THE EFFECT OF CONTEXT BASED INSTRUCTION ON 9TH GRADE STUDENTS' UNDERSTANDING OF CLEANING MATERIALS TOPIC AND THEIR ATTITUDE TOWARD ENVIRONMENT

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

RIDVAN ELMAS

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY
IN
SECONDARY SCIENCE AND MATHEMATICS EDUCATION

JUNE 2012

Approval of the thesis:

THE EFFECT OF CONTEXT BASED INSTRUCTION ON 9TH GRADE STUDENTS' UNDERSTANDING OF CLEANING MATERIALS TOPIC AND THEIR ATTITUDE TOWARD ENVIRONMENT

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

THE EFFECT OF CONTEXT BASED INSTRUCTION ON 9TH GRADE STUDENTS' UNDERSTANDING OF CLEANING MATERIALS TOPIC AND THEIR ATTITUDE TOWARD ENVIRONMENT

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June 2012, 176 pages

The purpose of the present study was to compare the effectiveness of context based instruction over traditionally designed chemistry instruction on 9th grade students' understanding of cleaning materials topic and their attitudes toward environment. Moreover students' science process skills were measured for using as a covariate. Participants were 222 ninth grade students from eight classes in two different types of high schools in Ankara. Experimental group students were instructed with context based instruction and control group students were instructed with traditionally designed instruction through five weeks. Cleaning Materials Achievement Test and Attitudes toward Environment Scale were used as pre and post tests. Science Process Skills test was used only as a pretest. MANCOVA

technique was used as a statistical analysis procedure. According to statistical analyses, there was a significant mean difference with respect to context based instruction and traditionally designed instruction on cleaning materials topic in favor of experimental group and no significant difference with respect to attitude toward environment. There was no significant mean difference with respect to school type in both Cleaning Materials Achievement Test scores and Attitude toward Environment Scale scores. Beside, science process skills were a strong predictor for understanding the cleaning materials topic. Four focus groups were conducted separately regarding the students' career choices after the treatment to have an idea over the quality of the instruction in experimental group. Focus group results revealed that students were appreciated and more motivated with context based instructional design.

Keywords: Context based Chemistry Instruction, Cleaning Materials Topic, Attitudes toward Environment, School Type, Science Process Skills

ÖZ

BAĞLAM TEMELLİ YAKLAŞIMIN 9. SINIF OĞRENCİLERİNİN TEMİZLİK MADDELERİ KONUSUNU ANLAMALARINA VE ÇEVREYE KARŞI TUTUMLARINA ETKİSİNİN İNCELENMESİ

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Haziran 2012, 176 sayfa

Bu çalışmanın amacı bağlam temelli kimya eğitimi yaklaşımının 9. Sınıf öğrencilerinin temizlik maddeleri konusu kimya başarısına ve çevreye karşı tutumlarına olan etkisini incelemektedir. Bununla birlikte öğrencilerin bilimsel işlem becerileri analizde kullanılmak üzere bir ön test ile belirlenmiştir. Bu çalışmaya Ankara'dan iki farklı okul tipinden seçilen sekiz sınıftan 222 tane 9. Sınıf öğrencisi katılmıştır. Deney grubunda 5 hafta boyunca bağlam temelli kimya eğitimi yaklaşımına uygun ders dizaynları kullanılmış kontrol grubunda ise geleneksel yaklaşım uygulanmıştır. Temizlik Maddeleri Başarı Testi ve Çevre Tutum Anketi bütün sınıflara ön ve son test olarak uygulanmıştır. Bilimsel işlem becerileri testi sadece ön test olarak uygulanmıştır. Elde edilen veriler MANCOVA istatistiksel yöntemi ile analiz edilmiştir. Analizler sonucu, bağlam temelli kimya eğitimi ders dizaynları ile geleneksel yöntemle eğitilen gruplar arasında temizlik

maddeleri konusunu öğrenmede anlamlı bir farklılık deney grubu lehine vardır ama çevreye karşı tutumda bu anlamlı farklılık gruplar arasında bulunamamıştır. Anadolu Lisesi ve Düz Lise öğrencileri arasında hem Temizlik Maddeleri Başarı Testi sonuçlarında hem de Çevreye Karşı Tutum Anketi sonuçları arasında okul tipine göre anlamlı bir farklılık bulunamamıştır. Bilimsel süreç becerilerinin istatistiksel olarak temizlik maddeleri konusunu anlamaya anlamlı bir etkisi olduğu bulunmuştur. Uygulanan bağlam temelli yaklaşıma dayalı ders tasarımlarının öğrencilere tam olarak yansımasının anlaşılabilmesi için ve öğrencilerin uygulanan yöntem hakkında görüşlerinin ve fikirlerinin alınabilmesi için deney grubundaki öğrencilerle odak gruplar düzenlenmiştir. Odak grup sonuçları bağlam temelli derslerin öğrenciler tarafından beğenildiğini ve öğrencileri daha fazla motive ettiğini göstermiştir.

Anahtar Kelimeler: Bağlam Temelli Kimya Eğitimi, Temizlik Maddeleri Konusu, Çevreye Karşı Tutum, Okul Çeşidi, Bilimsel İşlem Becerileri

To ELMAS Family

ACKNOWLEDGMENTS

I would like to extend my thanks and deepest gratitude to my supervisor Prof. Dr. Ömer Geban for his guidance and support throughout the study.

I would like to extend my thanks and appreciation to my committee members; Prof. Dr. Ayhan Yılmaz, Prof. Dr. Ömer Geban, Assoc. Prof. Dr. Yezdan Boz, Assoc. Prof. Dr. Esen Uzuntiryaki and Assist. Prof. Dr. Ömer Faruk Özdemir for their valuable guidance.

I wish to express my gratitude also to my friends, Savaş Pamuk, Betül Demirdöğen, and Haki Peşman for their enduring friendship and continued support.

I also express gratitude to the students who participated in this research. I thank students who shared their ideas and provided additional information when needed. I appreciate their support and cooperation.

I wish to express my gratitude to my wife and my family for her patience and support throughout the study.

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LIST OF ABBREVIATIONS

CBE: Context based Education

CBCI: Context based Chemistry Instruction

CTL: Contextual Teaching and Learning

TDI: Traditionally Designed Instruction

CMAT: Cleaning Materials Achievement Test

ATES: Attitude toward Environment Scale

SPST: Science Process Skills

DV: Dependent Variable

IV: Independent Variables

CHAPTER 1

INTRODUCTION

Science is the most important part of the human life that shapes today and the future. The quest for challenges in many problematic situations such as environment, health, and energy is directly related to the science and technology. Science is the key factor for economic, social, and political solutions to these issues. It should be accepted that we are raised and educated in the industrial age and from now on a paradigm shift is needed our educational ideas, beliefs and perspectives to adapt to the new era (Nordgren, 2002). The countries, which provide their students with high quality education, are sharing six main characteristics (Jennings, 2011). These characteristics are;

1. Providing resources for needy students
2. Making teacher salaries competitive and comparable
3. Providing high quality professional development trainings for teachers and educational leaders
4. Supporting collaborative planning and professional learning at schools
5. Designing curriculum based on problem solving and critical thinking skills
6. Rare testing but multifaceted and authentic assessment

Many recent reports and articles have focused on the skills in education for every citizen to survive in global competition (Greenhill, 2009; Symonds, Schwartz, & Ferguson, 2011; Grubb & Oakes, 2007; Brand, Partee, Kaufman, &

Wills, 2000; Hoachlander, 2008; Hughes Bailey, & Mechur, 2001). Greenhill listed and defined these skills very extensively and collected them under three main headings; Learning and innovation skills, information and technology skills, and life and career skills. Hull listed the most important five skills as computer literacy, critical thinking, problem solving, team work, and interpersonal relations for future jobs (Hull, 2005: Brand, 2003). Darrah (1992) warned not to isolate the skills from the job context in which they are executed and researcher determined two main important skills; ability to work independently and efficient time and resource management. In addition, Ananda (2002) debated about what can be measured with high stake exams and whether these skills are parallel to what future jobs can be demanded from employees. So many of these skills are in critical importance for students' future career, they have to master them in schools in some level. Instructional designs and processes contribute to develop these skills in school settings so choosing a design which also opens to emerge or empower these skills is critical. Contextual teaching and learning is one of the instructional designs which provide chances for students to develop or improve these skills in school environment.

Science and the technologies it generates permeate every aspect of our life styles. Engaging science and technology provides new perspectives and enriches citizens' life styles significantly. Every citizen needs to engage with science and technology in some level to make worthy decisions about policies today. For instance; recently, Turkey has had a very significant energy problem and the community divided into two camps. Whether to support the building of a nuclear power plant or not is a very critical issue in the public agenda. Because of this kind of dilemmas, students' attitude toward environment is a significant issue in chemistry teaching. If students have scientific and informative ideas about the environment, this can make them a better citizen and responsible toward the environment. Contextual teaching and learning provide chances for students to be a better citizen for engaging them to social issues for the perspective of science.

Throughout the world, science education faces some problems; however, there are numerous studies conducted on these problems. Over-load of curricula with content and isolated facts, inability to transfer learning skills to life, lack of relevance, and inadequate emphasis of science curriculum may be cited among important science education problems (Guo, 2007; Gilbert, 2006; Gilbert, Bulte, & Pilot, 2011). Moreover, students' ideas and opinions are not taken into consideration while adapting the new content and pedagogies to the new curriculum; in addition they do not receive any training related to this new curriculum as compared to teachers (Rudduck & Flutter, 2000). Many of these problems are also a case for contextual teaching and learning in some level. On the other hand some of them are easily dealt with by enhancing the learning process with contexts and the principles of the context based education. The problem here is how to design the process which meets student's needs.

Organizing and disseminating effective curricula is one of the most important contributing factors for the success of context based education. School curricula have been designed as traditional factory assembly lines. Just as a product moves down a predetermined path and the parts are added one after the other to its frame, students move from one course to another and eventually are fully equipped with the requirements for graduation (Finch, Frantz, Mooney & Aneke, 1997: Grubb & Oakes, 2007). Mbajiorgu and Reid did an extensive research to determine ten basic rules for effective curricula especially for chemistry (Mbajiorgu & Reid, 2006). These ten rules are (p. 2);

1. *Meet needs of all learners*: Taking into account both students who are following the chemistry related path and those who are not.
2. *Relate to life*: Using applications led or context based approaches as the core of the curriculum
3. *Reveal chemistry's role in society*: Reflecting how important chemistry is to our lives
4. *Have a low content base*: Considering ''less is more''
5. *Be within information processing capacity*: Presenting abstract and symbolic ideas accordingly to the students' level

6. *Take account of language and communication*: Using appropriate language concurrent with students' developmental level
7. *Aim at conceptual understanding*: Seeking to develop conceptual understanding instead of recall of information
8. *Offer genuine problem solving experience*: Asking more open ended questions emphasizing on group work
9. *Use lab work appropriately*: Not doing cookbook experiments, lab work should offer opportunities for genuine problem solving
10. *Involve appropriate assessment*: Using formative and summative assessment together and emphasizing understanding and thinking

To support effective instruction elementary to high school, Turkish curricula were redesigned and disseminated for adapting new pedagogies and assessment techniques (Savas, Elmas & Ozturk, 2011). In addition, the curricula were developed in a spiral structure for revisiting the topics in depth each following year, which is an additional factor to support context-based education. Although the curricula are new and modern, there are inconsistencies between their aims and their implementations in the classroom (Berberoglu, 2010; Elmas & Geban, 2010; Savas, Elmas & Ozturk, 2011; Ozturk, Elmas & Savas, 2011; Aydin & Cakiroglu, 2010; ERG, 2011). Reconciling teachers' views and opinions over new pedagogies takes time, and teachers need serious training programs (Gur & Celik, 2009). Curriculum policies should be aligned across all stake holders and aspects of the educational system; they need to be disseminated, implemented, and developed consistently and coherently over a sustained period of time for a high quality education (OECD, 2010). Adapting context-based instructional practices similarly requires time and resources because preparing an innovative context-based curriculum and adapting it into our current chemistry education system need a paradigm shift in many aspects.

There is a tendency for developing countries to define the science education problems strictly as defined in the developed countries and to imitate their expensive solutions despite their limited human and economic resources (Gray, 1999). Although the problems look similar, they are culturally and contextually

different. Developing countries like Turkey should develop a curriculum that is authentic, affordable and contextually relevant for its circumstances, economical limitations and social life. Such a curriculum has to be operational and connected with local issues, problems and resources which are embedded in contexts. A top down approach might be problematic if there is not a reconciled educational product on what is implemented in schools and classrooms. The success of curricula greatly depends on the degree to which budgets, plans, trainings and materials altogether produce the maximum efficiency in the system. These factors are really important for the success of any type of curricula or instructional practices such as context-based curriculum or instruction.

Moreover, there is a perception among students that science courses are the most difficult ones when compared to other courses (Osborne & Collins, 2001). Furthermore, science textbooks are not admirable for students and supportive for reform movements (Kahveci, 2010; Irez, 2009). These barriers have effect on the comparatively low numbers of students to choose science courses beyond the compulsory period in high schools (Murphy & Whitelegg, 2006) and they do not choose science related departments in the university. Context based instruction also needs its own textbooks to supply the contexts that are embedded in classroom instruction. Moreover, context-based education is probably much better to focus on student's interest on chemistry or any branches of science because of its extensive use of real life contexts in instruction.

Besides, science courses do not qualify the students with the scientific knowledge, creative thinking, critical thinking, wise decision making and problem solving abilities they need as adults in a post modern society (Sanger & Greenbowe, 1996; Thomas & Pederson, 1998; Hull, 2005). Context-based instruction has a potential to develop these skills because students are mostly working on their own real life problems and they have a chance to support higher order skills. Also, in the university, general chemistry courses are not above the line and they present conceptual, isolated, and abstract concepts which many students do not know how to use (Talanquer & Pollard, 2010). Context-based

instruction might be used for higher levels of education for stimulating interest and getting attention of university students.

The science curriculum is just chock-full of topics and both teachers and students feel that they are rushing from topic to topic (Osborne & Collins, 2001). Students who covered few topics, spending too much time on each topic and skipped a lot of topics did better in college than the ones who covered every chapter in the book (Sadler & Tai, 2001). Learning about one particular topic in depth can be a tremendous advantage for students because they learn what understanding a topic is. In addition to this, accumulation of isolated facts in students' minds does not form a meaningful whole. Students cannot transfer these separated facts to other situations and they are not aware of their relevance to their daily or social life (Perin, 2011). These challenges are also accompanied by low motivation and engagement in science courses. Although physics is anticipated to be the most antipathic science course, some research studies found out that chemistry is taking this reputation from the physics (Osborne & Collins, 2001).

To deal with all these problems, a recent approach is organizing an inquiry process with authentic practices embedded in a context (Bulte, Westbroek, De Jong & Pilot, 2006) is called context-based instruction. Context-based instruction focuses on scientific concepts with in contexts that are valuable in for students and society. Contextual instruction is a unique opportunity to teach science within meaningful contexts (Stinner, 1980). Contextual instruction provides settings that push students in a position where they have a motive to learn and a need-to-know for more understanding. Another important strategy is that the activities should also be facilitating a logical proceeding to the next activity (Bulte et al., 2006). There should be a balance between the structure of the inquiry tasks and the autonomy of students because more structured activities favor lower achievers and more autonomy demanding activities favor higher achievers (Tai, Sadler & Maltese, 2007). Besides, students should be required to work on the inquiry projects with a group of other students since this supports their social abilities (Baines, Blatchford & Chowne, 2007), and carries them to the top point of their zone of proximal development (Fernandez, Wegerif, Mercer, & Rojas-Drummond, 2001). Peer

teaching is an effective strategy for improving the students' understanding in chemistry (Tai & Sadler, 2007). When students have a degree of control over the steps of the inquiry task and their learning process, it supports more meaningful learning and deeper understanding.

Discovering how students learn when receiving context-based instruction as compared to with other more traditional teaching methods is the main purpose of this study. In Turkish context, there is a need to design a context-based instructional practice to see and prove its efficiency. There is need to explore its efficiency with experimental and quasi-experimental studies (Medrich, Calderon & Hoachlander, 2002). The main research problem of this study is to compare the effectiveness of context based instruction over traditionally designed chemistry instruction on 9^{th} grade students' understanding of cleaning materials topic and their attitudes toward environment.

Cleaning materials topic is interwoven with daily life in many aspects because of the importance of cleaning in social and physical life of the individuals. In addition, overuse of cleaning materials is a significant problem for environment and economy. Especially mixing inappropriate cleaning materials in daily life for the better results might cause really drastic health issues as there is a possibility for the inhalation of poisonous gases. Because of these and many other reasons concerning health, environment, and economy, effective learning of cleaning material topic is crucial for students.

To sum up we enlisted the significance of the study in below list:

1. Context based instruction is an effective instructional strategy but it is rarely used in Turkish educational settings. This study provides an instructional design and materials as an example of this effective strategy for Turkish classrooms.

2. This study provides evidences for the effectiveness of context based chemistry instruction in Turkish classrooms.

3. The Cleaning materials topic, which is very significant for our daily and social lives, was presented in this study with the scope of context based instruction.

4. This is one of the first attempts to design a context based instruction with student generated questions and multiple contexts in Turkey.

CHAPTER 2

LITERATURE REVIEW

This chapter is presented in seven sections.

2.1. What is Context based Education?

Raising achievement and providing a quality education for all Turkish students are the major aims of our educational system. This is one of the biggest challenges in Turkish educational agenda for developing all educational system. However there is no single move for firing up student achievement, it is a complex process with many components in the system. One significant part of the achievement issue is directly related to improving instructional implications in the classroom. Although researchers are aware that there is no magical instructional method that fits everybody, the present study is concentrated on one possible approach for empowering classroom instruction; that is context-based education or contextual teaching and learning. Interestingly, most of the science education literature in Europe named it as context-based education (CBE), but most of the USA science education literature called it contextual teaching and learning (CTL). Most of the time, they are referring to the same philosophy for similar instructional practices. Our preference is using them interchangeably according to the citations and appropriateness. In addition, other names that are used in the literature were listed in a review study by Perin (2011).

Context-based education is mostly used as a strategy to empower classroom instruction and connecting knowledge and skills to particular contexts that supports motivation, meaningful learning and transfer. Generally context-based education or

contextual teaching and learning are defined as an instructional approach that provides learners opportunities for making connections between subject matter and real life situations. Souders (1999) listed two basic statements regarding the context-based education (p.1):

- The mind seeks meaning in the environment in which a person is located.
- The mind seeks meaning through searching for relationships that makes sense and appear useful

The collaboration of Ohio State University and Bowling Green State University on a project brought us a broad definition of context-based education (As cited from Medrich, Calderon & Hoachlander, 2002).

"Contextual teaching and learning is a conception of teaching and learning that helps teachers relate subject matter to real world situations; and motivates students to make connections between knowledge and its applications to their lives as family members, citizens, and workers (Contextual Teaching and Learning, 2000)." (p.51)

Another broad definition came from Berns and Erikson (2001);

"CTL helps students connect the content they are learning to the life contexts in which that content could be used. Students then find meaning in the learning process. As they strive to attain learning goals, they draw upon their previous experiences and build upon existing knowledge." (p. 2)

Before moving further on context-based education, there is a need to explore what context denotes. The denotation of the word "context" has become vague because of its extensive use in many fields. Clark and Carlson (1981-p.313) reported their concern that the term turned into a "Conceptual Garbage Can" (as cited in Akman, 2000). One of the primordial denotations of the context emerged at 1970's. Goffman (1974) defined it as "a frame that surrounds the event being examined and provides resources for its appropriate interpretation". Harris (1988,

p.78) defined it as “an experience which is a social and cultural construct that aids us in interpretation” (As cited in Akman, 2000). Most recent definition in linguistic perspective was addressed by Duranti and Goodwin (1992), who clarified it as “a focal event embedded in its cultural setting”. Gilbert (2006) used Duranti and Goodwin’s definition of context as a basis for its discussion of the denotation of context. “The focal event” here is the central concept or event at the heart of the context, and it might be the use of a diagram, an animated model or a photograph (Gilbert, 2006). Gilbert (2006) also adapted Duranti and Goodwin’s four dimensions (Duranti & Goodwin, 1992-p.6) of context to four attributes of context for chemical education. The examples of contexts that possess these attributes are presented in further sections.

Contextual teaching and learning is a very popular in both science education community and other disciplines such as agriculture (Conroy, Trumbull, & Johnson, 1999), adult education (Imel, 2000), pharmacology (Kwiek et al. 2007), medicine, architecture, business, marketing (Berns & Erikson, 2001), language teaching (Baker, 2010). Contexts can be in many different forms according to the discipline or disciplines. Berns and Erikson (2001) gave an example of using Dinner Theatre Marketing Research Project as a context for marketing students in Career and Technical Education. Three Teachers worked very collaboratively for integrating three disciplines; Marketing, Math and English for Dinner Theatre Marketing Research Project. Another example is using some principles of chemistry to the chemical reactions in baking or cooking as a context (Medrich, Calderon & Hoachlander, 2002). Hands on and minds on applications and concrete relationships are a necessary feature of a context-based education. These types of applications and relationships empower and enhance meaningful learning and understanding, then the specific context itself must facilitate the learning process and excite student for extra effort. For this reason, the contexts are likely to fire up the instruction and motivate students positively, yet at the same time it runs the risk of decreasing student attention and focus if contexts are not relevant.

2.2. Theoretical Background of Context based Education

2.2.1. History and Development of the Idea of CBE

Contextual teaching and learning emphasizes the relevance of science to students' daily lives, their ideas based on their prior knowledge and experiences and students' responsibility on their own learning in a meaningful social context. This approach originated in 1900's in the work of Dewey, Piaget, Bruner and others (Resnick & Hall, 1998). Dewey mentioned transforming schools to small learning communities which students learn in a contextualized way with a practical work in order to become a good citizen (Resnick & Hall, 1998). Piaget's accommodation concept which refers to altering individuals existing ideas or schemas as a result of new learning and experiences are key ideas that can easily be used or adapted in explaining some processes in context based learning (Schunk, 2000).

Major philosophical position constructivism which originated in 1980's claims that knowledge is human constructed and it is not an external reality detached from the individual (Gredler, 2001). Context based instruction uses major principles of constructivism. For instance, learning takes place as individuals interact with their environment. Moreover, cognitive conflict or confusion is an initiator of searching for the unknown, and learning enhances through social negotiation (Savery & Duffy, 1995).

