding of atom, molecule, ion and matter concepts. In addition to this, the misconceptions which are related to atom, molecule, ion and matter concepts were searched and investigated.

Before the treatment, 'the atom, molecule, ion and matter concepts test' was administered to the students in control and experimental group. As the results analaysed, it was found that there was no significant difference between the pretest mean scores of two groups. This results showed that the both groups were equal in terms of achievement related to atom, molecule, ion and matter concepts. After the treatment of two groups, the same test was given as a posttest to the subjects of the study. Then, the results of the posttest analysed and the effects of conceptual change text instuction and traditionally science instruction were compared in terms of understanding of atom, molecule, ion and matter concepts.

As it was compared the posttest mean scores of experimental group instructed CCTI and control group instructed TDSI, it was found that there were significant difference between the two groups. The results showed that students' understanding of scientific conceptions in experimental group are better than the students in control group. It became possible to conclude that conceptual change text instruction with analogies was more effective to grasp the scientific knowledge to understand conceptualy the natural phenomena than tradionally designed instruction. At the same time, this result supported the idea that traditional desing science instruction is not enough to eliminate the misconceptions. In this study, a significant difference in AMMICT post score was investigated for the CCTI group and TDSI group whose avarage correct responses for AMMICT are %67 and %47 respectively. These results are supported findings by Çakır, Uzuntiryaki, Geban (2002); Andre, Chamber (1997); Günay (2005) that conceptual change text instruction was more effective to get better understanding of scientific conceptions. High score of the students CCTI group may come from conceptual change text instrucion. Because students' existing ideas and misconceptions were very important in this instruction. Students consider their pre-existing knowledge and they create a conflict between their misconceptions and they realize that their pre-existing ideas are inconsisitent with scientific knowledge. Because of this conflict, dissatisfaction occurs in students misconceptions. By this way, this dissatisfaction enabled conceptual change texts to reconstruct the compatible knowledge of students in CCTI group and realize their miscoceptions. As a result, conceptual change text caused students in CCTI groupto raise their scores on post-test scores of AMMICT and to gain more conceptual understanding.

However, in conceptual change text instruction the conceptions were instructed to the students in different ways. By using prior knowledge of the students in conceptual change text instruction, special learning statements were constructed. In treatment group students became activated in the classroom. While the conceptual change text was being examined, students were encouraged to discuss and share their ideas. Students' alternative ideas and scientific explanation were given in qualitative examples, and the students activated to find out the descriptive evidence in the text. It was provided by asking questions about the examples consisting misconceptions. During this process, there was a close interaction between the instructor and the students. Instructor guided the discussions that could facilitate the meaningful and conceptual learning. This discussion environment caused dissatisfaciton and reconstructing the existing knowledge and acquisition the scientific knowledge.

Thus, students were able to acquire feddback for the accuracy of their existing knowledge and they were able to aware of the inconsistency between their intuitive ideas and scientific explanation. Therefore, students realize that their intuitive ideas are inadequate to explain the descriptive events. The study showed that activating students' prior knowledge and refuting their misconceptions led to enhance students' understanding of the conceptions and their achievement.

In traditionally science instruction, the science class sessisions were based on the teacher explanations of scientific phenomena, logical presentation of knowledge, some examples given in the textbooks. Students' previous knowledge or misconceptions related to atom, molecule, ion and matter concepts were not took into the account in this instructions. Discussion of the concepts were limited so that students' engagement to science class sessisions in TDSI were were confined to explaining the concepts and solving the quantitative problems. Students in TDSI had less abilitiy to grasp the concepts and their scores from post-test of the AMIMCT which is composed of conceptual questions were low. Traditionally instruction didn't give enough progress in understanding the concepts related to atom, molecule, ion and matter concepts

The attitude scale toward science as a school subject was administered to all students in two groups. When the results of the study analysed it was found that there was no significant difference between the test scores of the conceptual change text instruntion group and traditionally science instruction group in terms of attitudes toward science as a school subject. The results indicated that statistically development of experimental group and control group are similiar. Students attitudes toward science have been constructed from first science course in their education life. Conceptual change text instruction was administered to students a 4 week period. This is short time to change students attitude toward science. In order to have more positive attitude, the new method may need to be used for more length time period.