2.2.2. Learning Theories Related to CBE

Learning theories which are expected to enlighten as about the major psychological dynamics of processes related to learning and instruction are theoretical frameworks (Gredler, 2001). The major function of the learning theories is to frame organizational structure of learning and instruction and they must be

systematically supported by research (Schunk, 2000). They explore the implication of events related to instruction (Gredler, 2001).

Context-based instructional practices have been widely used for almost two decades in many countries (King, 2012). In order to be an effective educational approach, it must be based upon these learning theories. In addition, there is a need to explain how learning occurs under contextual designs. The most major theories that are related to the contextual teaching and learning are situated learning, constructivism, and activity theory (Gilbert, 2006; Mandl & Kopp, 2005; Edwards, 2009; Berns & Erickson, 2001). Situated learning approaches emphasize that most of the knowledge and behavior are context and situation bound, transfer of knowledge does not easily occur between tasks, teaching abstract knowledge is ineffective, and social environments are very critical in the instructional processes (Mandl & Kopp, 2005). These assertions are mostly true for many instructional approaches like context-based instruction but they are not exact rules for all learning processes (Anderson, Reder & Simon, 1996).

Constructivist instructional practices emphasize very seriously on facilitating the learning process. Savery and Duffy (1995) determined and elaborated eight principles for designing of a constructivist instruction. Most of these principles are congruent with contextual teaching and learning if they executed in certain ways. These principles are anchoring learning to a more complex tasks or contexts, supporting student's ownership for the process, designing an authentic activities, supporting the learner in complex contextual environments, developing a relevant contexts and tasks for students, adjusting the organization and structure of the work or task for students developmental level, providing opportunities for alternative views and contexts, and supporting the reflection over instruction. In the present study we preferred to use constructivist approach as a basis in our contextual design.

Activity theory also provides another framework for context-based education because of its emphasis on meaning making which depends on the interaction of the focal event and the learner. Teachers provide support for

reconciling students' ideas and the socially accepted norms related to this focal event (Gilbert, 2006).

2.2.3. Projects Related to the CBE

Context based courses are generated from the idea of science for society and most recent studies about this issue focus on the development of new science courses in order to develop a new school science curriculum (Burton et al., 1995; Ramsden, 1997; Bulte et al. 2005; Bennett & Lubben, 2006; Pilot & Bulte, 2006; Bulte et al., 2006; King, 2007). There are many projects based on context based educational principles. Most popular ones are:

- Harvard Project Physics (Holton, 1967:1969; Kortland, 2005)
- The Large Context Problem approach in Canada (Stinner, 2006; Stinner, 1980; Stinner, 1981; Stinner, 1996; Stinner, 1993; Stinner, 1995, Park & Lee, 2004)
- Science in Society (USA) (Lewis, 1981)
- Science in a Social Context (Solomon, 1980:1983a:1983b: Kortland, 2005)
- Chemistry in Practice (Chip) and Physics Curriculum Development Project in The Netherlands PLON, 1988 (Kortland, 2005; King, 2012)
- Science and Technology in Society SATIS (Kortland, 2005)
- Science and Society SaS (Kortland, 2005)
- Chemistry in the Community (USA) (Ware & Tinnesand, 2005; Chemcom, 1988)
- Salters' Chemistry, Salters' Science and Salters' Advance Chemistry 1989-1990-1992 in UK (Bennett & Lubben, 2006)
- The Applications-led Approach in Scotland (UK) (Park & Lee, 2004)
- The Supported Learning in Physics Project (UK) (Whitelegg, 1996)
- The Victorian Certificate of Education Physics Course in Australia (Whitelegg & Parry, 1999)

- Contextual Teaching and Learning Project (USA) (Berns & Erickson, 2001)
- The Chemical Education for Public Understanding (USA) (CEPUP, 1991)
- Chemistry in Context, 1994 (USA) (Schwartz, 2006)
- Science, Technology, Environment in Modern Society Project in Israel (Dori & Tal, 2000)
- Science Education for New Civic Engagement and Responsibilities (USA) (SENCER, 2001)
- Event Centered Learning in Brazil (Souza Cruz & Zylbersztajn, 2002)
- Chemie im Kontext in Germany (Parchmann et al., 2006)
- ChemConnections (USA) (ChemConnections, 2005)

One of the first examples of context based education is ChemCom (Chemcom, 1988); Chemistry in the Community is a secondary school text that was prepared in United States under the sponsorship of the American Chemical Society (ACS) and supported through the National Science Foundation (NSF). The reason that ChemCom needed to be developed was the nature of textbooks and lab exercises at that time in the USA. The textbooks which provided an encyclopedic knowledge of science facts and lab exercises were like the confirmation experiments that needed to follow the steps to reach the known results. Besides, traditional secondary school texts were not equipped with the necessary scientific and technological skills and sufficient knowledge about science that the students needed (Sutman & Bruce, 1992). ChemCom was prepared by professional science educators and teachers and extensively tested on classrooms for its effectiveness (Mason, 1998; McMahon & Harwood, 1995). ChemCom presents the topics in contexts and uses student centered approaches, and also chemical principles are presented in a need to know basis. There is a positive change in the enrollments of high school chemistry courses when the ChemCom is available (Schwartz, 2006). Because of its successful implementation in United States, it translated into Russian, Japanese and Spanish (Ware & Tinnesand, 2005).

ChemCom has also served as a model for other context based projects in chemistry education and was followed by another project, Chemistry in Context (CiC). The motivation for the creation of CiC is the same for ChemCom; both aim to improve chemical literacy of students. Six university chemistry professors were assigned to write this new context based chemistry textbook in CiC. These professors presented the fundamental chemistry ideas interwoven with the contemporary issues that would be effective vehicles for conveying those ideas. The effect of CiC on American students was measured by a survey which was measuring these constructs: students' beliefs about chemistry as a topic of study, as a necessary component of modern society, and as a factor in their daily lives (Nakhleh, Bunce, & Schwartz, 1995). The study showed that third or fourth year students have much more change in their ideas towards these constructs then first or second year students. Furthermore, there is too much positive anecdotal data and reports of CiC instructors that supported this project. These two projects, ChemCom and CiC, have especially demonstrated that a context based approach can be more successful for secondary school students and university students who do not concentrate on sciences (Schwartz, 2006).

In some projects like ChemConnections, researchers prefer modular approach in context-based education (Schwartz, 2006). In ChemConnections, two consortia of colleges and universities designed, applied, and revised the modules. Topics and chemistry concepts are embedded in a context that is interwoven with a contemporary application or issue. In the project, most important design concerns are focused on student centered approaches and inquiry tasks. The other aim is to reduce the verification lab exercises. The modules are prepared for the use of first two years of chemistry courses in the universities.

Some instructors present these modules in order to support their traditional course topics with real life issues and just use one or two modules. The other strategy is using these modules for the whole semester. This is more challenging than using just one or two modules which are related to your course topics. In this case, instructors have to ensure that the modules they have covered should include all fundamental chemistry topics for students. The selection and sequence of the

topics are an important issue for an unstructured course. Another issue is the use of supplementary texts and articles. In other words, most of the time students should be required to use additional texts, articles and reference sources.

To sum up we would like to discuss about some of the projects which were prominent in the literature. These projects were good examples of contextual teaching and learning. They presented us the advantages and importance of context based courses.

2.3. Design of a Context based Instruction

2.3.1. Context based Instructional Design

Let's think about a classroom, teacher is in front of the whiteboard lecturing and writing the main points of unit to the board as summary, students are transferring it to their notebooks. At the end of the lecture students get the multiple choice tests as a practice for the exam. After the unit finishes, students take the test to get the grades and to determine who is successful in the class. This instruction is neither meaningful nor insightful. It does not require any interdisciplinary knowledge, higher level thinking or real experience for the life (Berns and Erikson, 2001). Students learn better if they are taught concepts and skills in a contextual way which they will also use them in (Hughes, Bailey, & Mechur, 2001). Learning is more meaningful for students while they are dealing with problems in meaningful contexts and within a specific culture rather than fragmented conceptual work (Lave & Wenger, 1991; Caine & Caine, 1991). Classroom instruction must contain higher level thinking skills, real experiences from daily life contexts, good communication skills, and some responsibility for students' own learning (Berns and Erikson, 2001). Because the real life problems are complex, they mostly require higher level thinking skills and the knowledge of more than one discipline.

Context based learning supports these skills in classroom instruction as its limits are drawn from our teachers. Teachers' positive perceptions regarding to the

context based learning is as important as choosing the right contexts for the appropriate content and the discipline (Elmas, Sahin & Eryilmaz, 2011). For successful instructional purposes, contextual education can easily be extended across disciplines so that students can have chance to deal with complex problems. Bulbul and Eryilmaz (2010) advised human body as a multidisciplinary context for instructional purposes. Conroy, Trumbull and Johnson (1999) emphasized the agriculture context as a way to explore key biological and math concepts and skills. In addition, Elmas, Sahin and Eryilmaz (2011) tried to determine the choices of pre-service teachers related to the context-discipline relationship and their preferences to teach and learn from 77 science contexts.

The usage of contexts in educational settings is based on some criteria. Gilbert (2006-p.960) mentioned four attributes of an educational context. These attributes are *setting, behavioral environment, the use of specific language, and background knowledge*. Setting is the focal event that is placed at the center of context. Behavioral environment is the actions that are expected to take place under this setting. The specific language is related to concepts regarding the focal event, and background knowledge is related to the transfer of this knowledge to broader perspective. In addition to these attributes Gilbert (2006) proposed 4 models for implication of context-based education: *context as the direct application of concepts, context as reciprocity between concepts and applications, contexts as provided by personal mental activity and context as the social circumstances*. The first model is a one way model from chemistry concepts to applications. The emphasis is on how the concepts were used in applications after teaching them in the course. The core of the second model is reciprocity between the concepts and applications. Science technology and society (STS) approaches mostly used this model (Gilbert, 2006). Maybe some students do not value the applications that are presented in this model and may not acquire the specific language related to listed applications. The third model stresses the importance of using narratives to link chemical ideas to the context and the events in learner's daily life. But using narratives limits the focal event as an abstract concept such as emergence of soap or history of soap. Students can engage in the practice if they see the social value of the presented description of the event. In the fourth model using context as the

social circumstance fulfill all the required attributes sufficiently. This model bridges the gap between concepts and socially valuable activities for learners. The main source of focal events is those with major public issues such as nuclear power plants, global warming, and ozone depletion. The third model was used as a framework while shaping the contexts in this study because generating real authentic experiences for students was not possible in Turkish school contexts. The detailed description of the contexts and attributes related to this study will be discussed in method chapter.

Context based learning is easily used as an umbrella term for variety of approaches (Medrich, Calderon & Hoachlander, 2002; Berns & Erickson, 2001) such as; problem based learning (Hmelo-Silver, 2004; Savery, 2006; Hmelo-Silver & Barrows, 2006), collaborative and cooperative learning (Johnson, Johnson & Stanne, 2000), project based learning, service learning, work based learning. These approaches are not separated from each other with very distinct lines but there are differences within them. They are easily used in conjunction with another. They may transform into to a context based approach easily if they are executed in certain ways.

Context-based chemistry education is for encouraging students to overcome many obstacles related to the chemistry education. In this approach, there is an inquiry task that is served in contexts which provoke students to think critically and provide a reason to search for the unknown. The inquiry task, which was embedded in the context, yields students the responsibility to cope with their questions related to the issue. Context-based approaches assume that students engage in an inquiry process that is served in a real life context, create and refine new questions, seek and collect information regarding the answers to these questions by investigation, analyze and synthesize these data, draw conclusions and report findings (Abd-El-Khalick et al., 2004; Marx et al., 2004).

Another important issue is the retention of the knowledge in long term and transfer of this knowledge to other contexts. Evidence from the literature proposed that what has been learned in a specific context is strongly retrieved in the same

context (Eich, 1985). Because of this, transfer of knowledge to different contexts and problems is a concern (Edwards, 2009; Perin, 2011; Driscoll, 1994). Teachers can provide opportunities for students to learn in several different contexts or settings to overcome the transfer problem (Eich, 1985). When instruction is in multiple contexts, and includes examples of wide applications of what is being taught, students are more likely to have a better understanding of the topic which allows better transfer (Gick & Holyoak, 1983).

Context-based courses are characterized by three main points (Bennett et al. 2005). The first point is that researchers use contexts and applications of science as the starting point to develop deeper understanding of science. They also require student centered and active learning environments. The last one to mention is the idea of Jerome Bruner's spiral curriculum to tie the contexts together for forming a complete understanding of topics. Besides, Berns and Erickson (2001) address seven crucial points for an instructional design to be counted as contextual teaching and learning. These are;

1. *Lesson plans are concurrent with students' developmental process*: While preparing the instructional design, lesson plans should be appropriate for students' age, social, emotional and intellectual level.
2. *Design requires interdependent group works among students*: Group work provides a chance for students to reflect and criticize on their work as a whole. Besides, it empowers social and communication skills which are very important for their future careers.
3. *Classroom environment provides opportunities for self-regulated learning*: Self-regulated learning helps students to discover their weakness and strengths and supports them reflecting their own learning process. Presenting students attainable goals and providing them enough opportunities to achieve these goals are crucial.
4. *Design must take into consideration of the student diversity*: Teachers must take into account their students' socioeconomic statuses, ethnic back grounds and previous experiences.

5. *Design should support students who have different types of intelligences*: Instruction should be prepared for students who have different abilities because students are very diverse in intelligence some students are good at communication, reading, leading and language and some are at dancing, numbers, illustrations and presenting things.
6. *Design must include higher order questioning*: Questioning enhances learning and satisfies students about the content. Questions are organized in manner to produce the intended levels of thinking in students.
7. *Design should include authentic assessment*: The nature of the Contextual teaching and learning requires the authentic assessment (Darling-Hammond & Snyder, 2000) of skills in multifaceted ways instead of assessing factual information with a paper pencil test. Both formative and summative assessments are used together.

The significant role of the teachers while designing and implementing the contextual instruction is very critical. Teachers are the key actors of any types of instruction or reform because they are facing the classroom realities and their internalization of the approach is determined the success of it. Teachers should be especially used contextual instruction to reach the teaching objectives if they set the broader academic goals such as those (Medrich, Calderon & Hoachlander, 2002):

1. *Attitudinal outcomes:* Motivation, self-regulation, independent and cooperative learning
2. *Behavioral outcomes:* Regular participation to the classes, more focused students, coordinated work with groups
3. *Skill acquisition outcomes:* Better retention, Problem solving, Critical thinking

2.3.2. Teachers and Students Role

Teachers should determine clear set of instructional objectives for students and guide them in the inquiry processes and for further research by discussions,

questions, and activities (Avargil, Herscovitz & Dori, 2011). Teachers should support team work among groups and with in groups in a variety of leadership and facilitator roles. So the role of the teachers in contextual teaching is to facilitate or guide the instructional process, to discuss or question the steps of the ongoing process, and to listen and clarify the preliminary and ultimate results (Souders, 1999; Berns and Erickson, 2001). Teacher should balance the classroom integrity and flexibility at the same time. Students feel free to talk about their ideas and share their knowledge about the content and contexts at that time they have to be respectful and responsible for their actions. Student's role is to discover, explore, investigate, discuss, question, and produce accurate, valid and reliable results for the process (Souders, 1999; Bulte et al., 2006; Pilot & Bulte, 2006).

Students have always right to share their ideas and opinions related to the content and context but they have to realize their rights and responsibilities together to sustain the classroom instruction efficiently. Students probably are more motivated and following the guidelines of the contextual teaching approach more willingly because they faced with a real problem from their lives not an artificial one. They have to take more responsibility from their own learning and they have to proceed for the next level of the solution of the problem at regular intervals.

Maybe, at the beginning of the context based learning students feel puzzled because of not having direct sources for their learning, unstructured nature of the process, and self directed learning that emerge with the proceeding of the students within the process (Medrich, Calderon & Hoachlander, 2002). To overcome these issues, teachers must organize an instructional process started structured inquiry to semi structured inquiry to open investigation. Taking the steps in a careful and cautious manner not to intimidate students with the ambiguity and the workload of the process is crucial. Table 2.1. shows the main differences between contextual and current instructional practice differences regarding the nature of content, teacher's role, classroom atmosphere, student's role, and measurement in Turkey. This table is adapted and constructed from the work of Medrich, Calderon and Hoachlander, (2002) and some other research literature (Tharp & Gallimore, 1988; Berberoglu, 2010; Berns & Erikson, 2001; Barrows, 1996).

Table 2.1. Contextual Instruction versus Current Instructional Practices

Educational Features	Current Instructional Practices	Contextual Instruction
Nature of Content	• Superficial content • Knowledge of facts and formulas	• In depth content knowledge • Relationships, patterns in the content is important
Teachers Role	• Source of knowledge • Lecturer, instructor • Question asker	• Facilitator/Guide • Resource provider • Opens up the critical points with high level questions • Member of the team work
Classroom Atmosphere	• Highly organized direct forms of didactic teaching • Recitation • Students working alone & competition • Teacher & textbook questioning • Highly structured materials • Demonstrations & cookbook experiments • Strict and quiet	• Designing frameworks and experiments on the way to solution • Student questioning • Working as a team • Collaboration and cooperation • Finding solutions to real problems • Flexible and open to discussion
Students Role	• Following the instructions • To memorize and repeat the content • Transferring what was written on the board to notebook • Listener	• Discoverer, explorer, researcher • Discuss and debate on ideas • Leading the learning process • Responsible for his own learning

Table 2.1. Contextual Instruction versus Current Instructional Practices (Continued)

	• Practices with multiple choice work sheets	• Self-directed learning
Measurement and Assessment	• Multiple choice tests • Exams with open ended questions	• Both formative and summative assessment • Presentations • Reports • Rubrics • Concrete products • Individual journals • Communicational skills

Class size is also another determination factor for the positive social relations and student behavior (Cotton, 1996). If the classes are small enough teachers have chance to know most of the students individually, it probably be helpful for the teacher while guiding the students in the instructional process. Downsizing the classroom, by itself, cannot guarantee better instruction and higher grades (Jones & Ezeife, 2011) but it provides better opportunities and chance for it (Jimerson, 2006; Raywid, 1997; Oxley, Barton & Klump, 2006). If the class size is between 10 and 40, context based education will be concluded in better results (Schwartz, 2006). Instructors can care about all the students and facilitate the classroom discussions and environment more steadily in small classes.

Most recent text books concerning the context based education are Chemistry: The Science in Context (Gilbert, Kirss, & Davies, 2004) and Chemistry (Bell et al. 2005). The latter presents the topics largely in biological systems and it is more appropriate for medical schools. Salters' Chemistry and Advance Chemistry Books are also very popular in the UK (Bennett & Lubben, 2006). In addition, The New Turkish Physics Curriculum is based on context-based approach and new physics high school textbooks were designed according to these principles in Turkey (Balta & Eryilmaz, 2011; Elmas, Bulbul & Eryilmaz, 2011).

2.4. Measurement and Assessment in CBI

Context based instruction mostly does not only align with standardized multiple choice tests, which are mostly inadequate to evaluate the real student outcomes (Sri, 2002) but also additional forms of assessment are required for determining the student performance in many skills. Ensuring the alignment of context based instructional outcomes with multiple choice tests is a real challenge because of the multiple outcomes that emerge with the desired educational objectives. Teachers need to both focus on processes and products of classroom instruction. For instance portfolios, rubrics, presentations, project works, exhibitions, concept maps and all other appropriate types of assessment tools can used in accordance with the course design in contextual instruction (Medrich, Calderon & Hoachlander, 2002).

2.5. Challenges and Advantages of CBI

There are also some challenges in context based education that needs additional explanations in detail. Schwartz (2006) mentioned some of the issues that need clarification about the context-based education (Talanquer & Pollard, 2010).

I. How much information is enough for an inquiry task embedded in a context?

II. Using context based education reduces the number of topics in the chemistry courses. Can this be a problem for later chemistry classes?

III. What is the importance of student centered authentic education for the context based education?

IV. What is the appropriate class size for context based education? Is it useful for all sizes of classes?

V. Is context based education really durable enough to change the whole school system?

VI. Sometimes, the used context to make the things clear and transferable is the real obstacle for transfer; how do the instructors provide enough support for transferability of a wide range of contexts and patterns of reasoning?

Not all these questions have exact or clear answers now, but these answers will be future topics of context based education researchers.

There were some challenging studies that were done related to the context based science education (Taasoobshirazi & Carr, 2008). Reid (2000) proposed that the content is determined by the demands of traditional curriculums even though there are enacted contexts to the courses. Mason (1996) observed students at the university level who studied over ChemCom, which was a popular context based program. She did not find any significant difference in achievement but a decline in enrollment. Sanger and Greenbowe (1996) explained these results according to the different philosophies and approaches under these courses. Context based approaches are mostly based on real world applications and regard science as a process of learning. Working in groups on research projects, discussions over scientific issues, identifying the problem and sub problems, developing solutions to these problems, and debating over alternative view points are important components of these courses. In contrast, university level general chemistry courses value the knowledge which is essential to solve logical mathematical problems on textbooks, and instructors mostly evaluate students' performance only on the basis of their ability to correctly answer the open ended and multiple choice questions. Sanger and Greenbowe (1996) explained reason why these students experienced "culture shock" as a result of downshift of their paradigms and reported this as a reason why sometimes context based approach students have problems with general chemistry courses.

Although these are some challenging questions over the issue, there are also many aggregating evidence for supporting contextual teaching and learning

(Hughes, Bailey & Mechur, 2001). Bennett and colleagues (2007) reviewed 17 experimental studies for the effects of context based education and the results indicated that both male and female students who are educated with contextual teaching and learning, have more positive attitudes towards science and their understanding of science concepts is at least as good as traditional approaches (Bennett, Lubben & Hogarth, 2007; King & Ritchie, 2007). Context based education also provides opportunities for students to behave like a scientist and encourages them to search for the unknown. Moreover, these methods provide chances for students to explore the nature of science and motivate them to contribute to an inquiry process because students are very enthusiastic about searching for the unknown instead of doing some classic lab experiments whose results they already know. Another advantage of context based chemistry education is that assists students to understand how the scientific knowledge expands and comprehend what the accurate measurement, reliable and valid knowledge is. (Bulte et al., 2006; Pilot & Bulte, 2006).

Some studies conducted related to the effects of context-based education on understanding, attitudes toward chemistry, motivation, retention of knowledge in Turkish educational settings (Elmas & Pilot, 2009; Kutu & Sozbilir, 2011; Demircioglu, Demircioglu & Calık, 2009; Ultay, 2012). Various methods and strategies were integrated with context-based educational designs such as ARCS (Kutu & Sozbilir, 2011), REACT (Ultay, 2012), and inqury (Elmas & Pilot, 2009). Studies which were used context-based instructional practices mostly focused on high school (Elmas & Pilot, 2009; Demircioglu, Demircioglu & Calık, 2009; Kutu & Sozbilir, 2011; Acar & Yaman, 2011) and university (Ultay, 2012; Ozay & Cam, 2011) students in Turkey. In addition these studies are related to various science fields such as chemistry (Kutu & Sozbilir, 2011), physics (Ultay, 2012), and biology (Ozay & Cam, 2011; Acar & Yaman, 2011). There are two studies which explored the eligible contexts for instruction and students' interest (Elmas, Bulbul, & Eryilmaz, 2011; Yaman, 2009). Elmas, Bulbul and Eryılmaz (2011) explored the eligible contexts for students' interest and contexts which were multidisciplinary in nature. They proposed to integrate chemistry and physics courses in an integrated

physical chemistry curriculum based upon the context-based educational principles for Turkish educational system.

Demircioglu, Demircioglu, and Calik (2009) designed a chemical storylines (Demircioglu, Demircioglu, & Ayas, 2006; Koch, 2010) embedded contextual teaching and learning environment in periodic tables unit for 9^{th} grade students in a Turkish high school. The aim of the research was to investigate the effectiveness of chemical storylines (Bostrom, 2008) embedded contextual instruction on achievement, attitudes and retention of knowledge. The study included 80 students from two intact classes. Their results were indicated a significant achievement increase, more positive attitudes toward chemistry, and better retention of knowledge (Demircioglu, Demircioglu, & Calik (2009). The results were very promising but there were three critical points to highlight in this study; these were the three weeks treatment period, sample size, and teacher proficiency and skills. Three weeks treatment period was a very short time span to provide very promising results. In addition, sample size was at the limits to conduct an experimental study (Frankel & Wallen, 2000). In addition experimental and control groups were instructed by two different teachers who have different years of experience. So these promising results might be blurred by some confounding variables but similar studies also reported many occasions of successful implementation of science stories (Bostrom, 2008; Koch, 2010; Demircioglu, Demircioglu, & Ayas, 2006) for instance Luhl (1990) designed an instruction to teach atomic theory with storyline approach. Luhl used the historical development of atom models from Ionians to Dalton as a context. Pursuing the traces of historical development of atom ended up with Bohr Atom model (Luhl, 1990). The present study was also used chemical storylines in the designed contextual instruction and the results of this study maybe an evidence for the effectiveness of them.

In addition to chemical storylines some other instructional strategies were adapted to context-based education such as ARCS (Kutu & Sozbilir, 2011) or REACT (Ultay, 2012). Kutu and Sozbilir (2011) designed a contextual instruction with ARCS model in Chemistry in Our Lives Unit. The purpose of the research was to determine the effectiveness of this design on retention of knowledge, and

students' motivation and attitudes toward chemistry. The sample of the study was 9th grade 60 students from a high school. The results were indicated a better retention of knowledge and an increase in students' motivation but there was no change in students' attitudes toward chemistry. Ultay (2012), and Ozay and Cam (2011) conducted contextual design studies with university students. These studies were related to physics (Impulse and Momentum) and biology (Nervous System) respectively. Both studies were reported a significant achievement increase in students scores. In biology, Acar and Yaman (2011) developed a contextual instructional design with microorganism's topic. They designed an experimental study with 9th grade 191 students. Their results indicated a significant achievement rise in students test scores. To sum up, in Turkish educational settings, contextual teaching and learning in most cases empowers students' achievement in science, attitudes toward science, motivation and knowledge retention.

School type and school characteristic was also important factors for innovative designs. Gutwill-Wise (2001) designed a study with two different types of schools and encountered different school characteristics while adapting a modular context based instructional design. First one was a small private college and other one was a large public university. Researcher conducted two evaluation studies for context based chemistry education with modules, each of which took 3-4 weeks in these both public and private schools. One group was taught with modules and other group was taught with traditional methods. Class observations proved that contextual modular approach classes were much more interactive and students were in an active learning environment in both public and private ones. Besides, the results of an exam that was held following semester also supported the better retention of knowledge for modular approach students in both schools. In both of the studies students' performance were assessed by pre and post tests, in class examinations and problem solving interviews at the end of semester. Student performance in both studies was not significantly different for the favor of any courses but modular approach students performed better than traditional approach students in interviews designed for assessing scientific thinking in both schools.

One of the studies related to the Salters' Advanced Chemistry and their textbooks was focused on the experiences and opinions of teachers over this course (Bennett at al., 2005). Researchers had conducted a questionnaire and collected data from 222 teachers. These teachers had experience between 4-10 years over Salters' Advanced Chemistry. The questionnaire collected data for teachers' views and experiences in six dimensions: student and teacher motivation, chemical knowledge and development of concepts, learning activities, assessment, challenge to teachers, and support for students and teacher. The data presented that teachers and students are more motivated in Salters' Advance Chemistry regarded to the class work and also in their career decisions. Besides, teachers reported that students are more willing to take their responsibility for learning and more enthusiastic about course work. Teachers also mentioned that the success of the course is significantly related to the role of in service support provided for the teachers. Also there are some research studies that focused on the understanding of chemical ideas regarding the Salters' Chemistry Texts (Barker & Millar, 1999; Barker & Millar, 2000).

2.6. Science Process Skills

Science Process Skills are composed of many skills such as observation, identifying variables and hypothesis, interpreting data, organizing a research, interpreting the results, and drawing conclusions from the results (Tan & Temiz, 2003; Uzuntiryaki, 2003). These skills and many others are very important either in school, work or in social life. In this research, the contribution of 9^{th} grade students' science process skills to their understanding of contextually designed cleaning materials topic was investigated.

Science Process Skills were investigated in many research studies (Uzuntiryaki, 2003; Ceylan 2008; Cetin, 2009; Kaya, 2011) in difference subject topics in chemistry. In these studies Science Process Skills were made a significant contribution to understanding of chemical bonding, state of matter and solubility, gases topic, and rate of reaction topics in chemistry (Uzuntiryaki, 2003; Ceylan

2008; Cetin, 2009; Kaya, 2011). These results lead us to the importance of Science Process Skills in chemistry teaching.

Avargil, Herscovitz and Dori (2011) did a research work on higher order thinking skills which encloses science process skills. They reported the problems of 8 teachers who were trying to practice these skills in a context based module. The effect of using different approaches in laboratory on science process skills also was investigated in Turkey (Kanlı & Yağbasan, 2008). 7E learning cycle model based instruction was found effective on improving science process skills in the laboratory.

2.7. Attitudes toward Environment

Students who are responsible and respectful to other people and their environment have more potential also to be a good citizen. Environment either social or physical are significant determinants of healthy human generations. Physical environment which if we extensively think is the classroom, school, city, nature, and the world has to be treated very gently. Students, who are the future of this generation, should have positive attitudes toward environment because these students ultimately will be affected by the consequences. At the end they will face with the environmental problems and need to provide solutions for them.

Context based chemistry education is one of the approaches who requires student activities for meaningful learning. Many of the activities which students engage support environmental awareness and attitudes toward environment when it's appropriate to the aims of the designs. In this study, cleaning materials subject topics in the design supports students' environmental awareness and attitudes. The research process, students involved in this study, faced them many environmental issues related to cleaning agents. For instance, they involved many topics related to the hazards of cleaning agents to water supplies and their capability of polluting the water.

For measuring the students' attitudes toward environment, a sub scale of T-CHEAKS was used as a measuring instrument. It is a derivative instrument from the Children's Environmental Attitude and Knowledge Scale (CHEAKS; Leeming, Dwyer, & Bracken, 1995). The reason why these researchers developed the CHEAKS, was they needed a psychometrically robust scale which can be used in a variety of research settings. Leeming and Porter (1997) used the scale for measuring students' knowledge and attitudes toward environment. They designed eight activities for raising the awareness of the environment in an academic year. The goal of the study was determining if there was a significant change in the attitudes toward environment and environmental knowledge level of students. 16 experimental and 19 control group classes were involved in the study. The scale was used as a pre and post test in the beginning and at the end of the intervention. Significant positive effect in experimental group students' attitudes toward environment was detected and their families displayed more pro-environmental behaviors ultimately.

This scale was used in many other studies as a valid and reliable (0.89 to 0.91) research instrument (Bodzin, 2008; Walsh-Daneshmandi & MacLachlan, 2006; Broyles, 2011; Makki, Abd-El-Khalick, & Boujaoude, 2003). Walsh-Daneshmandi and MacLachlan (2006) used the scale with Irish adolescents for checking its' usability with different ages groups in a different context. The results of their study indicated that CHEAKS has strong psychometric credentials for educational research. Similarly with the present study, Bodzin (2008) used the CHEAKS attitude subscale with 4^{th} graders and try to determine the changes of students' attitudes toward environment with the after school science club. Again scale is effective for determining the positive change towards environment. CHEAKS was also used in dissertations for instance; Broyles (2011) used the scale in a quasi experimental dissertation study for detecting the effectiveness of his intervention in an environmental education camp.

Turkish version of Children's Environmental Attitude and Knowledge Scale (T-CHEAKS) was derivated from the orginial CHEAKS scale (Alp, 2005; Alp, Ertepinar, & Tekkaya, & Yilmaz, 2006) for assessing students' knowledge on

environment and attitudes toward environment. The reliability of T-CHEAKS was reported as 0.90 and 0.92 in two studies (Alp, Ertepinar, Tekkaya & Yilmaz, 2008; Alp, Ertepinar, Tekkaya, & Yilmaz, 2006). Alp (2005) first adopted the CHEAKS to T-CHEAKS and did a survey research with the scale. Researcher surveyed 2536 students with varying (6^{th}, 8^{th}, and 10^{th}) grade levels from randomly selected 18 elementary and 10 secondary schools for determining students. The results indicated that grade level has a significant effect on environmental knowledge and attitudes, the gender difference on environmental knowledge favors male students in 6^{th} grade and females had more favorable attitudes toward environment than males. Alp et al. (2008) did a survey research with T-CHEAKS for investigating elementary school students' environmental knowledge and attitudes. 1140 students who were selected from 18 randomly selected elementary schools were involved into the study. The results showed that father's educational level has a significant effect on students' environmental knowledge, the sex difference favors girls about having positive attitudes toward the environment, and elementary school students' behaviors towards the environment were not affected from their previous knowledge about the environment.

Moreover, other researchers did also some research work on attitudes toward environment. Tuncer, Ertepinar, Tekkaya, & Sungur (2005) surveyed with a 45 item likert-type questionnaire for investigating the effect of school type and gender on 6^{th}, 7^{th}, 8^{th} and 10^{th} grade students' attitudes toward environment. They had 1497 seven students both from public (603) and private (892) schools. They used MANOVA as a statistical procedure. They found that school type had a significant effect, and girls and private school students had more positive attitudes toward environment. They concluded that there was a wide spread support for protection of environment in Ankara, Turkey. Yilmaz, Boone and Andersen (2004) utilized a 51 item Attitude toward Environmental Issues Scale (ATEIS) with 458 students in grades 4 to 8 for identifying the intensity of Turkish students' views about environmental problems presented in the curriculum and to these differ for some variables such as previous science achievement, grade level, gender, and so on. They found that female students have more support for environmental problems gradually with their age similar to previous studies. Moreover, they reported that

students who have high family income and lives in cities have more sensitive about the environmental problems. The last finding was the better the science course grades the higher to interest for environmental issues.

In the present study, researchers are using the attitude toward environment subscale of T-CHEAKS for determining 9^{th} grade high school students attitudes toward environment before and after the intervention. Context based course design pointed out the significance of the environmental issues in many incidents. Many times environmental concerns were put on the stage with classroom discussions, students' research problems, students' questions and activities. The topic was very appropriate to induce students attitudes and awareness related to environmental issues which especially caused by using cleaning materials. This may be used as a fire starter about the awareness of environmental issues for further grades in the high school.

CHAPTER 3

METHOD

This chapter is presented in eleven sections.

3.1. Research Problem

The aim of the present study is to find out the effects of context based instructional design as compared to traditionally designed teacher-centered chemistry instruction and school type on 9^{th} grade high school students' understanding of cleaning materials topic and attitudes toward environment.

3.1.1. Main and Sub Problems

3 main and 6 sub problems related to the present study are given below;

1. Do methods of teaching (Context-based instructional design versus traditionally designed teacher-centered chemistry teaching) make difference on the collective dependent variables (Cleaning Materials Achievement post test scores and Attitudes toward Environment post test scores) when the effects of science process skill test scores are controlled?

2. Do Anatolian and public high school students differ on the collective dependent variables (Cleaning Materials Achievement post test scores and Attitudes toward Environment post test scores) when science process skill test scores are controlled?

3. Is there any interaction between method of teaching and school type on the collective dependent variables (Cleaning Materials Achievement post test scores and Attitudes toward Environment post test scores) when the effects of science process skill test scores are controlled?

4. Do methods of teaching (Context-based instructional design versus traditionally designed teacher-centered chemistry teaching) make difference on student conceptual understanding of cleaning materials concepts when the effects of science process skill test scores are controlled?

5. Do Anatolian and public high school students differ on their conceptual understanding of cleaning materials topic when the effects of science process skill test scores are controlled?

6. Is there any interaction between method of teaching and school type on student conceptual understanding of cleaning materials when the effects of science process skill test scores are controlled?

7. Do methods of teaching (Context-based instructional design versus traditionally designed teacher-centered chemistry teaching) make difference on students' attitudes toward environment when the effects of science process skill test scores are controlled?

8. Do Anatolian and public high school students differ on their attitudes toward environment when the effects of science process skill test scores are controlled?

9. Is there any interaction between method of teaching and school type on students' attitudes toward environment when the effects of science process skill test scores are controlled?

3.1.2. Hypothesis

Main problems were tested with the first three hypotheses and the rest covers the sub problems;

$H_0$1: There is no statistically significant overall effect of teaching methods taking into account context-based instructional design oriented teaching and traditionally designed chemistry teaching on the population mean of the collective dependent variables of ninth grade students' post-test scores of cleaning materials concepts and attitudes toward environment when the pretest scores of science process skills test scores are controlled.

$H_0$2: There is no statistically significant mean difference between Anatolian and public high school students on the population means of the collective dependent variables of ninth grade students' posttest scores of cleaning materials achievement test and attitudes toward environment when the pretest scores of science process skills test scores are controlled.

$H_0$3: There is no statistically significant interaction between the methods of teaching and school type on the population means of collective dependent variables of ninth grade students' cleaning materials achievement test posttest scores and attitudes toward environment posttest scores when the pretest scores of science process skills test scores are controlled.

$H_0$4: There is no statistically significant difference between the posttest mean scores of students taught via context-based instructional design and who taught via traditionally designed chemistry instruction on the population means of cleaning materials achievement test posttest scores when the pretest scores of science process skills test scores are controlled.

$H_0$5: There is no statistically significant difference on the posttest mean scores between anatolian and public high school students' understanding of cleaning

materials concepts when the pretest scores of science process skills test scores are controlled.

$H_0$6: There is no statistically significant interaction between methods of teaching and school type on students' understanding of cleaning materials concepts when the pretest scores of science process skills test scores are controlled.

$H_0$7: There is no statistically significant difference between the posttest mean scores of students taught via context based chemistry instruction oriented teaching and who taught via traditionally designed chemistry teaching on the population means of attitudes toward environment posttest scores when the pretest scores of science process skills test scores are controlled.

$H_0$8: There is no statistically significant difference on the posttest mean scores between Anatolian and public high school students' attitudes toward environment when the pretest scores of science process skills test scores are controlled.

$H_0$9: There is no statistically significant interaction between methods of teaching and school type on students' attitudes toward environment when the pretest scores of science process skills test scores are controlled.

3.2. Research Type and Design

Present study is a quasi experimental design (Nonequivalent Groups Pretest-Posttest Design) because it was in the lack of random assignment of subjects to both experimental and control groups (McMillan & Schumacher, 2001). Intact, already established classes of students were used in the study. The students in the experimental group were instructed by context-based chemistry instructional (CBCI) design while control group students were instructed by traditionally designed instruction (TDI). Cleaning Materials Achievement Test (CMAT) and Attitude towards Environment Scale (ATES) were used as a pre and post test in the design at the beginning and at the end of the treatment period in both groups.

Science Process Skills Test (SPST) was administered only at the beginning of the treatment for using as a covariate in the analysis.

Table 3.1. Research Design

Nonequivalent Groups Pretest-Posttest Design

Group	Pretest	Treatment	Posttest
Experimental Group	CMAT, ATES, SPST	CBCI	CMAT, ATES
Control Group	CMAT, ATES, SPST	TDI	CMAT, ATES

3.3. Population and Sample

All 9th grade students in Public and Anatolian high schools in Ankara were in the target population of the present study. The accessible population of the study was selected as all 9th grade students in Public and Anatolian high schools at Etimesgut district. The results of the present study might be generalized to this population. Two schools, three teachers and eight classrooms were selected from this sample. Two teachers and four classrooms from a Public High School and a teacher and her four classrooms from an Anatolian High School were selected. Table 3.2 presented the data related to the school type and gender in detail.

Table 3.2. Participants Related to School Type and Gender

	School Type		Gender		
	Anatolian	Public	Male	Female	Total
Experimental	59	60	58	61	119
Control	56	47	49	54	103
Total	115	107	107	115	222

3.4. Variables

There are two dependent variables (DV) and five independent variables (IV) in the present study. Cleaning Materials Achievement Test post test scores and Attitudes toward Environment Scale post test scores were continuous and interval scale dependent variables. Independent variables were separated into two groups; group membership and covariate. Independent variables related to group membership were method of instruction and school type. Both are categorical and nominal scale independent variables. Science Process Skills Test Scores was assigned as a covariate. All variable types, their type of value and scale were displayed in the table 3.3.

Table 3.3. Variables in the Present Study

Type of variable	Name	Type of Value	Type of Scale
DV	CMAT_post	Continuous	Interval
DV	ATES_post	Continuous	Interval
IV	CMAT_pre	Continuous	Interval
IV	ATES_pre	Continuous	Interval

Table 3.3. Variables in the Present Study (Continued)

IV	SPST	Continuous	Interval
IV	Teaching Method	Categorical	Nominal
IV	School Type	Categorical	Nominal

3.5. Measuring Tools

In the present study, the data were gathered by using three instruments; Cleaning Materials Achievement Test (CMAT), Attitude toward Environment Scale (ATES: Sub scale of T-CHEAKS) and Science Process Skills Test (SPST).

3.5.1. Cleaning Materials Achievement Test (CMAT)

The aim of the creation of CMAT (Appendix A) is to measure the ninth grade Public and Anatolian high school students' chemistry achievement scores on cleaning materials topic. Before the development of the instrument a simple table of specifications was prepared to present the relationship between the questions and significant concepts of the cleaning materials topic. This topic empowers the learning of five main concepts related to cleaning materials. These are soaps, detergents, washing soda, bleach and dirt. In addition, there is an emphasis on the similar and dissimilar structural properties of these substances, their mechanisms of cleaning, and their various effects on environment.

Throughout the development process of the CMAT instrument, many resources was investigated in detail such as curriculum objectives, high stake testing exam questions, test banks, chemistry text books so on for the aim of preparing a quality instrument to assess chemistry achievement in cleaning materials topic. The CMAT instrument consists of 20 multiple choice items. Each item has one correct answer and four distracters. Content-related validity evidences regarding CMAT were collected by several meetings with science educators, and public and Anatolian high school teachers. Representativeness of the important

concepts, clarity of printing, appropriateness of the questions to high school students and so on were at the stage during these meetings (Frankel & Wallen, 2000). For ensuring reliability, a pilot data collection study with 121 high school students was done with the pre CMAT instrument. After the data cleaning procedure, SPSS was used to calculate the reliability of the CMAT instrument. The reliability of scores, Cronbach alpha coefficient (Crocker & Algina, 1986) was calculated as 0.62.

CMAT was used as a pre and post test in both experiment and control groups to measure their pre and post chemistry achievement scores related to the cleaning materials topic. It was used to compare the effects of two instructional methods on understanding of cleaning materials topic concepts.

3.5.2. Attitude toward Environment Scale (ATES: Subscale of T-CHEAKS)

The aim of using Attitude toward Environment Scale (ATES-Appendix B) is basically for measuring students' attitudes toward environment in both experimental and control groups for determining the difference in two teaching methods. Turkish version of Children's Environmental Attitude and Knowledge Scale (T-CHEAKS) was derivated from the orginial CHEAKS scale (Alp, 2005; Alp, Ertepinar, & Tekkaya, & Yilmaz, 2006) for assessing students' knowledge on environment and attitudes toward environment. The reliability of T-CHEAKS was reported as 0.90 and 0.92 in two studies (Alp, Ertepinar, Tekkaya & Yilmaz, 2008; Alp, Ertepinar, Tekkaya, & Yilmaz, 2006). Alp (2005) first adopted the CHEAKS to T-CHEAKS and did a survey research with the scale.

In the present study, researchers are using the attitude subscale of T-CHEAKS for determining 9^{th} grade Public and Anatolian high school students' attitudes toward environment before and after the implementation of two different teaching methods. The scale consists of 36 items on a five point Likert type response format (Strongly agree, Agree, Undecided, Disagree, Strongly disagree). The reliability Cronbach alpha coefficient of the attitude subscale scores was found

0.92 (Alp, 2005). In the present study, the reliability of scores Cronbach alpha coefficient was calculated as 0.94.

3.5.3. Science Process Skills Test (SPST)

The aim of using Science Process Skills Test (SPST-Appendix C) is for determining students' science process skills in both experimental and control groups. Science Process Skills Test scores were used as a covariate in the analysis process. Okey, Wise, and Burns (1982) was originally developed the SPST, it was adapted and first used in Turkish context by Geban, Askar, and Ozkan (1992). The SPST consists of 36 questions. It is a multiple choice test with four alternatives. The SPST was composed of five main constructs; identifying variables, identifying and stating hypothesis, operationally defining, designing investigations, and graphing and interpreting data. The Turkish version of SPST was very popular among Turkish researchers and various reliability scores were reported related to this test. In its first Turkish implementation, Geban, Askar, and Ozkan (1992) was reported the reliability coefficient as 0.81. In various studies, different reliability coefficients related to the scores of scale such as 0.85 (Uzuntiryaki, 2003; Pabuccu, 2004; Bulbul, 2010), and 0.59 (Tasdelen, 2011) were reported in the literature. In the present study, the reliability of scores Cronbach alpha coefficient was calculated as 0.72.