One of the results of the analyses was the gender effect on understanding of atom, molecule, ion and the matter concepts. The result of the analyses showed that there was no significant difference between girl and boy with respect to understanding of atom, molecule, ion and the matter concepts. During the treatment, girls and boys were exposed the same materials, teaching methods in both TDSI and CCTI group classes. In other words, boys and girls were under the same conditions. That factor may be the reason of this analyses' result.

In summary, the present study tried to search and determine the misconceptions about atom, molecule, ion and the matter concepts in science. It showed that the conceptual change text oriented instruction accompanied with analogies provided better conceptual understanding of atom, molecule, ion and the matter concepts than the traditional instuction in science. This research also indicated tah conceptual change text oriented instruction has a significant importance as a teaching strategy to identify the misconceptions in science concepts.

6.2 Implication

The implications of the presents study are:

1. Misconceptions have an important role in understanding of the concepts. So, teachers must be aware of the students' misconceptions and pre existing knowledge about the concepts.

2. Misconceptions and students' pre existing knowledge may prevent the conceptual understanding of the sicence.

3. In order to find out the students' misconceptions, teachers should ask some questions to students. These misconceptions should be identified in behavioral objectives that were determined by the teacher.

4. Teachers must develop such teaching strategies that students think about their pre existing knowledge, misconceptions and that they can easily eliminate these misconceptions.
5. Conceptual change text and analogy can cause a better understanding of science concepts.

6. Teachers should be informed and encouraged to use conceptual change text in instructional activities.

7. Traditionally instruction is not enough to understand conceptually science phenomena.

8. Teacher must pay attention the concepts, figures, examples and language that used in the texts and textsbook.

9. It can be produced dissatisfaction with pre existing knowledge by using conceptual change texts.

10. Students thinking ability can be enhanced by using conceptual change texts.

11. Conceptual change texts and analogies help students to understand the abstract concepts. Matter and particulate nature of the matter are fundemental part of the science education. Matter, atom, molecule and ion are base of the other chemistry concepts like chemichal bonds and electrochemistry. These concepts seem to be abstract to students. So, conceptual change texts and analogies can be effective in understanding of them.

6.3 Recommendations

The recommendations of the present study are;

1. For further research, different science subjects may be choosed to investigate the effects of conceptual change text instruction.
2. For further research, sample size can be increased and can be generalized to cities in different region.
3. Further research can be conducted to students in high school and university.
4. Further research can be conducted to trainee teachers.
5. Further research can be done in long period

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APPENDIX A

INSTRUCTIONAL OBJECTIVES

General Objectives:

To know the nature and structure of matter.

Behavioral Objectives:

1-To define matter

2-To distinguish between examples of matter and examples of nonmatter.

3-To describe the particulate nature of matter.

4-To identify size of atom.

5- To identify size of molecule.

6-To describe electrons.

7- To describe protons.

8- To describe neutrons.

9- To describe ions.

10-To define atomic number and mass number.

General Objectives:

To understand the nature and structure of matter.

Behavioral Objectives:

1-To explain intrinsic motion of particles in all phases.

2- To explain distrubition of particles in all phases.

3- To explain scattering of gases is an enclosed space.

4-To draw evenly scattering of gases in an enclosed space after evacuation of some gases in it.

5-To describe states of matter at molecular level.

6-To explain expansion of gases at molecular level.

7-To explain compression of gases at molecular level.

8-To draw the best representation of the structure of the atom.

9-To understand electrons.

10- To understand protons.

11- To understand neutrons.

12-To discriminate atom and molecule.

13-To understand relationship protons, neutrons, electrons within an atom.

14-To discriminate size of an atom and molecule.

15-To explain cation.

16- To explain aion.

17-To explain difference between hot and cool air in terms of molecules.

APPENDIX B

ATOM MOLEKÜL MADDE İYON KAVRAMLARI TESTİ

Adı: Soyadı: Sınıfı:

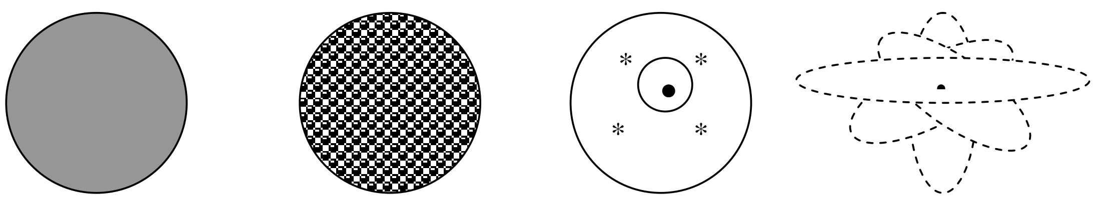
YÖNERGE: Aşağıda çoktan seçmeli sorular verilmiştir. Lütfen, her soru için doğru olan cevabı işaretleyiniz.

1)Aşağıdakilerden hangisi bir madde değildir?

A) Kapı B) Isı C)İnsan vücudu D) Bulut

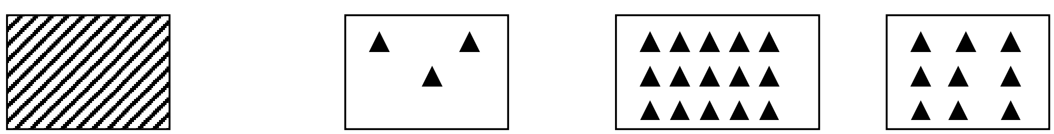
2)Aşağıdakilerden hangisi atomun yapısını en iyi temsil eder ?

A) B) C) D)



3)Aşağıdaki şekillerden hangisi sıvı yağ içindeki moleküllerin dağılımını gösterir?

A) B) C) D)



4)Aşağıdakilerden hangisi ya da hangileri maddedir?

I)Işık

II)Parfüm kokusu

III)Ses

A) Yalnız I B)II ve III C) Yalnız II D) I ve III

5)Bir oksijen molekülünün büyüklüğü aşağıdakilerden hangisi gibi olabilir?

A) Mikroskopla görülemeyecek derecede küçük

B) Mikrop büyüklüğünde

C) Toz zerreciği kadar

D)Toplu iğne ucu kadar

6)Su, sıvı halden gaz hale geçtiği zaman, suyu oluşturan moleküllerdeki değişiklik hakkında söyleyebileceğimiz yargılardan hangisi doğru olur?

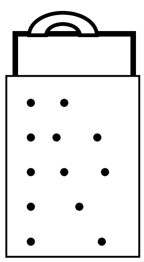
A) Su gaz hale geçince içindeki moleküllerde değişir.

B) Su gaz hale geçince içindeki moleküllere hiçbir şey olmaz.

C)Su gaz hale geçince yeni bir madde oluşur.

D)Su gaz hale geçince içindeki kendini oluşturan Hidrojen ve Oksijene ayrılır.

7)Yandaki şekilde bulunan kap içinde Oksijen gazı bulunmaktadır. Piston aşağı doğru itilerek içerideki gaz sıkıştırılmaktadır



Buna göre aşağıdaki yargılardan hangisi yada hangileri doğrudur?

I-Oksijen molekülleri birbirine daha yakın dururlar.

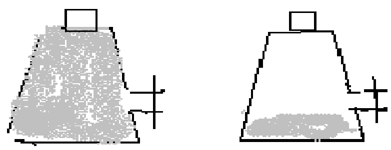
II-Oksijen molekülleri sıkıştığı için moleküllerin şekli değişir

III-Kabın hacmi değiştiği için içindeki gazın kütlesi değişir.

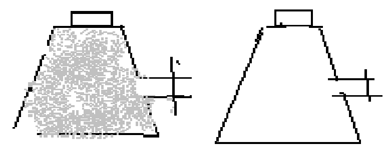
A) I ve II B) I ve III C) Yalnız I D) I, II, III

8) Aşağıdaki kaplar içinde hava bulunmaktadır. Musluklar kısa bir süreliğine açılıp kapatılarak, havanın bir kısmı dışarı çıkarılmaktadır. Buna göre gaz çıkışından önceki ve sonraki durum aşağıdaki şekillerden hangisi gibi olur?

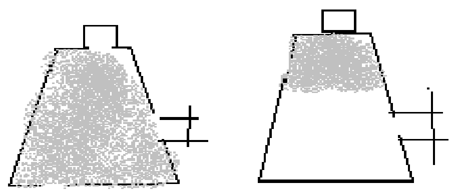
A)



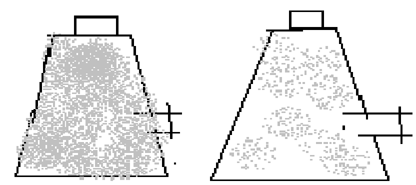
B)



C)



D)



9)Aşağıdakilerden hangisi proton için söylenemez?

A)Çekirdeğin içinde bulunur.

B) Kütlesi bir gramdır.