3.6. Instructional Materials

The design framework of the classroom instruction consists of the ice breaker activity, eight lesson plans, four chemical storylines, student workbook, inquiry plan, and poster evaluation form. The classroom instruction is designed with a sequence of instructional and inquiry activities which are embedded in contexts, and with a set of specific expectations regarding the teacher and student responses to the design. The design framework also uses a strategy for instructional and learning sequence to have the students understand why to do what and aims to prepare a learning environment that contains challenges for students' intuitive reasoning, creativity and curiosity. The lesson plans are the core of the design and

they provide the opportunity to explore what the effects of the design framework was. A five phase framework which mentioned below was developed to use in context-based education (Bulte et al., 2006). These are;

1. *General Orientation*: Students face with the problem embedded in the context and they try to discover solutions to the problem. The problem is mostly from the daily life and they have chance to feel the connection between the daily life and the context-based unit. Because of the attraction of the problem and appreciation of the purpose served by solving such problems, students become focused and more willing to continue on the solutions of the problem.

2. *Need to Proceed*: After recognizing the problem and possible ways of the solution, students intuitively realize that they need further information over to offer effective solutions to the problem.

3. *Determining Procedures*: Students determine and refine the steps of the procedure for solving the problem while extending their relevant knowledge about the problem until an appropriate consensus is reached by all the students in the team.

4. *Internalizing the Step*s: Students understands the necessary steps and they propose similar solutions to other problems in the study.

5. *Transfer to Other Problems:* Students offer some alternative solutions to the similar type of questions and they perform operational procedures to solve the new problem.

Similar to this framework a new six step framework was designed to use in context-based design framework of this study. This was presented in the table 3.4.

Table 3.4. Contextual Teaching and Learning Model

Need to Explore ⇨	Need to Engage ⇨	Need to Know ⇨	Need to Proceed ⇨	Need to Share ⇨	Need to Transfer
Encountering with the concept web embedded in the context. Contexts should be interesting and appropriate for the developmental level of the learner.	Learner value the context for themselves or society. Contexts should be relevant to learners.	Learning is meaningful to learner because it is a need.	Learner had the concept web embedded in contextual experience. S/he is ready to move on additional inquiries.	Learners are motivated to share their experiences with peers and others.	Experiences and knowledge are ready to transfer to similar problems.

All the instructional materials that were used in the study were listed and explained here;

1) Lesson Plans: For each of the eight hours, a lesson plan was prepared for teachers to use as a road map for the instruction in the classroom. These lesson plans were prepared in close cooperation between the researcher, adviser and the teachers. (Appendix D)

2) Chemical Storylines: Four chemical storylines (Appendix F-G-H-I) were used in the present study. These chemical storylines were presented the chemical concepts embedded in contexts. When chemical ideas and concepts were connected to a storyline, a new level of relational significance or discursivity is created, supported by the emphasis of the connections with the daily life (Bostrom, 2008). Chemical storylines were chosen in terms of their relevance to students' daily and

social lives (Bostrom, 2008; Demircioglu, Demircioglu & Ayas, 2006). These chemical storylines were used as hooks to get the students into the topics of the unit (Koch, 2010).

A Sample with respect to Chemical Storyline:

"Choosing the Quality Soap" chemical storyline was related to soaps. It started with a contextual way, putting students in a position that they were sent to buy soap in the market by their mother. When they went to the market there are many types of soaps in the shelves. Which one the appropriate, cheap, healthy, long lasting, is a problem. There are many variables that affect the soap quality and there is need to make a decision. This is a real life situation which students encountered many similar events in their daily life. They "need to know" more things about to buy the right soap for the appropriate aims. Besides, they also "need to proceed" to learn more about the structure, ingredients of soap, the problems the soap may cause for their health and so on. They read the packages of soaps' for the ingredients; they searched it from the internet and they probably asked someone who is more knowledgeable than their selves. For the right decision this storyline mentioned variables but not limit it to these such as brands name, production of country, price of the soap, weight of the soap, per gram cost of the soap, and color. But students were defined and added some additional variables such as PH and fragrance. Interestingly almost all groups who are dealing with this chemical storyline added PH by solely as their own idea. In the first step students bought soaps from the market and various types of soaps were brought to classroom. First, groups smell the soaps and noted if they liked it or not. After that all the soaps were sunk into a cup full of water, one hour later all the soaps were taken from the cup. They all dropped to dry for one day. The next day each group was calculated the weight loss of their each soap and reported it. Meantime, groups were also discussing about designing any other try outs to support them to find the best soap which recompensed their money. After discussing about their results, each group reported the reasons and why they choose which brand as a best soap. Some sample pictures were presented from this activity below in figure 3.1.

Figure 3.1. Photos of the Students While Dealing with ‘‘Choosing the Quality Soap’’ Chemical Storyline


All the chemical storylines and their concept webs were presented below in table 3.5.

Table 3.5. Chemical Storylines and Concept Webs

Chemical Storylines	Area Covered (Chemical ideas)	Context
Bubbles, Bubbles, Soap	*Soaps and Detergents * Surface tension *Surface active agents * Chemical structure of soap (hydrophilic/hydrophobic) and detergents * Effects of hard water on cleaning agents * Effects of cleaning agents on stain *Effects of cleaning agents on environment	↳ The history of emergence of soap and detergents and their developmental process ✓ History of soap and detergents ✓ Developmental process of soaps and detergents ✓ How do I make soap? ✓ How do I remove a stain from my clothes?
Choosing the Quality Soap	* Types of soaps * Fragrances of the soaps * PH values of different soaps	↳ Choosing the appropriate soap by considering the purpose of usage

Table 3.5. Chemical Storylines and Concept Webs (Continued)

	* Melting speeds of different soaps in the water * Choosing the right soap for the environment	✓ Types of variables that effects soap quality and structure
Jeopardy in our houses	* Bleach (NaOCl) * Inappropriate mixing of cleaning agents (Chlorine and chloramines) * Health issues (Cancer)- effects of carbon tetrachloride and chloroform (trichloromethane) after using bleach as a cleaner * Effects of extensive and abundant usage of bleach on ozone depletion and global warming	↳ Extensive and abundant usage of bleach ✓ Household chemicals (Bleach) ✓ Cautions about how to use the cleaning agents ✓ Preferring the fragrance free bleach ✓ Preferring the non intense bleach
Cleaning without cleaning materials	* The importance of cleaning for healthy living in dirt free environment	↳ How do animals clean their selves ✓ Cleaning in the animal kingdom ✓ Why do they need a mutual relationship for cleaning?

3) Student Workbook: (Appendix J) was used together with the chemical storylines; it contained different types of questions related to the chemical conceptual framework of articles. The aim of the questions was to support students to catch the critical chemistry content of the articles and keep them on track about the important points of the chemistry content.

4) Inquiry Plan: (Appendix K) was the students' research plan for their research problem. Students used it as a blueprint for their inquiry project. They planned what they would do for each week and it presented the roles of students in

the group. Moreover students reported how their research proceeded and which resources they were used for their research problem.

5) Activity: (Appendix F) There is an ice breaker activity in the present study. The aim of the activity was to warm up students for the process. Groups were prepared two jars filled with water and a drop of food coloring in both jars. They shook both jars to color the water with the food coloring. It helped to easily see the different levels of oil and water later in the activity. Then they poured vegetable oil to both jars. After, that they spilt 3-4 drops of liquid soap to one jar, after jars were closed and shook by the groups, one jar was easily separated two distinct levels of oil and red colored water. But the other jar was blurry and water was mixed with vegetable oil. The groups were tried to explain and discuss the situation with each other and the whole class. Some sample pictures were presented in below figure 3.2.

Figure 3.2. Photos of Students From Ice-breaker Activity

6) Poster Evaluation Form: (Appendix L) Last week, (fifth week) of the study students had to make presentations related to their research question. One of the requirements of the presentations was preparing a poster related to their research question. These posters supported the results of their research questions visually and provided them a framework while making the presentations. Poster evaluation form was used to assess their products.

3.7. Treatment (CBCI & TDI)

There were two groups in this study, experiment group which was instructed by context-based chemistry instruction (CBCI) and control group which was instructed by traditionally designed instruction (TDI) in five weeks time. Experimental group was instructed basically with the originally developed lesson plans for CBCI, chemical story lines, an ice breaker activity, and went through an inquiry process. At the end, they needed to present their findings with posters and oral presentations. Students mostly worked in groups and teachers were usually guiding the classroom and facilitating the discussions, not teaching them directly. The enactment of the CBCI for classroom instruction was presented below in detail.

The cleaning materials topic was intentionally chosen for this study because of its conceptual structure. The understanding of this topic do not required mathematical background. In addition, making connections with daily life is easier than many chemistry topics in the curriculum. The main purpose of the instruction was to provide opportunities for students develop such skills as creative thinking, managing resources, social skills, data handling and see the connections of chemistry to daily life as well as cover the chemical content as intended in the curriculum. The drawback here was to design the topic as consecutive segments that enforce the next activity as a need. This knowledge need was defined in the literature as a content related motive and this method was named problem posing (Lijnse and Klaassen, 2004). This was expressed as; classroom instruction was constructed in such a way that students feel the need to expand their knowledge in the direction of the expected chemical ideas and concepts for the sake of their own desire.

The challenge would be to interweave the activities consistently from different perspectives: the vision of designers, the teachers and the students. The design should put students in a learning process guided by two main principles. Former one is “need to know” and the latter one is “need to proceed” for the next activity (Bulte et al., 2006). For developing a more effective design, besides the

researchers and science educators, three chemistry teachers who were in this study supported the design giving instant feed backs to regulate the instruction before class hours. The design team shared the aims and perspectives of the context based education, considering the realities of the classroom environment and preparing an educationally valuable context based chemistry course design. The topic was "The chemistry of cleaning materials" and the study was conducted in 5 weeks period with 3 chemistry teachers. The design of the study was presented in table 3.6 this table showed what was done in the 5 weeks period in the experimental classroom.

Table 3.6. The Design of Classroom Instruction

Week 0	Week 1	Week 2	Week 3	Week 4	Week 5
*Folders are given to students. *They were given general information about what to do in following weeks. * Ice Breaker Activity	Chemical Storyline 1 "Bubles Bubles Soap" ✚ Student Workbook ⇩ Research Questions ⇩ Inquiry Plan	Chemical Storyline 2 "Choosing the Quality Soap" ✚ Student Workbook ⇩ Research Questions ⇩ Inquiry Plan	Chemical Storyline 3 "Jeopardy in Our Houses" ✚ Student Workbook ⇩ Research Questions ⇩ Inquiry Plan	Chemical Storyline 4 "Cleaning without cleaning materials" ✚ Student Workbook ⇩ Research Questions ⇩ Inquiry Plan	*Poster Presentations *Discussions * Evaluation of posters and presentations

A week ago, before the study was started all the materials were given to the students in a folder and they were informed about what they would do in upcoming days. Each week, classroom instruction was driven by a chemical storyline. Chemical storylines were used in the study because they provided a more linear and structured classroom environment in addition they support less labor intense

teaching (Koch, 2010). Students worked through each chemical storyline, making visits to chemical ideas at appropriate points. While students were dealing with chemical ideas, students would need to answer questions from their student workbooks in and out of class time. Student workbooks were designed to confirm and consolidate their understanding of chemical concepts, principles and formulas. The context of the chemistry for each week was dealt with in the chemical storyline itself and in related discussions, questions and inquiries. The chemical story lines were arranged to fire up discussions and questions that supported students to frame the topics in a broader perspective. In addition, these discussions emerge new questions to search for as a need to learn and proceed for their answers. Students posed many questions and mostly they were willing to work on these research questions (Stinner, 2006). After choosing an appropriate research question, they were expected to conduct an inquiry plan and to proceed on it. What is appealing about this kind of classroom environment is that the student generated research questions naturally emerged from the context and student workbook questions were artificially given related to the context which supported each other for better understanding (Stinner & Williams, 1993; Stinner, 2006).

In an effective context-based instruction the used contexts were needed to have 4 critical dimensions (Gilbert, 2006). Since the contextual framework was set by focal events in chemical storylines, there was need to determine these four dimensions of contexts for each week. Because of the budget and time limitations, permission procedures, and teacher considerations authentic activities in this study were limited in some level. These limitations also pushed designers to use 3 abstract focal events in the design (Chemical Storyline 1-3-4). Table 3.7 is related to the first chemical storyline and presented the four dimensions or attributes of the context (Gilbert, 2006).

Table 3.7. The Chemical Storyline Bubbles Bubbles Soap

1. *Setting:* The focal event is the history of emergence of soap and detergent and their developmental process. People found out by chance that soap was a better cleaning agent then the former ones. The emergence of the detergent was a need for a cleaning agent which was also effective in cold and hard water. In addition to these factors, it was also related to the decrease of oil storages in the second world war.
2. *Behavioral Environment:* Producing soaps with different colors, fragrances, etc. in the school laboratory. Conducting a research on the effects of different types of soaps for the environment. Using sources to learn about the chemical structures of soaps and detergents and very first materials that were used in soap production.
3. *Chemical Talk:* The history of the emergence of soap and detergents were initially framed the chemical talk that some students were really curious about. First cleaning materials such as milk, sand, plant leaves were mentioned as primer chemical ideas. Latter, very first methods of soap and detergent production, chemical structures of soaps and detergents, chemistry of cleaning and dirt, eventually ended with anti-bacterial soaps. In addition there was a special emphasis on the similar and dissimilar structural properties of soaps and detergents, their mechanisms of cleaning, and their various effects on environment. These chemical talks involved specific terms such as surface tension, surface active agents, hydrophilic, hydrophobic, hard water, fatty acids, and salts.
4. *Extra-situational Background Knowledge:* This might involve more general knowledge about some chemical concepts such as oils, bases, acids, lime, and salts. The chemical concepts which were presented here might also used to understand the dry cleaning.

Using historical chemical storylines was an advantage to present students some stages of how a developmental process was passed through out human history. The American Association for the Advancement of science (AAAS, 1990) proposed that historical examples were one of the best ways of illustrate scientific enterprise. In addition, Elwell (1993) pointed out that well-crafted stories can effectively be used as hooks to gain students' attention. Table 3.8 is related to the second chemical storyline and presented the four dimensions or attributes of the context (Gilbert, 2006).

Table 3.8. The Chemical Storyline Choosing the Quality Soap

1. *Setting:* The focal event is choosing quality soap from the market to use in the house. In the setting student was in the market in front of the soap shelves but s/he had no idea about making the right choice about which soap to buy from the market.
2. *Behavioral Environment:* Defining variables that effects soap quality, designing an experiment, and developing research plans. How to cope with real life problems and understanding what the accurate measurement, reliable and valid knowledge is.
3. *Chemical Talk:* How to choose the quality and appropriate soap was initially framed the talk. The chemical talks involved specific topics such as soap types, PH, soap chemistry, soap coloring, soap related health especially skin problems, anti-bacterial soaps.

Table 3.8. The Chemical Storyline Choosing the Quality Soap (Continued)

4. *Extra-situational Background Knowledge:* This might involve more general knowledge about some chemical concepts such as PH, bases, acids, salts. In addition to these, knowing about how to make a valid and reliable measurement is critical. The chemical ideas and skills were helpful about how to develop an experiment in other similar situations.

Science is always a critical component of our lives; it always provides us some alternative ways when we encountered the problems. Making the appropriate choices was easier if we dealt with similar problems in some stages of our life. Table 3.9 is related to the third chemical storyline and presented the four dimensions or attributes of the context (Gilbert, 2006).

Table 3.9. The Chemical Storyline Jeopardy in Our Houses

1. *Setting:* The focal event here was the hazards of extensive and abundant usage of bleach. Students probably encountered and used bleach in some parts of their daily life. (Average 3 liters per household in Turkey yearly)
2. *Behavioral Environment:* Defining the chemical components of bleach. Realizing the fatal effects of mixing inappropriate cleaning agents. The contributing effects of bleach on the environmental problems such as ozone layer depletion and global warming were discussed. Warning their parents about delicate usage of bleach and preferring to buy fragrance free bleach.

Table 3.9. The Chemical Storyline Jeopardy in Our Houses (Continued)

3. *Chemical Talk:* The hazardous effects of extensive and abundant usage of bleach on human health and environment initially framed the chemical talk. The new evidences related to the possible serious effects of bleach on human health such as gas poisoning (because of mixing with other cleaning agents), various types of cancers (because of inhaling bleach especially with the ones with jell form and fragrances), and breathing problems were mentioned. Latter, the effects of extensive and abundant usage of bleach on ozone layer depletion and global warming were discussed. These chemical talks involved specific terms such as sodium hypochlorite (NaOCI), Carbon tetrachloride (CCl_4), and chloroform ($CHCl_3$).
4. *Extra-situational Background Knowledge:* This might involve more general knowledge about chemical formulas, chemical reactions, ozone depletion and global warming. The chemical ideas which were embedded in this chemical storyline also expected to use in determining the hazardous effect of other cleaning agents or chemical substances.

Using chemical storylines which encounters students with chemicals that were used in students' day life was a crucial process. Because this helped students to connect bridges between school knowledge and their life and also showed the relevance of the chemistry knowledge. Table 3.10 is related to the fourth chemical storyline and presented the four dimensions or attributes of the context (Gilbert, 2006).

Table 3.10. The Chemical Storyline Cleaning without Cleaning Materials

1. *Setting:* The focal event here was how the animals clean their selves without using any cleaning materials. It helped to connect the topic with real life and presented evidences of the importance of cleaning.
2. *Behavioral Environment:* Making observations about animals and realizing how they clean themselves. The awareness of cleaning with very simple materials such as mud, water, and leaves. Explaining about how their pets in the houses or animals on the streets were cleaning themselves.
3. *Chemical Talk:* The Importance of cleaning for animals and humans were initially framed the chemical talk. The importance of living in a clean social environment was emphasized in chemical talks.
4. *Extra-situational Background Knowledge:* This might involve some general knowledge about animals. How to make observations and taking filed notes was a necessary skill.

While using these chemical storylines, the emergence of new student questions related to the chemical ideas in the storylines were expected. In addition some student questions were raised from students' daily experiences regarding the cleaning agents. These student generated research questions were very helpful to provide meaningful connections with students' daily life. Students were encouraged to work in groups while they were dealing with their research questions. Various aspects of student generated research questions, dealing with them, and managing and handling the data were sometimes mentioned and discussed in the classroom. These intermediate processes were very helpful to

support students to focus on their research questions. Students mostly used the Internet, science textbooks and other reference resources to gather information about their research problems. Sometimes, students found conflicting ideas in different references and they had to discuss about the issue within their groups and also they started to question the reliability and validity of the knowledge, especially the reliability and validity of the sources they had found from the internet.

Student questions were basically classified into three main groups according to their content. Student generated questions in these three main groups are related to the chemistry, environmental concerns, and health. Some examples of student generated questions were;

- Soaps are mostly colored why do soap bubbles are always white?
- Is there a black soap? If it exists, what is it used for?
- We knew that soaps are basic but many soap brands advertise that their soap is neutral? Is it right?
- What is the effect of hard water on soaps and detergents?
- Are there environmental friendly soaps and detergents?
- What are the types of soap and their relation with health?
- What are the types of bleach?
- How does bleach remove the colors from our clothes?
- What is the effect of bleach on ozone depletion?
- What is the effect of bleach on global warming?
- What is the importance of cleaning for animals?
- What is dry cleaning?

Using poster presentations in context-based education is one of the effective ways to assess students (Anthony, et al. 1998). All groups prepared posters about possible explanations about their research questions. All posters were hung up to classroom walls and all groups presented their posters in about 6-10 minutes. One group of students differently prepared a timeline of how soap was produced in historical soap production facilities and this timeline and sample posters were presented in figure 3.3. There were always discussions about the presented

chemical ideas in posters and students looked very motivated to discuss about their explanations regarding the critical points in posters.

Figure 3.3. Photos of Some Posters From Poster Presentations

Teachers and researcher worked very collaboratively in the whole period of the study and materials were checked at every step with several meetings. After each week, researcher and teachers made phone calls and meetings as needed related to any problems. Range of activities and skills that were supported by this design reported below;

1. Open-ended, prescriptive inquiry tasks: Students engaged to an inquiry process which questions were purely emerged from student curiosity and interest.

2. Finding and using a range of resources: To find solutions their naturalistic questions they used range of resources such as internet, books, more knowledgeable others and so on.

3. Computer link (Possible research source, World Wide Web): Internet is in the critical importance to search for the unknown; it is one of the important sources of students.

4. Independent and collaborative learning: Mostly students worked in groups and support each other to find possible answers to their query. Some students prefer to work alone or some parts of the inquiry process are conducted independently from the group members.

5. Preparing and giving a presentation and poster: At the end, student groups were presented what and why they research and what about their findings.

6. Discussion in groups: Every week students had chance to discuss over chemical concepts and chemical ideas in groups. Last week, after each presentation, discussions over the work were done.

7. Data handling and analysis in some level: Students engaged in an inquiry process which they needed to handle some data.

The traditionally designed instruction was the way teachers most regularly used to present the content to the class. Teacher was mostly in front of the white board explaining the chemical concepts and structures to students and asking questions about what he or she just thought. Teacher was at the center of the teaching process and s/he was the source of the knowledge. Students were mostly listening, answering teacher questions and note taking. Student questioning was rare and mostly textbook and teacher questioning were appreciated. After covering the all chemical concepts, they started to practice with problems and multiple choice tests.

For detecting the effect of two instructional methods, researcher was provided the same content to both groups. For instance, science articles were also

read in the control groups by some students out loud. This assured that the detected difference was not from the different content loads of the two instructions. For assuring the treatment verification and fidelity, most of the procedures were tried to be standardized like test durations were the same for all groups in the study and another science educator came to both groups' class hours randomly and took field notes and filled a classroom observation checklist (Appendix M) about what happened on that time period. These notes and checklists were checked for their consistency with what was planned before hand as in both groups' instructional processes.