C)Protonun sayısı atom numarasını belirler.

D) Kesinlikle hareket edemez.

10) Kimyasal değişimlerde etkili olan tanecik aşağıdakilerden hangisidir?

A)Elektron B)Nötron C) Proton D)Proton-Nötron

11)Aşağıdaki ifadelerden hangisi yanlıştır?

A)Proton ve nötronlar atomun çekirdeğindedir.

B)Çekirdeğin çekim gücü protondan kaynaklanır.

C)Çekirdeğe yakın elektronlar çekirdek tarafından daha kuvvetli çekilirler.

D)Protonun kütlesi elektrondan daha büyüktür.

12) Yolda bulunan bir çiçeğin üzerinden araba geçmiştir ve çiçek tamamen ezilmiştir.Buna göre çiçeğin içindeki atomlar hakkında ne söylenebilir?

A)Atomlarda ezilir ve yok olur.

B)Atomlar ezilerek belirsiz bir şekle dönüşür.

C)Atomlara hiçbir şey olmaz.

D)Atomlar değişerek başka bir atoma dönüşür.

13)I-Su moleküllerinin belirli bir şekli yoktur.

II-Su molekülü oksijen ve hidrojen gazının birleşimidir.

III-Su molekülünün içindeki atomlar da sıvı halde bulunur.

Yukarıda verilen yargılardan hangisi ya da hangileri doğrudur?

A)Yalnız I B)Yalnız II C) I ve II D)I ve III

14) Bir öğrenci plastik şişenin ağzına balon geçiriyor ve bu şişeyi öce soğuk su dolu bir kapta bekletiyor ve balona hiçbir şey olmadığını görüyor. Daha sonra sıcak su dolu bir kaba koyuyor ve balonun şiştiğini gözlemliyor. Bu deneye göre öğrenci aşağıdaki yargılarlardan hangisine ulaşabilir?

A)Su molekülleri şişeden geçip gaz hale gelir ve balonu şişirir.

B)Şişenin içinde bulunan gaz moleküllerinin ısınınca enerjileri artar ve yükselirler böylece balon şişer.

C)Şişenin içinde bulunan gaz molekülleri ısınınca genleşirler, büyürler ve balon şişer.

D) Şişedeki gazlar ısındığında başka moleküllere dönüşürler ve balon bu nedenle şişer.

15)Bir X atomu elektron aldığında yada verdiğinden aşağıdakilerden hangisinde değişme olmaz?

A)Çekirdek yükü C)Atom çapı

B)Fiziksel özellikleri D)Kimyasal özellikleri

16)Elektron almış iyona ne ad verilir?

A) Anyon B) Katyon C)Anot D) Katot

17) $_{11}Na^{+1}$ iyonu için aşağıdakilerden hangisi yanlıştır?

A)Atom numarası=11 C)Kütle numarası=11

B)Elektron sayısı=10 D)Protonsayısı=11

18) Birbirinden farklı iki atom için aşağıda verilen niceliklerden hangisi yada hangileri aynı olamaz?

I-Proton sayısı

II-Nötron sayısı

III-Kütle numarası

A)Yalnız I B)I ve II C)I ve III D)I, II ve III

19) Atom numarası 13, kütle numarası 27 olan atomun e^-,p^+ ,n^0 sayıları nedir?

	e^-	p^+	n^0
A)	13	13	14
B)	13	14	13
C)	13	14	14
D)	14	27	13

APPENDIX C

FEN BİLGİS DERSİ TUTUM ÖLÇEĞİ

AÇIKLAMA: Bu ölçek Fen Bilgisi dersine ilişkin tutum cümleleri ile her cümlenin karşısında Tamamen Katılıyorum, Katılıyorum, Kararsızım, Katılmıyorum ve Hiç Katılmıyorum olmak üzere beş seçenek verilmiştir. her cümleyi dikkatle okuduktan sonra kendinize uygun olan seçeneği işaretleyiniz.