3.8. Data Analysis

3.8.1. Statistical Procedures

All the pretest and posttest results of the study were entered to the SPSS 20 computer program directly and all statistical analyses were conducted with using this program. Student ID, group membership, gender and school type were entered as the starting point of first row in data set among others. Descriptive statistics such as mean, median, range, skewness and so on were calculated and reported. Multivariate analysis of covariance (MANCOVA) was used as an inferential statistical procedure because of existence of covariate and two dependent variables.

MANCOVA statistical procedure has five assumptions: these are normality, homogeneity of regression, equality of variances, multicollinearity, and independence of observations. Variables in the present study were tested for ensuring the all assumptions of MANCOVA.

3.8.2. Power Analysis

During the analyses, the probability of rejecting a null hypothesis (Type 1 error), alpha was set to 0.05 as a priori to hypothesis testing. The probability of failing to reject a false null hypothesis (Type 2 error), beta was set to 0.20. The power value was set to 0.80 (1-beta) and the effect size was set to medium value

f^2=0,15 prior to the study (Cohen, Cohen, West, & Aiken, 2003). Ka, number of covariates was 3 and Kb, number of fixed factors was 2 (Treatment (2 sublevels=n-1=2-1=1) and School Type (2 sublevels=n-1=2-1=1)). Normally, using Kb (2) value for determining L value is appropriate but at this point researcher took a more radical approach and used K value (Ka+Kb) for determining the L value which resulted in a bigger sample size and more power. L value was found 12.83 from Cohen's table (Cohen et al. 2003, p.651) for alpha=0.05, power=0.80, and K=5. The sample size required for this study calculated from these values was 91 (n=L/f2+Ka+Kb+1). For obtaining desired power at the end of the study, determination of the required sample size prior to the study is a must.

3.8.3. Unit of Analysis

The validity of statistical procedures for any experimental study greatly depends upon how the data approximate the conditions of statistical model employed (Peckham, Glass, & Hopkins, 1969). Students, who were in the study, were determined as the unit of analyses and each intact class indicated the experimental unit (Hopkins, 1982). Choosing participants as unit of analyses allows exploring other interesting questions regarding the interaction and generalizability (Hopkins, 1982). Independence of observations is a significant assumption of statistical model employed in this study. The eight classes in the present study were not performed with any intentional selection process, which causes biased classes. But it is not possible to instruct students individually in an isolated environment hence this severely restricts external validity. Moreover, for empowering the quality of the comparison between teaching methods, the instructional methods (CBCI & TDI) were randomly assigned to control and experimental classrooms (Peckham, Glass, & Hopkins, 1969).

3.8.4. Procedures for Students' Opinions Related to the Experimental Treatment in Focus Groups

Turkish chemistry teachers and students do not have much experience related to the context based instruction in chemistry education; it is a newly

adapted approach and there is not much evidence as to how Turkish high school students responded to it. After experimental students were instructed with the CBCI and finished all the requirements of the course. Conducting interviews with all students were very burdensome and ineffective way of investigating their ideas so we prefer to use focus groups. Focus groups are dynamic environments that use group interaction to discuss and probe the opinions and positions. Focus groups were arranged to gather some evidences related to the ideas, beliefs, and experiences about the effectiveness of contextual course design of the present study.

For reaching this goal, four focus groups average size of seven students were conducted totally with 28 students to explore the perspectives of students related to this design.

1. What are the students' ideas about the way the content is presented to them in context-based unit?

2. Are the students' more motivated and focused on the chemistry learning than other conventional chemistry classes?

3. Are the students willing to search for their research questions and additional information related to their posters?

Focus groups were conducted with two different groups of students; students who seek science related jobs (2 focus groups) and students who seek non-science related jobs (2 focus groups). Selection process to different interest groups was made by asking students which profession they will plan to have in the future. After that their job choices placed them to the either science or non science path in the focus groups. This distinction was necessary to see how students who have different interests respond to the CBCI.

3.9. Threats to Internal Validity

There are various internal validity threats for quasi experimental designs (McMillan & Schumacher, 2001 p.347; Frankel & Wallen, 2000). As a general

strategy, researcher tried to standardize many procedures such as the way in which CBCI instruction implemented, the way tests were implied and so on. Additional information related to participants was collected like age, gender, etc. from the field to use in analyzing and interpreting results. Field notes were taken related to the participants, classrooms, teachers, schools, implementation process, extraneous events, and so on to support for controlling location, history, subject attitude, instrumentation, and implementation threats (Frankel & Wallen, 2000).

Using MANCOVA as a statistical procedure helped to eliminate the subject characteristics threat in some level because of using the covariates to statistically match subjects on certain variables. In addition to this, the intact classes were randomly assigned as an experimental or a control group for eliminating the subject characteristics threat. Location threat was not an important issue for this study because both schools in the present study were in the same neighborhood and the characteristics of the locations were similar for all participants. Testing effect threat was considered and time period between implications of tests was set to five weeks to reduce the remembrance of the pretest responds.

Hawthorne effect and John Henry effect were extremely hard to eliminate in this kind of studies. Hawthorne effect is positive self presentation of some subjects because of their self realization of receiving a special treatment (McMillan & Schumacher, 2001). John Henry effect is realization of some subjects to be in the control group and because of that they try harder and more motivated than their usual performance (McMillan & Schumacher, 2001). To deal with this threat, teachers behaved that the instruction in the entire classes was the regular part of their instructional style. Both of the threats are the limitation of this study.

3.10. External Validity

The extent to which the results of a research can be generalized to similar other cases is called external validity (Frankel, Wallen & Hyun, 2011). It is the degree to which the sample represents the characteristics of the population. According to statistical analysis, there is a significant effect between the

achievement scores of both experimental and control groups. Experimental students who received contextual instruction did better than students who received traditionally designed instruction. This study is conducted in the Etimesgut district near 20 kms far from city center of the Ankara. There are 3 Anatolian and 4 public high schools in the district. Two schools were in the sample. One of them is Anatolian High School which students enrolled it with an entrance exam. The other one is public high school in the district. The socio economic status of residents in the district is usually medium or below medium. Sample size of the present study (n=222) exceeds the 10% of the accessible population. Hence the findings of the present study can be generalized to accessible population.

3.11. Assumptions and Limitations

Assumptions and limitations of the present study listed below respectively;

Assumptions

1. All the instruments in the present study conducted in the classroom in standardized conditions.

2. All the participants of the present study were answered the items sincerely.

3. Teachers followed the guided instructions in the study and they were not biased for the sake of any instructional methods.

4. There were no interactions between experimental and control group students (Independence of observation).

Limitations

1. This study was conducted with 9^{th} grade students in Ankara city center with Public and Anatolian High Schools.

2. This study only focused on the cleaning materials topic.

CHAPTER 4

RESULTS AND CONCLUSIONS

4.1. RESULTS

4.1.1. Descriptive Statistics

Screening and cleaning data and missing data analysis were done before the analysis. Categorical and continuous variables were checked according to any distorting value which might be entered. Also, reverse items in the attitude toward environment scale were considered in preliminary analyses. Descriptive statistics related to continuous variables are presented in Tables 4.1, 4.2 and 4.3 respectively.

Table 4. 1. Descriptive Statistics for All Data

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
CMAT_pre	222	1	13	6,96	2,386	,144	,163	-,403	,325
CMAT_post	222	4	19	11,41	2,933	-,123	,163	-,408	,325
SPST	222	6	30	19,70	4,817	-,555	,163	,072	,325
ATES_pre	222	1,89	4,92	3,9731	,60924	-1,005	,163	1,212	,325
ATES_post	222	1,25	5,00	3,9996	,60254	-,904	,163	1,361	,325
Valid N (listwise)	222								

Skewness and Kurtosis values should be in the range of -2 and +2 for a normal distribution. With reasonably large samples, such as 200+ cases or more, skewness may not make a substantial difference in the analysis and the risk of underestimating the variance because of the violation of kurtosis values are disappeared in the analysis (Tabachnick & Fidel, 2007, p.80). In the present study, there is a violation of ATES_pre of the kurtosis value 2.144 (Table 4.2) but the sample size of this study is 222 and because of this, violation of the value is not a problem regarding the analysis (Tabachnick & Fidel, 2007). The values related to experimental and control groups were presented respectively in tables 4.2 and 4.3. All other values are between the margin values and all distributions are counted as normal regarding the values.

Table 4.2. Descriptive Statistics for Experimental Group

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
CMAT_pre	119	2	12	7,30	2,268	,012	,222	-,535	,440
CMAT_post	119	5	19	12,58	2,760	-,470	,222	,243	,440
SPST	119	6	30	19,98	4,440	-,505	,222	,321	,440
ATES_pre	119	1,89	4,92	4,0051	,576	-1,211	,222	2,144	,440
ATES_post	119	2,61	4,94	4,0378	,546	-,682	,222	-,269	,440
Valid N (listwise)	119								

Table 4.3. Descriptive Statistics for Control Group

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
CMAT_pre	103	1	13	6,57	2,468	,350	,238	-,109	,472
CMAT_post	103	4	16	10,05	2,522	,004	,238	-,378	,472
SPST	103	7	30	19,38	5,223	-,542	,238	-,220	,472
ATES_pre	103	1,97	4,89	3,9361	,64558	-,812	,238	,552	,472
ATES_post	103	1,25	5,00	3,9555	,66108	-,987	,238	1,959	,472
Valid N (listwise)	103								

4.1.2. Inferential Statistics

In this part, the determination of the covariates, assumptions of MANCOVA and results related to MANCOVA are presented respectively.

4.1.2.1. Determination of Covariates

MANCOVA can be used to control one or more covariates at once and covariates should be continuous variables (Pallant, 2007). Covariates are mostly determined regarding their known association with the DV; otherwise, it may not be as effective as expected. Choosing an optimal set of covariates are very important because using too many covariates which are correlated with each other reduces the power (Tabachnick & Fidel, 2007, p. 211). Statistically, the aim is to determine a small set of covariates which are correlated with DV but not among each other.

One way to determine the covariates is regarding the theoretical grounds of the topic and also stated variables in the literature which can be sources of variability can be used as covariates (Tabachnick & Fidel, 2007). Sometimes, it is

hard to determine the covariates from the theory or literature because of the insufficient number of research studies and at this point statistical principles guide the selection process of covariates. Checking the correlations between the possible covariates and selecting appropriate ones from them is the other way to determine the set of covariates. Potential covariates should have a significant correlation with at least one DV and correlations in between all the IV should be less than 0.80. The results of the correlation analyses of IV and DV are displayed in the Table 4.4 CMAT_pre, SPST, and ATES_pre are all have significant correlations with DV' s; CMAT_post and ATES_post. Correlations among potential covariates are also less than 0.80 hence choosing these 3 IV's as a set of covariates in the statistical analyses looked appropriate. However choosing all three as a set of covariates violated the homogeneity of regression assumption according to the preliminary analysis. Taking into account of the results of preliminary analysis, choosing SPST as an only covariate was reasonable to go on further analysis.

Table 4.4. Correlations between potential covariates and DV

	CMAT_post	ATES_post	CMAT_pre	SPST	ATES_pre
CMAT_post	1	,086	,351**	,401**	,006
ATES_post	,086	1	,137*	,049	,658**
CMAT_pre	,351**	,137*	1	,329**	,206**
SPST	,401**	,049	,329**	1	-,027
ATES_pre	,006	,658**	,206**	-,027	1

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

4.1.2.2. Assumptions of MANCOVA

Assumptions are in critical importance to perform any further statistical procedures with parametric tests (Field, 2005). Multivariate analysis of covariance has five assumptions and they are normality, equality of variances, multicolinearity, independence of observations, and homogeneity of regression.

Skewness and kurtosis values are used for checking the normality assumption and the values between the range of -2 and +2 can ensure the normality

(George & Mallery. 2003). Only ATES_pre value violated this assumption with a minor difference (2.14) with the upper boundary 2. This will not affect the analysis seriously because Tabachnick and Fidel stated that this violation with samples sizes over 200 is not a significant issue (Tabachnick & Fidel, 2007). Moreover, multivariate normality can be ensured by checking the Box's test. Table 4.5 presented the result of this test since Box's test is not significant; the multivariate normality assumption was ensured.

Table 4.5. Box's Test of Equality of Covariance Matrices

Box's M	12,955
F	1,415
df1	9
df2	466795,491
Sig.	,175

Multivariate analysis of covariance makes the assumption that samples were picked up from populations of equal variances. This ensures that variability of scores for each of the groups is identical. This assumption is controlled by the Levene's test for equality of variances. Finding insignificant results for the variables are hoped. Finding significant results showed that variances for two groups are not equal. CMAT_post is significant and the variances of two groups were not equal. The violation of this assumption is fairly robust if the size of groups (Largest/Smallest=1.5) is reasonably identical (Pallant, 2007). Since sizes of the groups were in the range of this value in the present study, this violation is not an issue.

Table 4.6. Levene's Test of Equality of Error Variances

	F	df1	df2	Sig.
CMAT_post	3,265	3	218	,022
ATES_post	1,075	3	218	,360

The multicolineratiy assumption was verified by checking the correlations among the concerning variables. Since there is not a strong relationship between

the variables and all the correlations are below the 0.80 in table 4.7, this assumption was settled.

Table 4.7. Correlations among Concerning Variables

	CMAT_post	ATES_post	CMAT_pre	SPST	ATES_pre	SCHTYPE
CMAT_post	1	,086	,351**	,401**	,006	-,161*
ATES_post	,086	1	,137*	,049	,658**	,021
CMAT_pre	,351**	,137*	1	,329**	,206**	-,300**
SPST	,401**	,049	,329**	1	-,027	-,413**
ATES_pre	,006	,658**	,206**	-,027	1	,053
SCH TYPE	-,161*	,021	-,300**	-,413**	,053	1

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

Independence of observation were tried to be reach by the researcher by preventing students interaction while performing the tests in the classroom. In addition all tests were checked for any violation of this assumption while entering the data. The last assumption is homogeneity of regression and it was checked by writing the below syntax (Figure 4.1) and running it in the SPSS (Tabachnick & Fidel, 2007, p. 282)

Figure 4.1. Syntax for Homogeneity of Regression

```
MANOVA Ct_post_sum,Ate_post_mean,Spst_sum by Schtyp(1,2),Group(1,2)
/PRINT=SIGNIF(BRIEF)
/ANALYSIS=Ct_post_sum,Ate_post_mean
/DESIGN=Spst_sum,Schtyp,Group,Schtyp by Group,
POOL(Spst_sum) by Schtyp +
POOL(Spst_sum) by Group +
POOL(Spst_sum) by Schtyp by Group
/ANALYSIS=Ct_post_sum
/DESIGN=Spst_sum,Schtyp,Group,Schtyp by Group,
POOL(Spst_sum) by Schtyp +
POOL(Spst_sum) by Group +
POOL(Spst_sum) by Schtyp by Group
/ANALYSIS=Ate_post_mean
/DESIGN=Spst_sum,Schtyp,Group,Schtyp by Group,
POOL(Spst_sum) by Schtyp +
POOL(Spst_sum) by Group +
POOL(Spst_sum) by Schtyp by Group.
```

According to the result of the homogeneity of regression test, a statistical non significant interaction was detected F(6,426)=1.883, p=0,082>0,001 (The more stringent cut off is used) (Tabachnick & Fidel, 2007, p. 281). Homogeneity of regression assumption was satisfied.

4.1.2.3. Results related to MANCOVA

Two way multivariate analysis of covariance was performed to investigate achievement and attitude differences in group membership and school type variables. Preliminary assumption testing was conducted to verify for normality, equality of variances, multicolinearity, independence of observations, and homogeneity of regression, with no serious violations observed. Two way multivariate analysis of covariance was performed with the IBM SPSS Statistics 20 program (Green & Salkind, 2007). Results related to the model indicated in the table 4.8.

The Wilks' Lambda of 0,802 is significant, F(2, 216)=26,715, p= 0,00; partial eta squared=0,198, indicating that we can reject the null hypothesis 1. There is a significant mean difference on the collective dependent variables of CMAT_post and ATES_post between experiment and control groups when SPST were controlled. The multivariate partial eta squared 0,198 indicates almost 20% of multivariate variance of the collective dependent variables is associated with the group factor. The observed power value regarding the treatment is 1,0 and it is greater than the assigned power 0,80 at the beginning of the study. Since effect size was preset as medium (0,15), calculated eta squared was medium to large (0,198-Tabachnick & Fidel, 2007, p.55) . Hence, it can be concluded that present study has a practical significance. The Eta Squared value based on Wilks' Lambda indicates the difference between the groups was large similarly it can be said that almost 20% of multivariate variance of dependent variables is related to the treatment.

Table 4.8. Result of MANCOVA

Effect	Wilks' Lambda	F	Hyp. df	Error df	Sig.	Eta Sq.	Observed Power
Treatment	,802	26,715	2,0	216,0	,000	,198	1,00
School Type	,998	,231	2,0	216,0	,794	,002	,086
Treatment* School Type	,974	2,882	2,0	216,0	,058	,026	,560

The Wilks' Lambda of 0,998 is not significant, F(2, 216)=0,231, p=0,794; partial eta squared=0,002, indicating that we cannot reject the null hypothesis 2 that there is no significant mean difference between posttest mean scores of anatolian and public high school students on the collective dependent variables of CMAT_post and ATES_post between groups when SPST scores was controlled.

The Wilks' Lambda of 0,974 is not significant, F(2, 216)=2,882, p=0,058; partial eta squared=0,026, indicating that we cannot reject the null hypothesis 3 that there is significant mean difference on the collective dependent variables of CMAT_post and ATES_post for the interaction of treatment with school type when SPST was controlled.

Covariate SPST was significantly contributed to the adjustment of the dependent variables. The Wilks' Lambda of 0,856 was significant for SPST, F(2,216)=18,217, p=0,000; partial eta squared=0,144. The effect size of the covariate SPST included in the present analysis was medium to large (0,144-Tabachnick & Fidel, 2007, p.55).

Table 4.9. Results of MANCOVA Regarding the Covariate

Effect	Wilks' Lambda	F	Hyp. df	Error df	Sig.	Eta Sq.	Observed Power
SPST	,856	18,217	2,0	216,0	,000	,144	1,0

In order to check the effects on each dependent variable separately follow up ANCOVAS were performed instead of step down analysis because the relationship between the dependent variables' was quite small (0,086-Correlations among concerning variables table 4.7).

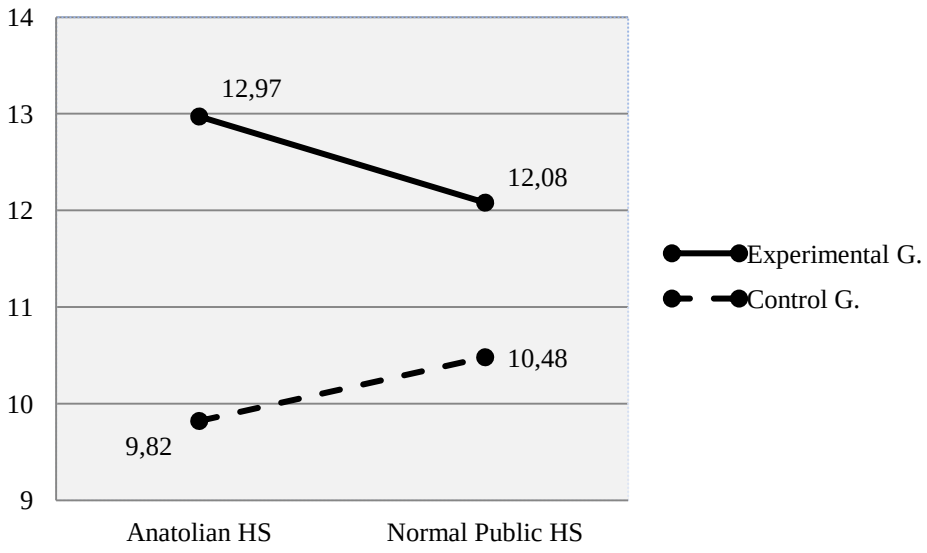
Associated with the group, CMAT_post was significantly effective F(1,217)=53,39, p=0,000; partial eta squared=0,197. The results showed that there is significant difference between the posttest mean scores of students taught via CBCI design and who taught via TDI on the population means of CMAT posttest scores when the pretest scores of SPST scores are controlled. Meanwhile, ATES_post was no significant effect F(1,217)=0,85, p=0,357; partial eta squared=0,004. There is no significant difference between the posttest mean scores of students taught via CBCI oriented teaching and who taught via TDI teaching on the population means of attitudes toward environment posttest scores when the pretest scores of science process skills test scores are controlled.

Associated with the school type CMAT_post F(1,217)=0,109, p=0,742, partial eta squared=0,001 and ATES_post F(1,217)=0,333, p=0,564, partial eta squared=0,002 are both were not significant. There is no statistically significant difference on the posttest mean scores between anatolian and public high school students' understanding of cleaning materials concepts when the pretest scores of science process skills test scores are controlled and there is no statistically significant difference on the posttest mean scores between anatolian and public high school students' attitudes toward environment when the pretest scores of science process skills test scores are controlled.

Associated with the Group*School Type interaction, CMAT_post was significant F(1,217)=5,686, p=0,018; partial eta squared=0,026. There is statistically significant interaction between methods of teaching and school type on students' understanding of cleaning materials concepts when the pretest scores of science process skills test scores are controlled. Meanwhile ATES_post was not significant F(1,217)=0,039, p=0,844; partial eta squared=0,000. There is no statistically significant interaction between methods of teaching and school type on students' attitudes toward environment when the pretest scores of science process skills test scores are controlled.

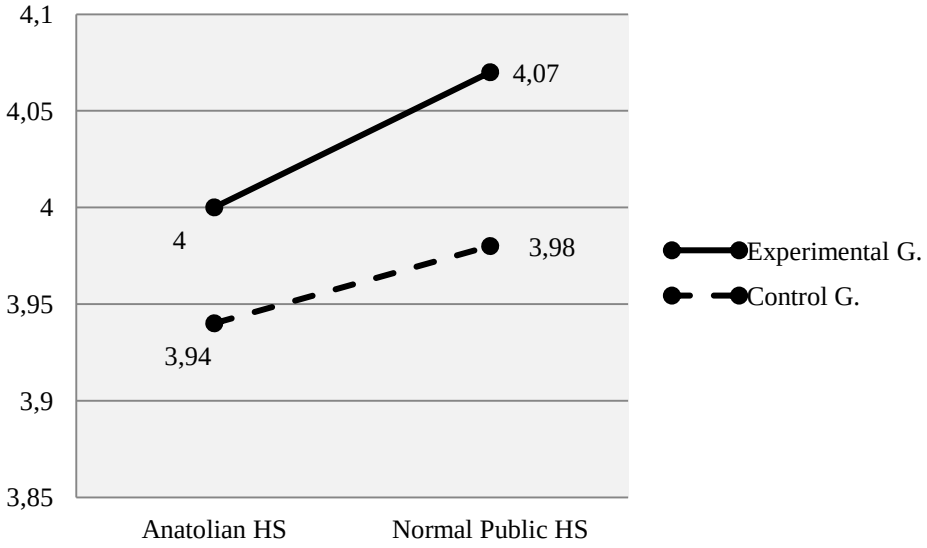
To explore the effects of CMAT-post and ATES_post plots were drawn.

Figure 4.2. Estimated Marginal Means of CMAT_post



In both schools, the differences in CMAT_post scores are in favor of experimental groups. However, Anatolian High School students seem to benefit more from contextual approach.

Figure 4.3. Estimated Marginal Means of ATES_post



The plot shows that the contextual approach proportionally contributes to students ATES_post in both Public High School and Anatolian High School. In addition, this contribution is in the favor of Public High School Students. In this school, contextual approach seems to improve their attitudes more than Anatolian High School. This non significant rise probably explained with social desirability.

4.1.3. Students' Opinions Related to the Treatment in Focus Groups

The aim of the focus groups were to bring out what students think about the contextual design, which points they were pleased about, and which points were needed to develop for more meaningful design. Four focus groups were conducted considering the two different student groups and these were students who plan to follow science and non-science related careers. Each two focus groups were conducted taking into account of the school type. Results were reported under two headings because school type was not found significant in quantitative data analysis. In addition, students stated similar advantages and challenges related to the contextual design in both schools.

4.1.3.1. Students Who Seek Non-Science Related Jobs (2 Focus Groups)

The aim of these two focus groups were to bring out what students who prefer to follow a non-science major career were thinking about related to our contextual design. Each focus group approximately took 25 minutes. There were seven students in each focus group. They were planning to follow career paths such as interpreter, prosecutor, actor or actress, psychologist, reporter, and teacher in social sciences. Their general ideas on design were reported below.

One of the students started to talk about their position against chemistry course.

> ‘‘I liked the chemistry but lately I lost my interest to chemistry because it turned to formulas and calculations on the board’’

They mentioned the powerful emphasis of mathematical problem solving in chemistry as a barrier for them to engage in chemistry because they believed that they do not have sufficient mathematical skills to solve the proposed problems. In addition, they did not realize the relevance of many disciplines such as math topics to their daily life.

> ‘‘We are learning the functions topic in weeks from our mathematics teacher, I have no idea how it is useful to us and how I can use functions knowledge in my life’’

One of the students explained why she liked the ice breaker activity which they saw how the soap helped to mix with oil and water together and removed oil and stain. She mentioned a case;

> ‘‘My mother always told me to wash my hands with the soap but mostly I am too lazy to wash my hands with it. I usually use just water but now I understand how soap

> functions to remove oil or stain from my hands and only water is not enough.''

As another important point they presented their ideas over the chemical storylines. They are mostly pleased with chemical storylines and said that;

> ''I read them all by myself and also I read all the chemical storylines to my mother and my sisters''

> ''When I was reading the chemical storyline about the bleach, my mother told me that she poisoned from the mixing bleach with tuzruhu (A diluted HCI solution used as a cleaning material) while cleaning the toilets ''

> ''Before the course, I believed that if I mixed many cleaning agents together in cleaning, I get better results. But now, I am very attentive while using them and I prefer to buy odorless and less intense ones''

These quotes strongly emphasized that students realized relevance of cleaning materials topic to daily life easily with chemical storylines. They read the chemical storylines properly and they shared what they learned from them to their friends and their family. This process helped them to see the relevance of chemistry knowledge to their daily lives and they did not compartmentalize what they learn in the school as school knowledge. In addition, mother of one of the students told her daughter about her poisoning story because of mixing inappropriate cleaning chemicals in the house. The emergence of these kinds of stories from students' daily lives supported the contextual and meaningful learning of chemistry.

Moreover 9 of the students pointed out that they liked the chemical storylines which mentioned the history of soap and how animals clean their selves. They discussed the importance of knowing how the things were firstly discovered or explored. They realized that if they knew the historical development process it

was hard to forget. The historical developmental process framed the chemical talk into a context. The chemical storylines about how animals clean their selves was another popular chemical storyline because most of the students were starting to observe their pets or street animals to understand how they clean themselves in a closer perspective. They thought of how fishes clean themselves because they are already in the water. Some students also mentioned their surprise when they learn how some animals like lions, flies and others clean their bodies. Chemical storylines seemed very useful to engage these students to chemistry. Perhaps, these students have more social sciences background and they enjoyed reading the chemistry concepts in chemical storylines.

In the design also there were student generated research questions and students also mentioned them in the focus groups. There are two quotes below related to that;

> ‘‘We are very bored of writing and drawing in many courses. Our teachers were writing on the board then we were rewriting. Research questions provided chances for doing different things than just writing to our notebooks’’

> ‘‘My research problem was about dry cleaning. I went to the dry cleaning shop, I talked to the workers and the shop owner, took photos, and learned how they dry-cleaned the clothes in general. I also examined their advertisement leaflets to get some tips for my poster. It is fun to search for something you wonder about’’

The advantages of using student generated questions were obvious in these quotes. Using student generated questions seemed effective because research questions were generated from the context and included sub-questions which mostly required students to do some additional research (Stinner, 2006). In addition, students seemed to present their enthusiasm of preparing their posters from the practical field. Furthermore, one student from the group who search for

the effects of detergents on environment stated that they were very surprised when they realized that there are alternative ingredients for producing detergents which are environmental friendly but most producers used to prefer cheap and non environmental friendly ingredients just for economical reasons.

Moreover, students discussed how they proceed and which resources they used in their research process in focus groups. Most of them reported that they followed what they planned in their research plan. They wrote what they planned to do as a research work and which parts were responsible for whom. They mentioned the main source for their research was the internet but they also stated that they realized many web sites providing an insufficient, similar or same knowledge for their research topic. Then they turned to other resources such as their textbooks, parents, books, more knowledgeable people, and chemists.

They were mostly pleased about preparing posters and presenting them in the last week of the course. These quotes were from students regarding this issue;

> ‘‘Making presentations in the last week was useful because it was a repetition of what we learned as a whole’’

> ‘‘I really liked the poster which showed how bleach brightens different types of fabric. They put different types of fabric and dropped bleach on each of them. It was really interesting to see the effects of bleach on different types of fabrics in the classroom.’’

> ‘‘I liked many posters and read most of them, we hanged them to our class’s walls also many students from other classes came to see them’’

Besides these positive quotes, some students talked about that some fonts and font sizes were not appropriate to read effectively and some posters were proposing too much knowledge then critical points. In addition some presentations

were not as inspiring and informative as they hoped. But one of the students explained this case in below quote;

> ‘‘We mostly experienced in preparing power point presentations, posters and poster presentations were different then power point presentations. I think in time, we will be better in this too.’’

Besides these evidences in effectiveness, students in these focus groups mentioned some points. Although they were pleased to engage in a research, they stated the work and time required to end up the research. Another concern of the students was the grades because they said that their families valued the grades more than everything. The extra work they made was just for the sake of their own learning. Under the high stake testing pressure this motivation was not seem to be expanding over upper classes in the high school. Moreover three students said that they were also very happy with note taking and teacher centered education. They said that they preferred to learn in more structured environments.

4.1.3.2. Students Who Seek Science Related Jobs (2 Focus Groups)

The aim of these two focus groups were to bring out what students who prefer to follow a science major career were thinking about related to our contextual design. Each focus group approximately took 20 minutes. There were seven students in each focus group. They were planning to follow career paths such as doctor, engineer, and teacher in science branches. Most of them would like to be a doctor and they have more positive point of view to science related branches.

One of the students mentioned that he has positive attitudes toward chemistry. He mentioned what he liked especially in the design in this quote.

> ‘‘Normally, I did not realize how chemistry is intermingled with our life. For instance I learned that soaps are basic in the school and I continued to learn other

> staff but in this instruction, when I went to home I needed to check the soap boxes we had in the house because we had a discussion related to it in the class. I saw my sister's soap box and on the box it was written that it was neutral. Then I started to inquiry about the knowledge I learn from the school and I searched from the internet and I chose my research questions related to how soap pH changed with its structure and ingredients.''

Relevance also seemed to be an important factor for students while learning new knowledge. Putting new knowledge in a context supported students to realize its importance and they noticed their connections with the daily life. Most of them stated that they liked the chemical storylines because they liked to learn new things about chemistry.

> ''I liked chemistry and physics because of that I liked to read related to these subject topics. Chemical storylines are nice they expand our point of views related to cleaning materials and their effects on the environment.''

They mostly seemed to be pleased about research questions; they said that they learn new things and it was nice to put some effort to enhance their knowledge. One of the students mentioned that what she learned in her research project also helped her in his biology exam.

> ''While I was searching for the harmful effects of detergents to our water supplies, I learned the concept of eutrophication. What was it and how it happened. Similar topics were also discussed in the biology class and our biology teacher asked us to define and explain the eutrophication concept in the exam. I searched for it, I explained it to the classroom in the presentations, I knew it

very well. It was really easy for me to handle the question.''

It was one of the evidences of the effectiveness of design. This girl stated her transfer of knowledge to chemistry to biology. The design provided chances for students to transfer their knowledge to other disciplines and situations. In addition to this, most of the students mentioned their willingness and excitement of searching what they wonder about. Their most popular resources for the research were internet, encyclopedias, textbooks and other books related to chemistry. Another girl noted that posters were also very effective for him to remember many concepts. She explained that she remembered most of the pictures in the posters and in some way they helped her in the exam to remember many things easily. One of the students explained his difficulty as in below quote while preparing the posters.

''It was more difficult for me to frame and outline the research in the poster, because you searched for huge pile of information to summarize the basic points in the poster took time and effort''

Some students were also mentioned that they had difficulty to understand some chemical concepts such as desulfurization while they were going deeper in the research process. But they mostly got help from their teachers about these concepts and how to frame their research into the posters. They also discussed about the poster presentations and they stated that preparing these presentations were stressful because they were not get used to make presentations in front of the class. But they felt more responsible and strict in the research process because of to be a presenter in front of the class.

Five of the students in the focus groups mentioned that they were also happy about the teacher centered method. They said that their traditional instruction was mostly based on practicing with problems and test questions. The focus was on school exams and university entrance examination. They perceived it as a task and

they mostly do not need to try to learn it meaningfully. They stated that if they get good grades and better test results, they will please them and their families.

4.1.3.3. Summary of the Focus Group Results

Firstly to keep in mind that these focus groups reflected students' ideas who were instructed in the contextual design for only five weeks because of that, results from these focus groups were evidences of the effectiveness of this design in the present study. In addition to this, focus groups were conducted in a very limited time and resources for just searching for pros and cons of the present design.

It was obvious that context-based instruction comprised of chemical storylines and student generated questions was appreciated from the experimental group students. Students were pleased about to be instructed with this type of instruction however also there were some points to be considered. The challenges were mostly related to the two main sources. Some challenges were related to the educational system and some were from the design. Some problems such as high-stake testing pressure, content-load, physical conditions, teachers openness to innovative approaches and class size are important problems in our educational system which also affect the quality of any type instruction. Some other problems related to the context-based design are its non linear sequence, more labor intense instruction than traditional one, and maybe it does not satisfy all the learners. Students in these focus groups mentioned many of these challenges as a concern. They were new in this type of design and some of the concerns were easily handled over their experience with the design.

Moreover there were some interesting points in the focus group results. Students did not prefer to use libraries as a source of knowledge. Beside they seemed to be very adapted to use internet as a source of their research. It was also an evidence of quick transformation to electronic resources. In addition to this, Anatolian high school students did not use their second language advantage and did not search for any English articles. They also preferred to use Turkish web sites and documents.

4.2. CONCLUSIONS

The following conclusions were the summary of the results:

1. The context based chemistry instruction produced a significantly better acquisition of chemical concepts and ideas regarding the cleaning materials topic than traditionally designed chemistry instruction.

2. The context based chemistry instruction produced a rise in students' attitudes toward environment but this rise was not significant regarding the cleaning materials topic in statistical analysis.

3. Science Process Skills made a contribution to the students' understanding of cleaning materials topic.

4. There was no significant effect of school type on students' understanding of cleaning materials topic as a chemistry subject and their attitudes towards environment.

5. Chemical storylines and student generated questions embedded contextual teaching and learning practices have a big potential to foster students curiosity and motivation.

CHAPTER 5

DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

This chapter is composed of three subsections.

5.1. DISCUSSION

The purpose of the present study was to investigate the effects of CBCI on students' achievement and attitude outcomes on cleaning materials topic in a quasi-experimental study. This research was designed because of the stated need (Medrich, Calderon & Hoachlander, 2002; Ultay & Calık, 2011) in the literature about the effects of contextual teaching and learning practices on students' achievement and attitude outcomes. The contribution of the present study to the literature is for generating evidences of the effectiveness of contextual design in Turkish high schools settings. While discussing the results, readers keep in mind that results are for the instructional design which was developed as a contextual design with multiple contexts (Four Contexts) comprised with chemical storylines (narratives), student generated questions, and supportive materials.

Turkey is contextually different from many other countries in the world because it has a strictly centralized educational system with a heavy content-loaded curriculum which demands teachers to royally follow the curriculum principles and contents. Although, Turkish curriculum is very centralized and possessed a heavy content-load, Turkish science educators initiated the adaptation of contextual teaching and learning principles to high school courses (Demircioglu, Demircioglu & Calık, 2009; Kutu & Sozbilir, 2011; Acar & Yaman, 2011), university courses (Ultay, 2012; Ozay & Cam, 2011) and curricula (Balta & Eryilmaz, 2011).

In Turkey, chemistry high school curriculum was not designed according to the principles of context-based approach. One of the concerns Reid (2000) mentioned emerged at this point that the content of the designed contextual instruction was determined by the demands of the Turkish curriculum even though there were enacted contexts. This study was one of the first attempts (Demircioglu, Demircioglu & Calık, 2009; Ilhan, 2010; Kutu & Sozbilir, 2011) to design a context based chemistry instructional design that tried to be fit into the Turkish school system. Ramsden (1997) noted that the effectiveness of context-based approach is obvious in many chemistry topics, but in some areas of chemistry it comes into prominence. Because of this, the chosen topic was intentionally a conceptual one (Cleaning Materials), which includes almost no mathematical calculations. Because utilization of conceptual topics leads to an increase in achievement outcomes, we have observed a similar and significant success level in the present study.

As a conclusion, it can be inferred that context-based instructional design caused a significantly better acquisition to understand cleaning materials topic than the conceptual instruction (Traditionally designed instruction). In both schools, the differences in CMAT_post test scores are in favor of experimental groups. However, Anatolian High School students seem to benefit more from contextual approach. This study was additional evidence that context-based instructional design produce better student achievement outcomes in Turkish educational settings. The probable underlying reasons of the effectiveness of the contextual design in students' achievement scores were related to the characteristics of context-based instructional design.

Chemical storylines were one of the first important characteristics in this design which supported to frame a better context based instruction. Students stated in focus groups stated that chemical storylines were attractive and interesting, and framed the chemical concepts in a context. Chemical storylines presented the chemical concepts and their relationship with each other in a more meaningfully way than normal texts because they portrayed the situation of their discoveries,

presented the historical developmental process, and stated how, when, and why they were needed for which reasons. In some other studies also reported the effectiveness of chemical storylines embedded contextual teaching and learning in chemistry (Demircioglu, Demircioglu, & Calik, 2009; Luhl, 1990) and other subjects (Bostrom, 2010; Koch, 2010).

Another important characteristic of context based instruction was its emphasis of relevance of knowledge to students' daily lives. In the present study, students gave many examples about the connections between chemistry and everyday situations. This type of instruction persuaded students to learn chemistry concepts more willingly because they realized that they have a chance to use their chemistry knowledge in their daily life. Context-based instruction does not allow students to compartmentalize their school knowledge and what they encounter in their lives (King, 2009). It helps students to connect their school knowledge to their everyday situation similar to other studies (Sutman & Bruce, 1992; Hofstein, Kesner & Ben-Zvi, 2000; Wiersta & Wubbels, 1994). This makes school knowledge meaningful to students, so they are more motivated and interested in their science lessons in the school (Parchmann et al., 2006; Ramsden, 1997) which supported their academic achievement (Sutman & Bruce, 1992; Gutwill-Wise, 2001).

Student generated questions were also another motivating factor for meaningful learning. Students should be more attentive and connected because they had to think a research question. To pose a good question, they had to know something about the topic and needed to think about it. Moreover, students, who are encouraged to pose their own questions about a course topic, develop their understanding as, first, to how answers are related, conditional, contextual, and, second, how their answers lead to supplementary questions. Besides, they used plenty of resources to reach their answers such as internet, books, more knowledgeable others and so on. Most of the students were pleased and motivated about searching for their own research questions not the textbooks' or teachers' questions. Student generated questions were also regarded as an important diagnostic tool for improving and regulating their understanding and

comprehension (Bowker, 2010; Dillon, 1990; Deluty, 2010). This active process of questioning rather than the passive repetition of concepts and facts supports the development of critical and creative thinking, which shapes students' perspective because students searched for what they wondered about the topic as a team. This was a leading factor to search for additional knowledge related to the topic. At the end of the course, presenting their findings the whole class and preparing the posters kept them in track and confirmed their learning.

Some research studies in Turkey reported the effectiveness of context based instruction (Demircioglu, Demircioglu & Calık, 2009; Ilhan, 2010; Kutu & Sozbilir, 2011) and produced better achievement results in topics ''periodic table'', ''chemical equilibrium'' and ''chemistry in our lives unit'' respectively. In addition, there are research studies which found significant student achievement results in contextual physics (Ultay, 2012) and biology (Ozay & Cam, 2011; Acar & Yaman, 2011; Yaman, 2009) courses in Turkey. There were also evidences for the effectiveness of context based instruction from many other research studies. Similar findings were noted in many studies in many different countries. Barker and Millar in two studies (1999:2000) reported a better conceptual understanding of chemical ideas such as thermodynamics, chemical bonding, and chemical reactions in context-based instruction. Bennett et al. (2005) pointed out that students are more motivated, willing to take responsibility for their learning and enthusiastic about the course work if they were instructed with contextual teaching and learning. Gutwill-Wise (2001) conducted a study with context-based modules in university introductory chemistry course. The researcher found a better student understanding in chemistry in modular classrooms. In addition modular approach students had better scientific thinking skills which were measured by in depth interviews. Bennett (2007) stated that context-based approach if it is executed in certain ways at least as good as traditional approaches.

Results related to the attitudes toward environment were not as powerful as expected. There was a rise in both experimental and control groups and the rise in experimental group was higher than control group but this rise was not significant according to the statistical analysis. Social desirability is mostly a case in Turkey

maybe some students did not fill the scale intuitively and sincerely but just to filled it what would be expected for them as in the both tests. Moreover, attitude change is a very complex process and needed a long term intervention. Five weeks intervention time maybe was not enough to make any significant changes in student attitudes. Maybe one of the probable reasons for not determining a significant rise in the attitude toward environment was students' initial high positive attitudes toward environment similarly in some other research studies (Kutu & Sozbilir, 2011). These are the probable reasons for not finding a significant rise in students' attitudes toward environment. On the other hand, there were studies which reported attitude change under context-based instructional practices (Demircioglu, Demircioglu, & Calık, 2009; Bennett, 2007; Gutwill-Wise, 2001; Ultay & Calık 2011).

School type was not significant factor on CMAT and ATES. In our study, both types of schools are in the same neighborhood and students' parents are approximately similar socio economic statuses. So the reason why we did not find any significant difference in school types may have been related to this. One of the important factors that determine school success was directly related to the socio economic status of parents (OECD, 2012). In addition there were different findings in the literature related to school type. Mostly similar approaches were producing similar achievement raises in different school types such as public schools (Bektas, 2011; Kaya, 2011), Anatolian high schools (Tasdelen, 2011) and private schools (Bulbul, 2010). On the other hand some studies reported the better achievement results with Anatolian High School Students than Public High School Students (Berberoglu, 2005; Demirel, 1986). Berberoglu (2005) and some also reported the trend in achievement decline in Anatolian high schools. Moreover, some studies reported the better student performance in some school types such as public (Newhouse & Beegle, 2006) but others reported better results with private schools (Jimenez, Lockheed, & Paque, 1991). In addition, Recber (2010) found that school type was mostly decisive in students' attitudes.

Focus group results also indicated a rise in students' appreciation and motivation. Students connected to the chemical ideas with real life issues and

realized the relevance of chemistry to their daily lives. This study was also additional evidence that context-based instruction was effective if executed under certain conditions. Excerpts from focus groups supported the effective usage of chemical storylines (narratives) in the present study similar to other studies (Demircioglu, Demircioglu, and Calik, 2009; Bostrom, 2008; Koch, 2010). The student generated questions which was one of the important parts of this study provided students chance to engage their ideas and problems. Many students in focus groups stated its excitement to fulfill their learning needs with their own research questions. Many studies reported a rise in motivation with context based approach similar to our study (Sutman & Bruce, 1992; Hofstein, Kesner & Ben-Zvi, 2000; Wiersta & Wubbels, 1994).

5.2. IMPLICATIONS

Context based chemistry instruction is a valuable approach for teachers who are more open to new methodologies and approaches. This study provided some new perspectives of implication of a contextual design and these are:

1. Contextual teaching and learning practices are good alternatives of classroom instruction for cleaning materials topic and others.

2. Contextual teaching and learning practices can be used with chemical story lines and student generated questions effectively.

3. Contextual teaching and learning practices can be used in the classroom instruction to please and motivate the students to chemistry.

4. Contextual teaching and learning can be a basis while preparing a new and innovative curriculum.

5.3. RECOMMENDATIONS

These are some recommendations for further research:

1. Similar studies can be carried out for different grade levels and different topics to investigate the effectiveness of context based instruction.

2. Similar studies can be planned for longer time periods of treatment such as 2 to 3 months to see the long term effects on context based education.

3. Similar studies can be organized with different school types such as public, private and public Anatolian high schools for tracking the effectiveness of context based instruction in different school environments.