	Tamamen Katılıyorum	Katılıyorum	Kararsızım	Katılmıyoru	Hiç Katılmıyoru
1.Fen Bilgisi çok Sevdiğim bir alandır.	☐	☐	☐	☐	☐
2. Fen Bilgisi ile ilgili kitaplar okumayı severim.	☐	☐	☐	☐	☐
3. Fen Bilgisinin günlük yaşamda pek yeri yoktu	☐	☐	☐	☐	☐
4. Fen Bilgisiyle ilgili ders problemlerini çözmel ten hoşlanırım.	☐	☐	☐	☐	☐
5. Fen Bilgisi konuları ile ilgili daha çok şey öğrenmek isterim.	☐	☐	☐	☐	☐
6. Fen Bilgisi dersine girerken sıkıntı duyarım.	☐	☐	☐	☐	☐
7. Fen Bilgisi dersine zevkle girerim.	☐	☐	☐	☐	☐
8. Fen Bilgisi derslerine ayrılan sürenin daha çok olmasını isterim.	☐	☐	☐	☐	☐
9. Fen Bilgisi dersine çalışırken canım sıkılır.	☐	☐	☐	☐	☐
10.Fen Bilgisi konularını ilgilendren günlük olay lar hakkında daha fazla bilgi edinmek isterim.	☐	☐	☐	☐	☐
11.Düşünce sistemimizi geliştirmede Fen Bilgisi öğrenimi önemlidir.	☐	☐	☐	☐	☐
12. Fen Bilgisi çevremizdeki doğal olayların anla şılmasında önemlidir.	☐	☐	☐	☐	☐
13.Dersler içinde Fen Bilgisi dersi sevimsiz gelir	☐	☐	☐	☐	☐
14. Fen Bilgisi konuları ile ilgili tartışmaya katıl- mak bana cazip gelmez.	☐	☐	☐	☐	☐
15.Çalışma zamanının önemli bir kısmını fen bilgisine ayırmak isterim.	☐	☐	☐	☐	☐

APPENDIX D

CONCEPTUAL CHANGE TEXTS
(KAVRAMSAL DEĞİŞİM METİNLERİ)

“Katı, sıvı, gaz içindeki taneciklerin hareketleri ve birbirlerine olan uzaklıkları nasıldır?”

Birçok insan bazı Fen konularını anlamakta güçlük çeker. Öğrenme süreci çinde yeni bilgiyi yanlış yorumlayarak bazı yanlış kavramalara sahip olabilirler. Katı, sıvı ve gaz içindeki taneciklerin hareketleri ve birbirlerine olan uzaklıkları hakkında bazı yanlış kavramalar mevcuttur.

Bazı insanlar, katı bir madde içindeki taneciklweerin arasında boşluk olmadığını ve taneciklerin hareket etmediklerini düşünmektedirler. Oysa tanecijkler arasında çok az da olsa bir boşluk vardırve tanecikler titreşim hareketi yaparlar. Sınıftan seçeceğimiz dört öğrencinin katı bir maddenin tanecikleri olduğunu düşünelim. Bu öğrencilerin dizilişleri birbirine çok yakın olacaktır . Tanecik olarak düşündüğümüz bu öğrenciler titreşim hareketi yapacaklardır. Eğer tanecikler arasında hiç boşluk olmasaydı, tanecikler hareket edebilrler miydi? Bazı insanlar tanecikler arsında boşluk olmadığını ve bu nedenle hareket etmediklerini düşünmektedirler. Oysa, tanecikler arsında boşluk vardır ve hareket ederler.. ancak, katı madde içindeki tanecikler arasındaki bağ çok kuvvetlidir ve birbirlerini sıkıca tutarlar.

Sınftan seçeceğimiz dört öğrencinin sıvı bir maddenin tanecikleri olduğunu düşünelim. Bu öğrencilerin dizilişlerinde katıya nazaran, biraz daha çok boşluk olacaktır. Kimi insanlar sıvı maddenin tanecikleri rasında boşluk olmadığını ya da katının tanecikleri arasında olan boşlukla aynı olduğunu düşünmektedirler. Oysa ayın boşluğa sahip olsalardı, sıvı madde de katı madde gibi sert olurdu. Ancak sıvı tanecikler arsındaki boşluk katıdakine nazaran daha çoktur sıvı maddedeki tanecikler arasındaki bağ katılara kıyasla daha zayıftır. Bu sayede sıvı maddenin akışkanlık özelliği vardır.

Kimi insanlar da sıvının tanecikleri arsında boşluk olmadığını düşünmektedirler. Oysa, tanecikler arasında boşluk olmasaydı; hareket edebilirler miydi? Örneğin küçük bir odanın içine yüzlerce insanı sığdırmaya çalıştığınızı düşünün. Bir şekilde insanları odanın içine yerleştirdiniz ve kapısını kapattınız. Böyle bir durumda insanlar hareket edip yürüyebilirler mi? Elbetteki yürüyemezler. İşte, sıvı maddenin tanecikleri arasında da boşluk olmasaydı, sıvının akışkanlık özelliği olmazdı. Sıvının içindeki tanecikler birbirlerinin üzerinden sürekli kayarak hareket ederler. Bu sayede de sıvının akmasını sağlarlar.