4. Similar studies can be conducted with chemistry topics which has more quantitative dimension and mathematical problem solving in it to monitor the effects of context based instruction in that type of activities.

5. For further studies, maybe retention of achievement test might be used to determine students' knowledge gain and what remains for them sometime later.

6. Other variables such as attitudes toward chemistry can be added to similar studies.

7. Chemical storylines and student generated questions can be used as an effective tool to engage and connect students to chemistry concepts effectively in further studies.

8. Science Process Skills are important for students and teachers should develop activities which emphasize and improve students' science process skills.

REFERENCES

Abd-El-Khalick, F., Boujaoude, S., Duschl, R., Mamlok-Naaman, R., Hofstein, A., Niaz, M., et al. (2004). Inquiry in science education: international perspectives. *Science Education*, *88*(3), 397–419.

Acar, B. & Yaman, M. (2011). The effects of context-based learning on students' levels of knowledge and interest. *H. U. Journal of Education, 40*, 1-10.

Akman, V. (2000). Rethinking context as a social construct. *Journal of Pragmatics, 32*, 743-759.

Alp, E. (2005). *A Study on Students' Environmental Knowledge and Attitudes: The Effect of Grade Level and Gender* (Doctoral Dissertation). Middle East Technical University, Ankara, Turkey.

Alp, E., Ertepinar, H., Tekkaya, C., & Yilmaz, A. (2006). A statistical analysis of children's environmental knowledge and attitudes in Turkey. *International Research in Geographical and Environmental Education, 15*(3), 210-223.

Alp, E., Ertepinar, H., Tekkaya, C., Yilmaz, A. (2008). A survey on Turkish elementary school students' environmental friendly behaviors and associated variables. *Environmental Education Research, 14*(2), 129-143.

American Association for the Advancement of Science (AAAS) (1990). *Science for all Americans*. NewYork, Oxford University Press.

Ananda, S. (2002). *Supporting high school students through assessment of academic and industry-valued skills: what have we learned?* In B. Brand (Ed.) Essentials of High School Reform: New Forms of Assessment and Contextual Teaching and Learning.

Anderson, J. R., Reder, L. M., and Simon, H. A. (1996). Situated learning and education. *Educational Researcher, 25*(4), 5-11.

Anthony, S., Mernitz, H., Spencer, B., Gutwill, J., Kegley, S. E., & Molinaro, M. (1998) The ChemLinks and ModularChem Consortia: Using active and context based learning to teach students how chemistry is actually done. *Journal of Chemical Education, 75*(3), 322-324.

Avargil, S., Herscovitz, O., & Dori, Y. J. (2011). Teaching thinking skills in context-based learning: teachers' challenges and assessment knowledge.

Journal of Science Education and Technology. doi:10.1007/s10956-011-9302-7.

Aydin, S. & Cakiroglu, J. (2010). Teachers' views related to the new science and technology curriculum: Ankara case. *Elementary Education Online, 9*(1), 301-315.

Baines E., Blatchford, P. & Chowne A. (2007) Improving the effectiveness of collaborative group work in primary schools: effects on science attainment, *British Educational Research Journal*, *33*(5), 663-680.

Baker, L. (2010). Taking the frustration out of phrasal verbs. Special English. Retrieved April 11, 2012, from http://www.voanews.com/learningenglish/home/Taking-Some-of-the-Frustration-Out-of-Phrasal-Verbs-107247254.html

Balta, N. & Eryilmaz, A. (2011). Turkish new high school physics curriculum: teachers' views and needs. *Eurasian Journal of Physics and Chemistry Education*, Jan (Special issue), 72-88.

Barker, V. & Millar, R. (1999). Students' reasoning about chemical reactions: what changes occur during a context-based, post-16 chemistry course? *International Journal of Science Education*, *21*, 645–665.

Barker, V. & Millar, R. (2000). Students' reasoning about basic chemical thermodynamics and chemical bonding: what changes occur during a context-based post-16 chemistry course?, *International Journal of Science Education*, 22(11), pp.1171-1200.

Barrows, H. S. (1996). *Problem-based learning in medicine and beyond: A brief overview*. In L. Wilkerson & H. Gilselaers (eds.), Bringing Problem-based Learning to Higher Education: Theory and Practice. San Francisco, CA, USA: Jossey-Bass Inc.

Bektas, O. (2011). *The Effect of 5e Learning Cycle Model on Tenth Grade Students' Understanding in the Particulate Nature of Matter, Epistemological Beliefs And Views of Nature of Science* (Doctoral Dissertation). Middle East Technical University, Ankara, Turkey.

Bell, J., Branz, S., Bunce, D., Cooper, M., Eubanks, I. D., Eubanks, L. P., et al. (2005). *Chemistry (Project of the American Chemical Society)*. New York: W. H. Freeman.

Bennett J., Gräsel C., Parchmann I. & Waddington D. (2005) Context-based and conventional approaches to teaching chemistry: comparing teachers' views. *International Journal of Science Education*, *27*(13), 1521–1547.

Bennett J., Lubben F., Hogarth S. (2007) Bringing science to life: a synthesis of the research evidence on the effects of context-based and STS approaches to science teaching. *Science Education*, *91*(3), 347–370.

Bennett, J. & Lubben F. (2006) Context-based chemistry: The Salter's approach. *International Journal of Science Education*, *28*(9), 999–1015.

Berberoglu, G. & Kalender, I. (2005). Investigation of student achievement across years, school types, and regions: The SSE and PISA Analyses. *Egitim Bilimleri ve Uygulama*, *4*(7), 21-35.

Berberoglu, G. (2010). Öğrenci başarısının değerlendirilmesi nasıl yapılır? *Cito Eğitim: Kuram ve Uygulama*, *9*, 10-22.

Berns, R. G. & Erickson, P. M. (2001). Contextual teaching and learning: Preparing students for the new economy. The Highlight Zone: Research @ Work No. 5. Columbus, OH. Retrieved December 26, 2011, from http://www.cord.org/uploadedfiles/NCCTE_Highlight05-Contextual TeachingLearning.pdf

Bodzin, A. M. (2008). Integrating instructional technologies in a local watershed investigation with urban elementary learners. *Journal of Environmental Education*, 39(2), 47-57.

Bostrom, A. (2008). Narratives as tools in designing the school chemistry curriculum. *Interchange*, 39(4), 391-413.

Bowker, M. H. (2010). Teaching students to ask questions instead of answering them. *Thought & Action*, Fall, 127-134.

Brand, B. (2003). *Essentials of high school reform: new forms of assessment and contextual teaching and learning*. Washington DC, American Youth Policy Forum.

Brand, B., Partee, G., Kaufman, B. & Wills, J. (2000). *Looking forward: school-to-work principles and strategies for sustainability*. Washington DC: American Youth Policy Forum. http://eric.ed.gov/PDFS/ED443947.pdf

Broyles, I. A. (2011). *Distributed cognition minicourse: an instructional intervention to improve the effectiveness of one-day environmental education camps* (Doctoral Dissertation). Capella University, Minneapolis, USA.

Bulbul, M. S., & Eryilmaz, A. (2010). Human as a context in learning physics: a guide for textbook authors. *GIREP-ICPE-MPTL Conference Proceedings* (pp. 57-58). Reims: Groupe International de Recherche sur l'Enseignement de la Physique.

Bulbul, Y. (2010). *Effects of 7e learning cycle model accompanied with computer animations on understanding of diffusion and osmosis concepts* (Doctoral Dissertation). Middle East Technical University Secondary Science and Mathematics Education, Ankara, Turkey.

Bulte, A. M. W., Klaassen, K., Westbroek, H. B., Stolk, M. J., Prins, G. T., Genseberger, R. J., et al. (2005). *Modules for a new chemistry curriculum*,

research on a meaningful relation between contexts and concepts. In P. Nentwig & D. Waddington (Eds.), Making it relevant. Context based learning of science (pp. 273-299). Münster, Germany: Waxmann.

Bulte, A. M. W., Westbroek, H. B., de Jong O. & Pilot A. (2006) A research approach to designing chemistry education using authentic practices as contexts. *International Journal of Science Education*, *28*(9), 1063-1086.

Burton W. G., Holman J. S., Pilling G. M., & Waddington D. J. (1995) Salters advance chemistry, a revolution in college chemistry. *Journal of Chemical Education*, *72*(3), 227-230.

Caine, R. N. & Caine, G. (1991). *Making Connections: Teaching and the Human Brain. Association for Supervision and Curriculum Development* (ERIC Document ED335141), Alexandria VA, USA.

CEPUP Chemical Education for Public Understanding Programme (1991) (Berkeley, CA: Lawrence Hall of Science, University of California Press).

Cetin, P. S. (2009). *Effects of conceptual change oriented instruction on understanding of gases concepts* (Doctoral Dissertation). Middle East Technical University Secondary Science and Mathematics Education, Ankara, Turkey.

Ceylan, E. (2008). *Effects of 5e learning cycle model on understanding of state of matter and solubility concepts* (Doctoral Dissertation). Middle East Technical University Secondary Science and Mathematics Education, Ankara, Turkey.

Chemcom (1988). About the chemistry in the community project. Retrieved October 5, 2010, from http://www.lapeer.org/chemcom/

Cohen, J., Cohen, P., West, S. G. & Aiken, L. S. (2003). *Applied Multiple Regression/Correlation Analyses for the Behavioral Sciences* (3th Edition). Lawrence Erlbaum Associates: UK.

Conroy, C., Trumbull, D. & Johnson, D. (1999). Agriculture as a rich context for teaching and learning, and for learning mathematics and science to prepare the workforce of the 21st century. White Paper, Presented to National Science Foundation.

Cotton, K. (1996). School size, school climate, and student performance. Portland, OR: Northwest Regional Educational Laboratory. Retrieved November 09, 2011, from http://upstate.colgate.edu/pdf/Abt_merger/Cotton_1996_Size_Climate_Performance.pdf

Crocker, L. & Algina, J. (1986). *Introduction to classical and modern test theory*. Holt, Rinehart and Winston Inc.: USA.

Darling-Hammond, L. & Snyder, J. (2000). Authentic assessment of teaching in context. *Teaching and Teacher Education*, *16*, 523-545.

Darrah, C. N. (1992). Workplace skills in context. *Human Organization, 51*(3), 264-273.

Deluty, E. W. (2010). Asking questions: cultivating the habit of inquiry. *Thought & Action*, Fall, 135-138.

Demircioglu, H., Demircioglu, G., & Ayas, A. (2006). Hikayeler ve kimya öğretimi. *H. U. Journal of Education, 30*, 110-119.

Demircioglu, H., Demircioglu, G., & Calık, M. (2011). Investigating the effectiveness of storylines embedded within a context-based approach: the case for the periodic table. C*hemistry Education Research and Practice, 10*, 241–249.

Demirel, O. (1986). Anatolian high schools and their contributions to the Turkish educational system. *H. U. Journal of Education, 1*, 27-34.

Dillon, J. T. (1990). *The Practice of Questioning*. London, UK: Routledge.

Dori, Y.J., & Tal, R.T. (2000). Formal and informal collaborative projects: engaging in industry with environmental awareness. *Science Education, 84*, 95-113.

Driscoll, M. P. (1994). *Psychology of Learning for Instruction*. Allyn & Bacon, Needham Heights, MA: USA.

Edwards, R. (2009*). Introduction: Life as a learning context?* In R. Edwards, G. Biesta, & M. Thorpe. Rethinking contexts for learning and teaching: communities, activities, and networks (1-13), London Routledge: UK.

Eich, E. (1985). Context, memory, and integrated item/context imagery. *Journal of Experimental Psychology: Learning, Memory and Cognition, 11*(4), 764-770.

Elmas, R. & Geban, O. (2010). "High School Chemistry Teachers' Views Related to the New Chemistry Curriculum" Paper presented at the *XIV World Congress of Comparative Education Societies (WCCES)*, Istanbul, Turkey.

Elmas, R., & Pilot, A. (2009, August). Exploring the Design Principles of Context-based Chemistry Education in Turkish High Schools. Interactive Poster Session, presented at the annual meeting of the *European Science Education Research Association (ESERA)*, Istanbul, Turkey.

Elmas, R., Bulbul, M. S., & Eryilmaz, A. (2011). Thematic Classification of Eligible Contexts for a Holistic Perspective in Curriculum Development. Paper presented at the 9th *European Science Education Research Association (ESERA)*, Lyon, France.

Elwell, L. P. (1993). Let's teach biology with a hook and a story. *The American Biology Teacher, 55*(6), 324.

ERG (2011). Egitim Izleme Raporu 2010. Istanbul: Egitim Reformu Girisimi.

Fernandez, M., Wegerif, R., Mercer, N., & Rojas-Drummond, S. (2001). Re-conceptualizing "Scaffolding" and the zone of proximal development in the context of symmetrical collaborative learning. *Journal of Classroom Interaction*, *36*(2), 1-15.

Field, A. (2005). *Discovering Statistics Using SPSS*. (2th Edition), Sage:UK.

Finch, C.R., Frantz, N.R., Mooney, M., & Aneke, N.O. (1997). *Designing the thematic curriculum: An all aspects approach.* Berkeley, CA: National Center for Research in Vocational Education, University of California, Berkeley.

Frankel, J. R. & Wallen, N. E. (2000). *How to design & evaluate research in education* (4th Edition). The McGraw-Hill Companies: USA.

Frankel, J. R., Wallen, N. E., & Hyun, H. H. (2011). *How to design and evaluate research in education* (8th Edition). Mc Graw-Hill Companies: USA.

Geban, O., Askar, P. & Ozkan, I. (1992). Effects of computer simulations and problem-solving approaches on high school students. *Journal of Educational Research*, *86*, 5-10.

George, D. & Mallery, P. (2001). *SPSS for windows step by step* (3th Edition), Allyn & Bacon: USA.

Gick, M. L. & Holyoak, K. L. (1983). Schema Induction and analogical transfer. *Cognitive Psychology, 15*, 1-38.

Gilbert, J. K. (2006). On the nature of "context" in chemical education. *International Journal of Science Education*, *28*(9), 957-976.

Gilbert, J. K., Bulte, A. M. W. & Pilot, A. (2011). Concept development and transfer in context-based science education. *International Journal of Science Education*, 33(6), 817-837.

Gilbert, T. R., Kirss, R. V., & Davies, G. (2004). *Chemistry: The science in context*. New York: Norton.

Goffman, E. (1974). *Frame analysis an essay on the organization of experience*. Northeastern University Press, Boston: USA.

Gray, B. V. (1999). Science education in developing world: issues and considerations. *Journal of Research in Science Teaching*, *36*(3), 261-268.

Gredler, M. E. (2001). *Learning and instruction theory into practice*. Merrill Prentice Hall (Fourth Edition), New Jersey: USA.

Green, B. S. & Salkind, N. J. (2007). *Using SPSS for windows and macintosh analyzing and understanding data*. (5th Edition), Bind-Rite Graphics: USA.

Greenhill, V. (2009). P21 framework definitions. the partnership for 21st century skills, Retrieved October 06, 2011, from http://p21.org/storage/documents/P21 Framework_Definitions.pdf

Grubb, W. N. & Oakes, J. (2007). 'Restoring value' to the high school diploma: The rhetoric and practice of higher standards. East Lansing, MI: The Great Lakes Center for Education Research and Practice.

Guo, C. J. (2007). *Issues in science learning: an international perspective*. In Abell, S. K., Lederman, N. G. (Eds.), Handbook of Research on Science Education (pp. 227-256). New Jersey, USA: Lawrence Erlbaum

Gur, B. S. & Celik, Z. (2009). Turkiye'de milli egitim sistemi, yapisal sorunlar ve oneriler. SETA Rapor.

Gutwill-Wise, J. P. (2001). The impact of active and context-based learning in introductory chemistry courses: An early evaluation of the modular approach. *Journal of Chemical Education, 78*(5), 684–690.

Hmelo-Silver, C. E. & Barrows, H. S. (2006). Goals and strategies of a problem-based learning facilitator. *The Interdisciplinary Journal of Problem-based Learning*, *1*(1), 21-39.

Hmelo-Silver, C. E. (2004). Problem-Based learning: What and how do students learn? *Educational Psychology Review*, *16*(3), 235-266.

Hoachlander, G. (2008). Bringing industry to the classroom. *Educational Leadership, 65*(8), 22-27.

Hofstein, A., Kesner, M., & Ben-Zvi, R. (2000). Student perceptions of industrial chemistry classroom learning environments. *Learning Environments Research*, *2*, 291-306.

Holton, G. (1967). Project physics. A report on its aims and current status. *The Physics Teacher*, *5*(5), 198-211.

Holton, G. (1969). Harvard Project physics a report on its aims and current status. *Physics Education, 4*(19), 19-25.

Hopkins, K. D. (1982). The unit of analysis: Group means versus individual observations. *American Educational Research Journal*, 19(1), 5-18.

Hughes, K. L., Bailey, T. R. & Mechur, M. J. (2001). School-to-Work: Making a difference in education. A Research Report to America. Institute on Education and the Economy: Newyork, USA. Retrieved December 09, 2011, from http://www.tc.columbia.edu/iee/papers/stw.pdf

Hull, D. (2005). Career pathways: education with a purpose. In D. Hull (ed.), Career Pathways: Education with a Purpose. Waco, Tex.: Center for Occupational Research and Development.

Ilhan, N. (2010). *The Effect of Context-based Approach on the Learning of Chemical Equilibrium* (Doctoral Dissertation). Ataturk University, Erzurum, Turkey.

Imel, S. (2000). *Contextual learning in adult education, Practice application brief no. 12.* ERIC Clearinghouse on Adult, Career, and Vocational Education, 2000. Retrieved April 4, 2012, from http://eric.ed.gov/PDFS/ED448304.pdf

Irez, S. (2009). Nature of science as depicted in Turkish biology textbooks. *Science Education*, *93*(3), 422-447.

Jennings, J. (2011). Have we gotten it wrong on school reform? Huffington Post Education. Retrieved December 2, 2011, from http://www.huffingtonpost.com/jack-jennings/school-reform-wrong_b_1110382.html

Jimenez, E., Lockheed, M. E., & Paqueo, V. (1991). The relative efficiency of private and public schools in developing countries. *World Bank Research Observer*, *6*(2), 205-218.

Jimerson, L. (2006). The Hobbit effect: Why small works in public schools. Arlington, VA: Rural School and Community Trust. Retrieved November 05, 2011, from http://www.ruraledu.org/articles.php?id=2026

Johnson, D. W., Johnson, R. T. & Stanne, M. B. (2000). Cooperative learning methods: a meta analyses. Retrieved December 14, 2011, from http://www.tablelearning.com/uploads/File/EXHIBIT-B.pdf

Jones, K. R. & Ezeife, A. N. (2011). School size as a factor in the academic achievement of elementary school students. *Psychology*, *2*(8), 859-868.

Kahveci, A. (2010). Quantitative analysis of science and chemistry textbooks for indicators of reform: a complementary perspective. *International Journal of Science Education*, 32(11), 1495-1519.

Kanlı, U. & Yağbasan, R. (2008). 7E modeli merkezli laboratuvar yaklasiminin ogrencilerin bilimsel surec becerilerini gelistirmedeki yeterliligi. *Gazi Egitim Fakultesi Dergisi*, *28*(4), 91-125.

Kaya, E. (2011). *The Effect of Conceptual Change Based Instructıon on Students' Understanding of Rate of Reaction Concepts* (Doctoral Dissertation). Middle East Technical University, Ankara, Turkey.

King D., & Ritchie S. M. (2007) Implementing a context-based approach in a chemistry class: Successes and dilemmas. Paper presented at the annual meeting of the *National Association for Research in Science Teaching*, LA: USA.

King, D. (2007). Teacher beliefs and constraints in implementing a context-based approach in chemistry. *Teaching Science*, *53*(1), 14–18.

King, D. (2009). *Teaching and Learning in a Context-based Chemistry Classroom* (Doctoral Dissertation). Queensland University of Technology, Australia.

King, D. (2012). New perspectives on context-based chemistry education: using a dialectical socio cultural approach to view teaching and learning. *Studies in Science Education, 48*(1), 51-87.

Koch, J. (2010). *Science stories: science methods for elementary and middle school teachers* (4th Edition). Wadsworth: USA.

Kortland, K. (2005) *Physics in personal, social and scientific contexts. A retrospective view on the Dutch Physics Curriculum Development Project PLON*. In Peter Nentwig, David Waddington (Ed.) Making it relevant Context based learning of science. Waxmann Publishing.

Kutu, H. & Sozbilir, M. (2011). Teaching chemistry in our lives unit in the 9th grade chemistry course through contex-based arcs instructional model. *Ondokuz Mayıs University Education Faculty Journal*, 3(1), 29-62.

Kwiek, N. C., Halpin, M. J., Reiter, J. P., Hoeffler, L. A., Schwartz-Bloom, R. D. (2007). Relevance. Pharmacology in the highschool classroom, *Science 317*, 1871–1872.

Lave, J. & Wenger, E. (1991). *Situated learning, Legitimate peripheral participation*. Cambridge, England: Cambridge University Press.

Leeming, F. C. & Porter, B. E. (1997). Effects of participation in class activities on children's environmental attitudes and knowledge. *Journal of Environmental Education*, *28*(2), 33-43.

Leeming, F. C., Dwyer, W. O. & Bracken, B. A. (1995). Children's environmental attitude and knowledge scale: construction and validation. *Journal of Environmental Education*, *26*(3), 22-32.

Lewis, J. (1981). *Science in Society*. London: Heinemann Educational Books.

Lijnse, P. L., & Klaassen, K. (2004). Didactical structures as an outcome of research on teaching-learning sequences? *International Journal of Science Education*, *26*(5), 537–554.

Luhl, J. (1990). The History of Atomic Theory and Its Societal and Philosophical Implications in Chemistry Classes (266-273). In D. E. Herget (Ed.), More History and Philosopy of Science Teaching. *Proceedings of the first international conference*. Tallahassee, Florida State University.

Makki, M. H., Abd-El-Khalick, F., & Boujaoude, S. (2003). Lebanese secondary school students' environmental knowledge and attitudes. *Environmental Education Research*, 9(1), 21-33.

Mandl, H., & Kopp, B. (2005). *Situated learning: Theories and models*. In P. Nentwig & D. Waddington (Eds.), Making it relevant. Context based learning of science (pp. 15-34). Münster, Germany: Waxmann.