Sınıftan seçeceğimiz diğer dört öğrencinin de gaz bir maddenin tanecikleri olduğunu düşünelim. Bu öğrencilerin dizilişleri birbirlerine uzak olacaktır ve taneciklerin hareketleri çok hızlı olacaktır. Öğrencilerin arasında çok boşluk olduğuna göre; bu öğrenciler hareketlerini rahat bir şekilde gerçekleştirirler mi? Evet, elbetteki rahat hareket ederler öyleyse gazın içindeki tanecikleri de böyle düşünebiliriz. Tanecikler arasında bulunan bağ katı ve sıvı taneciklerin bağlarına nazaran oldukça zayıftır. Bu nedenle tanecikler rahatça ve hızlı bir şekilde hareket ederek, birbirlerine ve bulundukları kabın iç çeperine çarparlar. Peki, gazlar bulundukları kabın şeklini sıvılar gibi alırlar mı? Bazı insanlar, gazın kabın şeklini almayacağını ve tanecikler arsında bulunan boşluğun bunu etkilemeyeceğini düşünürken; sıvının bu özellliğini kabul etmektedirler. Sıvı tanecikler arsında boşluk olması ve taneciklerin bağlarının katı gibi çok kuvvetli olmaması sayesinde sıvının bulunduğu kabın şeklini aldığını bildiğimize göre; gazın da bunu yapabilmesi gerekmez mi? Elbetteki gerekir çünkü, gazlar arasında hem daha çok boşluk vardır hem de daha zayıf bir bağ vardır.

"Atomlar ezilir mi ya da atomlar yok olabilir mi?"

Bir çiçek düşünelim. Bu çiçeğin üzerine 10 ton ağırlık bıraktığımız zaman çiçeğin çindeki atomlara ne olur?

Figure D.1 Ezilen çiçek içindeki atomlar

Bu sorunun cevabına kimi insanlar atomlar öldü diye yanıt verirler. Peki atomlar canlı mıdır ki ölürler? Yine bazı insanlar atomların canlı olduğunu düşünerek evet yanıtını verirler. Oysa, atomlar canlı olsalardı bizim gibi solunum, boşaltım yapması ya da bitkiler gibi fotosentez yapması gerekmez miydi? Elbetteki canlı olması için solunum, boşaltım, üreme gibi bazı faaliyetleri yapması gereklidir ve atomlar bunları yapamazlar. Ancak atomların içindeki elektronlar hareket edebilirler. Yalnızca hareket edebilme özellikleri var diye atomlara canlı diyebilir miyiz? Oysa, duran bir topa vurduğumuzda da top hareket etmektedir ya da arabaya benzin koyup çalıştırdığımızda da araba hareket etmektedir. Öyleyse, top ve arabaya da canlı dememiz gerekir ancak onların cansız olduğunu biliyoruz. Bu bağlamda atomların hareket özelliğine bakarak canlı dememiz doğru olmayacaktır. Atomlar cansızlardır. Ancak sahip oldukları bir enerji vardır ve bu enerji sayesinde hareket ederler.

Bazı insanlar ise çiçeğin içindeki atomların ezildiğin düşünmektedirler. Ancak çiçeğin çindeki atomların ezilmesi demek, onun içindeki nötron, proton ve elektronların da ezilmesi anlamına gelir. Proton ve nötronun kesinlikle hareket etmediklerini ve hareket ettiklerinde çok büyük bir enerji açığa çıkacağını, büyük bir patlama olacağını biliyoruz. Öyleyse atomların ezilmesi söz konusu olamaz eğer ezilselerdi atom bombası gibi büyük bir patlama olurdu.

Bazı insanlar da atomların yok olacağını düşünmektedirler. Oysa, atomlar yok olsalardı ezilmiş çiçek görülebilir miydi? Elbetteki görülemezdi ama çiçek ezilse dahi çiçek yok olmuyor öyleyse atomların yok olduğunu söylemek doğru olmayacaktır. Çiçeğin içindeki atomlara aslında hiç bir şey olmamıştır.