Marx, R. W., Blumenfeld, P. C., Krajcik, J. S., Fishman, B., Soloway, E., & Geier, R., et al. (2004). Inquiry-based science in the middle grades: assessment of learning in urban systemic reform. *Journal of Research in Science Teaching*, *41*(10), 1063–1080.

Mason, D. (1996). Life after ChemCom: Do they succeed in university-level chemistry courses?. Paper presented at *Meeting of National Association for Research in Science Teaching*, St. Louis, MO.

Mason, D. S. (1998). Life After ChemCom: Do these students succeed in university level chemistry courses? *The Texas Science Teacher, 27*(1), 1-4.

Mbajiorgu, N. & Reid, N. (2006). Factors Influencing Curriculum Development in Chemistry. Hull: The Higher Education Academy-Physical Sciences. Retrieved from September 10, 2011, from http://www.heacademy.ac.uk /assets/ps/documents/practice_guides/practice_guides/ps0074_factors_influencing_curriculum_development_in_chemistry_Nov_2006.pdf

McMahon, M. M. & Harwood, W. S. (1995). ChemCom vs. Traditional high school chemistry: How do ChemCom students fare? Paper presented at *ACS National Meeting*.

McMillan, J. H. & Schumacher, S. (2001). *Research in education a conceptual introduction* (5th Edition), Addison Wesley Longman Inc.: USA.

Medrich, E., Calderon, S., & Hoachlander, G. (2002). *Contextual teaching and learning strategies in high schools: Developing a vision for support and evaluation.* In B. Brand (Ed.) Essentials of High School Reform: New Forms of Assessment and Contextual Teaching and Learning.

Murphy, P. & Whitelegg, E. (2006). Girls in the physics classroom: A review of the research into the participation of girls in physics. Institute of Physics Report.

Nakhleh, M. B., Bunce, D. M., & Schwartz, A. T. (1995). Chemistry in context: Student opinions of a new curriculum. *Journal of College Science Teaching*, *25*(3), 174-180.

Newhouse, D., & Beegle, K. (2006). The Effect of school type on academic achievement. *Journal of Human Resources*, *41*(3), 529-557.

Nordgren, R. D. (2002). Globalization and education: what students will need to know and be able to do in global village. *Phi Delta Kappan*, *84*(4), 318-321.

OECD (2010). PISA 2009 Results: What Makes a School Successful? Resources, Policies, and Practices (Volume IV) Paris: OECD Publishing.

OECD (2012), Public and Private Schools: How Management and Funding Relate to their Socio-economic Profile, OECD Publishing. *http://dx.doi.org/10.1787/9789264175006-en*

Okey, J. R., Wise, K. C. & Burns, J. C. (1982). Integrated process skill test-2. (Available from Dr. James R. Okey, Department of Science Education, University of Georgia, Athens, GA 30602).

Osborne, J., & Collins, S. (2001). Pupils' views of the role and value of the science curriculum. *International Journal of Science Education*, *23*(5), 441–467.

Oxley, D., Barton, R. & Klump, J. (2006). Creating small learning communities. *Principal's Research Review*, *1*(6), 1-6. Retrieved November 09, 2011, from http://educationnorthwest.org/resource/913

Ozay, K. E., & Cam, T. F. (2011). Yaşam temelli öğrenmenin sinir sistemi konusunda öğrenci başarilarina etkileri. *Journal of Turkish Science Education*, *8*(2), 91-106.

Ozturk, N., Elmas, R., & Savas, M. (2011). "Private school elementary teachers' reflections on new science and technology curriculum" *International Conference on New Trends in Education and Their Implications (ICONTE)*, Antalya, Turkey.

Pabuccu, A. (2004). *Effect of Conceptual Change Texts Accompanied with Analogies on Understanding of Chemical Bonding Concepts* (Master Thesis). Middle East Technical University Secondary Science and Mathematics Education, Ankara, Turkey.

Pallant, J. (2007). *SPSS Survival Manual* (3th Edition). Mc Graw Hill:USA.

Parchmann, I., Grasel, C., Baer, A., Nentwig, P., Demuth, R., Ralle, B., & the Chik Project Group (2006). "Chemie im Kontext": A symbiotic implementation of a context-based teaching and learning approach. *International Journal of Science Education*, *28*(9), 1041–1062.

Park, J. & Lee, L. (2004). Analyzing cognitive or non cognitive factors involved in the process of physics problem-solving in an everyday context. *International Journal of Science Education*, *26*(3), 1577-1595.

Peckham, P. D., Glass, G. V. & Hopkins, K. D. (1969). The experimental unit in statistical analysis. *The Journal of Special Education*, *3*(4), 337-349.

Perin, D. (2011). Facilitating student learning through contextualization: A Review of Evidence. *Community College Review*, *39*(3), 268-295.

Pilot, A. & Bulte, A. M. W. (2006) The use of "contexts" as a challenge for the chemistry curriculum: its successes and the need for further development and understanding. *International Journal of Science Education*, *28*(9), 1087-1112.

Ramsden, J. M. (1997) How does a context-based approach influence understanding of key chemical ideas at 16?, *International Journal of Science Education*, *19*(6), 697-710.

Raywid, M. A. (1997). Small schools: a reform that works. *Educational Leadership*, *55*(4), 34-39.

Recber, S. (2011). *An Investigation of the Relationship among the Seventh Grade Students' Mathematics Self Efficacy, Mathematics Anxiety, Attitudes towards Mathematics, and Mathematics Achievement Regarding Gender and School Type* (Master Thesis). Middle East Technical University, Ankara, Turkey.

Reid N., (2000), The presentation of chemistry logically driven or applications-led?, *Chemistry Education Research and Practice*, *l1*(3), 381-392.

Resnick, L. B. & Hall, M. W. (1998). Learning organizations for sustainable educational reform. *Daedalus*, *127*, 89-118. Retrieved December 08, 2011, from http://www.pps.k12.pa.us/14311012710341520 3/lib/143110127103415203/ResnickHall_LrngOrgs.pdf

Robelia, B., McNeill, K., Wammer, K., & Lawrenz, F. (2010). Investigating the impact of adding an environmental focus to a developmental chemistry course. *Journal of Chemical Education*, *87*(2), 216-220

Rudduck, J. & Flutter, J. (2000). Pupil participation and pupil perspective: 'carving a new order of experience'. *Cambridge Journal of Education*, *30*(1), 75-89.

Sadler, P. M. & Tai, R. H. (2001) Success in introductory college physics: the role of high school preparation. *Science Education*, *85*(2), 111-136.

Sanger, M. J., & Greenbowe, T. J. (1996) Science technology society (sts) and chemcom versus college chemistry courses: is there a mismatch?. *Journal of Chemical Education*, *73*(6), 532-536.

Savas, M., Elmas, R., & Ozturk, N. (2011). "A curriculum reflection: new science and technology curriculum in Turkey" Paper presented at the *European Science Education Research Association (ESERA)*, Lyon, France.

Savery, J. R. & Duffy, T. M. (1995). Problem-based learning: An instructional model and its constructivist framework. *Educational Technology*, *35*, 31-38.

Savery, J. R. (2006). Overview of problem-based learning: definitions and distinctions. *The Interdisciplinary Journal of Problem-based Learning*, *1*(1), 9-20.

Schunk, D. H. (2000). *Learning Theories an Educational Perspective*. Prentice-Hall (Third Edition), New Jersey: USA.

Schwartz, A. T. (2006) Contextualized chemistry education: the american experience. *International Journal of Science Education*, *28*(9), 977-998.

SENCER (2001) Science Education for New Civic Engagements and Responsibilities. Retrieved January 5, 2009 from http://www.sencer.net /About/projectoverview.cfm

Solomon, J. (1980). The SISCON-in-schools project. *Physics Education, 15*, 155-158.

Solomon, J. (1983a). *Science in a social context way of living*. Association for Science Education & Basil Blackwell, Oxford.

Solomon, J. (1983b). *Science in a social context how can we be sure?* Association for Science Education & Basil Blackwell, Oxford.

Souders, J. (1999). Contextually based learning: fad or proven practice. Retrieved December 04, 2011, from http://www.aypf.org/forumbriefs/1999 /fb070999.htm

Souza Cruz, S. M. & Zylbersztajn, A. (2002). Event centered learning facing interdisciplinary problems. Paper presented at the *10th International Organization for Science and Technology Education* (IOSTE), 828-883.

Stinner, A. & Williams, H. (1993). Conceptual change, history, and science stories. *Interchange, 24*, (1-2), 87-103.

Stinner, A. & Winchester, I. (1981). The physics of star trek. *New Scientist, 92*, 884-888.

Stinner, A. (1980). Physics, and the bionic man. *The Physics Teacher, 18*, 352-362.

Stinner, A. (1995). Contextual settings, science stories, and large context problems: toward a more humanistic science education. *Science Education, 79*(5), 555-581.

Stinner, A. (1996). Providing a contextual base and theoretical structure to guide the teaching of science from early years to senior years. *Science & Education, 5*, 247-266.

Stinner, A. (2006). The large context problem (LCP) approach. *Interchange, 37*(1-2), 19-30.

Sutman, F. X. & Bruce, M. H., (1992). Chemistry in the Community. ChemCom: A five year evaluation. *Journal of Chemical Education, 69*(7), 564–567.

Swan, J. A. & Spiro, T. G. (1995). Context in chemistry: integrating environmental chemistry with the chemistry curriculum. *Journal of Chemical Education, 72*(11), 967-970.

Symonds, W. C., Schwartz, R. B., & Ferguson, R. (2011 February). Pathways to Prosperity: Meeting the challenges of preparing young Americans for the 21st century. Report issued by the Pathways to Prosperity Project, MA: Harvard Graduate School of Education.

Taasoobshirazi, G. & Carr, M. (2008) A review and critique of context-based physics instruction and assessment, *Educational Research Review*, *3*(2), 155-167.

Tabachnick, B. G. & Fidell, L. S. (2007). *Using multivariate statistics*. Pearson Education: USA.

Tai, R. H. & Sadler, P. M. (2007) High school chemistry instructional practices and their association with college chemistry grades. *Journal of Chemical Education*, *84*(6), 1040-1046.

Tai, R. H., Sadler, P. M. & Maltese, A. V. (2007) A study of the association of autonomy and achievement on performance. *Science Educator*, *16*(1), 22-28.

Talanquer, V. & Pollard, J. (2010) Let's teach how we think instead of what we know. *Chemistry Education Research and Practice*, *11*, 74-83.

Tan, M. & Temiz, B. K. (2003). Fen ogretiminde bilimsel surec becerilerinin yeri ve onemi. *Pamukkale Universitesi Egitim Fakultesi Dergisi*, *1*(13), 89-101.

Tasdelen, U. (2011). *The Effects of Computer-based Interactive Conceptual Change Texts on 11th Grade Students' Understanding of Electrochemistry Concepts and Attitude toward Chemistry* (Doctoral Dissertation). Middle East Technical University Secondary Science and Mathematics Education, Ankara, Turkey.

Thomas, J. A. & Pedersen, J. (1998). Draw-A-Science-Teacher-Test: A visualization of beliefs and self-efficacy. Paper presented at *the annual meeting of Association for Science Teacher Education*, Minneapolis.

Tuncer, G., Ertepinar, H., Tekkaya, C., & Sungur, S. (2005). Environmental attitudes of young people in turkey: effect of school type and gender. *Environmental Education Research*, *11*(2), 215-233.

Ultay, E. (2012). Implementing REACT strategy in a context-based physics class; impulse and momentum example. *Energy Education Science and Technology Part B: Social and Educational Studies*, 4(1), 233-240.

Ultay, N. & Calık, M. (2011) A thematic review of studies into the effectiveness of context-based chemistry curricula. *Journal of Science Education and Technology*. DOI 10.1007/s10956-011-9357-5.

Uzuntiryaki, E. (2003). *Effectiveness of constructivist approach on students' understanding of chemical bonding concepts* (Doctoral Dissertation). Middle East Technical University Secondary Science and Mathematics Education, Ankara, Turkey.

Walsh-Daneshmandi, A. & MacLachlan, M. (2006). Toward effective evaluation of environmental education: validity of the children's environmental attitudes and knowledge scale using data from a sample of Irish adolescents. *Journal of Environmental Education*, *37*(2), 13-23.

Ware, S. & Tinnesand, M. (2005). *Chemistry in the Community (ChemCom): Chemistry for Future Citizens.* In Peter Nentwig, David Waddington (Ed.) Making it relevant Context based learning of science. Waxmann Publishing: Germany.

Whitelegg, E. & Parry, M. (1999). Real life contexts for learning physics: meanings, issues and practice. *Physics Education, 34*(2), 68-72.

Whitelegg, E. (1996). The supported learning in Physics Project. *Physics Education, 31*(5), 291-296.

Wierstra, R. F. A. & Wubbels, T. (1994). Student perception and appraisal of the learning environment: core concepts in the evaluation of the PLON Physics Curriculum. *Studies in Educational Evaluation, 20*(4), 437-455.

Yaman, M. (2009). Context and methods on respiration and energy acquisition interesting for students. *H. U. Journal of Education, 37*, 215-218.

Yilmaz, O., Boone, W. J., Andersen, H. O. (2004). Views of elementary and middle school Turkish students toward environmental issues, *International Journal of Science Education, 26*(12), 1527-1546.

APPENDIX A

CLEANING MATERIALS ACHIEVEMENT TEST

1. Aşağıdakilerden hangisi eski zamanlarda insanların kullandıkları temizlik malzemelerinden değildir?

a) Kil
b) Kül
c) Süt
d) Bitki Özleri
e) Kolonya

2. Sabunlaşma olayı aşağıdaki seçeneklerden hangisinde en uygun şekilde anlatılmıştır?

a) Yağ + KCI $\Rightarrow$ Sabun + Su
b) Yağ + SiO_2 $\Rightarrow$ Sabun + Gliserol
c) Yağ + HCl $\Rightarrow$ Sabun + Su
d) Yağ + NaOH $\Rightarrow$ Sabun + Gliserin
e) Yağ + HCl $\Rightarrow$ Sabun + Lauril Alkol

3. I. Sert sabunlar karboksilli asitlerin Na tuzlarıdır.

II. Yumuşak sabuna örnek olarak arap sabunu verilebilir.

III. Suda çözünmeyen sert sabunlarda vardır.

Yukarıda verilen yargılardan hangileri doğrudur?

a) I ve II
b) II ve III
c) Yalnız I
d) Yalnız II
e) I, II ve III

4. Sabunun kalitesini belli eden en önemli faktör nedir?

a) Sabunun yapıldığı havanın nem miktarı
b) Yağdaki asit miktarı
c) Sert su ile sabun yapılması
d) İçine silikat karışmamalıdır.
e) İçine katılan kül miktarıdır.

5. Aşağıdaki maddelerden hangisi sabun yapısında bulunmaması gereken bir maddedir?

a) Amonyak
b) Sud Kostik (NaOH)
c) Silikatlar
d) Sodyum Perborat
e) Talk

6. Yüzey aktif maddeler yapılarından dolayı aşağıdakilerden hangisinde çözünebilir?

a) Yalnız Suda
b) Yalnız Yağda
c) Hem yağda hem suda
d) Saf sıvılarda
e) Sıvı – Katı karışımlarda

7. Hidrofil ve hidrofob ile ilgili aşağıdaki ifadelerden hangisi ya da hangileri doğrudur?

1. Hidrofil uç suyu sever
2. Hidrofob uç suyu sever
3. Hidrofil uç polardır
4. Hidrofob uç apolardır

a) Yalnız I
b) Yalnız II
c) Yalnız IV
d) II ve III
e) I, III ve IV

8. Temizlik maddeleri genel hatları ile sınıflandırılırsa aşağıdakilerden hangisi bir sınıf oluşturmaz?

a) Çamaşır Suyu
b) Çamaşır Sodası
c) Çamaşır Yumuşatıcıları
d) Sabunlar
e) Deterjanlar

9.

Sert Su + Sabun ⇨ Sabunun organik asidinin kalsiyum veya magnezyum tuzu ⇨ Suda çözünmez ve gri renkli köpük verir.
Sert Su + Deterjan ⇨ Deterjanın organik asidinin kalsiyum ve magnezyum tuzu ⇨ Suda çözünür.

Yukarıda sert su ile sabun ve deterjanın etkileşimi gösterilmiştir, buna göre aşağıdaki yargılardan hangisi doğrudur?

a) Sert su ile sabun ve deterjan etkileşimi sonucu benzer yapıda kalsiyum ve magnezyum tuzları oluşuğu için sabun ve deterjan arasında sert su ile etkileşimleri açısından bir fark yoktur.

b) Sert su ile sabun arasındaki etkileşim sonucu oluşan kalsiyum ve magnezyum tuzları suda çözünmeyerek lekelerin üzerinde birikir ve lekelerin temizlenmesini kolaylaştırır.

c) Sert su ile deterjan arasındaki etkileşim sonucu oluşan kalsiyum ve magnezyum tuzları suda çözündüğü için deterjanlar sert sularda sabundan daha etkilidir.

d) Sert sularda sabunun gri renkli köpük vermesi sert sularda sabunun etkinliğini artırır.

e) Sabun ve deterjan kullanımı ve etkisi açısından sert sular bir fark yaratmazlar.

10. Çamaşır sularının yapısı aşağıdaki etkilerden hangisinden etkilenmez?

a) Suyun sertliği
b) Sıcaklık
c) Metal İyonları
d) PH
e) Işık

11. Deterjanlar ile ilgili olarak,

I. Uzun zincirli sülfat ve sülfonatların sodyum tuzlarıdır.

II. En önemli özellikleri sert sulardaki metal iyonları ile lekelerin üzerinde katı çökelekler oluşturmaları ve böylece lekeleri temizlemeleridir.

III. Yüzey aktif maddeler içerirler.

Yargılarından hangileri doğrudur?

a) Yalnız I
b) I ve II
c) II ve III
d) I ve III
e) I, II ve III

12. Çamaşır sodası ile ilgili verilen bilgilerden hangisi yanlıştır?

a) Bir temizlik maddesidir.
b) Kimyasal yapısı deterjanın yapısına benzer.
c) Kimyadaki adı sodyum karbonattır.
d) Su ile tepkimesinden NaOH oluşur
e) Sert sularda kullanılabilr.

13. I. Hayvansal yağlar ile yapılan sabunlar sert ve suya dayanıklıdır.

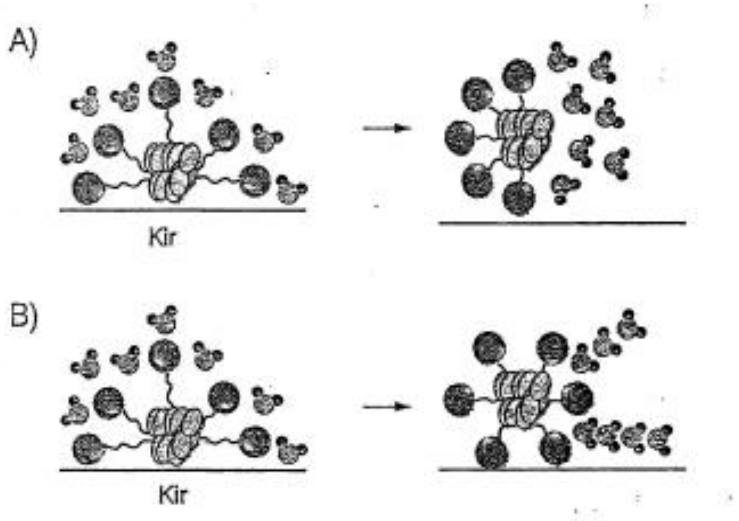
II. Bitkisel yağlardan yapılan sabunlar suda daha çabuk çözünür ve bol köpük oluşur.

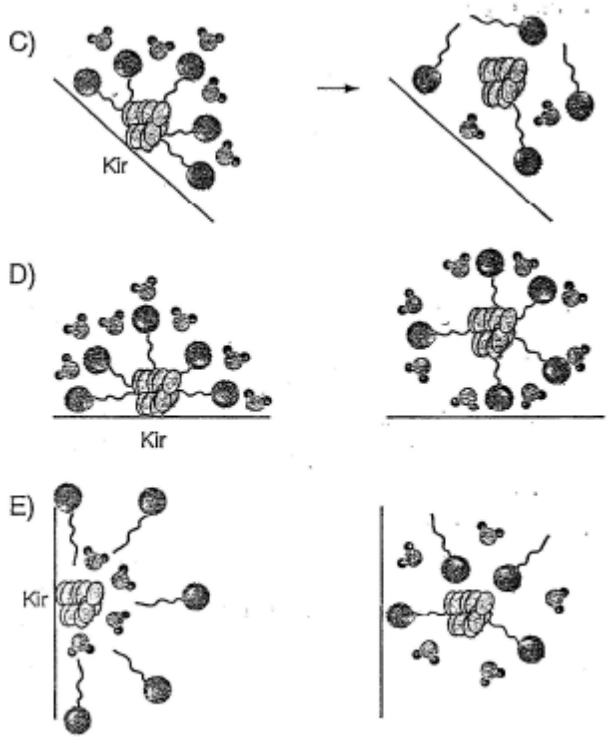
III. Sabun yapımında NaOH ya da KOH gibi bazlar kullanılmalıdır.

Sabunlar ile ilgili araştırma yapan bir öğrencinin ulaştığı yukarıdaki bilgilerden hangileri doğrudur?

a) Yalnız I
b) I ve II
c) I, II ve III
d) I ve III
e) II ve III

14. Sabun moleküllerinin () ve su moleküllerinin () kirli bir çamaşırın üzerinden kiri nasıl temizlediği aşağıda verilenlerden hangisinde doğru gösterilmiştir?





15. Arap sabunu ile ilgili,

I. Yumuşak sabun örneğidir.

II. Yağların potasyum tuzlarıdır.

III. Çevreye deterjanlardan fazla zarar verir.

Yargılarından hangileri doğrudur?

a) Yalnız I
b) I ve II
c) I ve III
d) II ve III
e) I, II ve III

16. Sabun ve deterjan aktif molekülleri için yargılarından hangisi yanlıştır?

a) Çok sayıda atom içeren uzun moleküllerdir.
b) Yapılarında çok sayıda C ve H atomu bulunur.
c) Hidrofil, hidrofob ve nötr kısımlar olmak üzere 3 bölümden oluşurlar.
d) Suda çözünürler.
e) Apolar organik moleküller olan kirlerle aktif moleküllerin hidrofob kısımları etkileşime girer.

17. Ayşe annesinin eve aldığı temizlik ürünleri kutularını yerlerine yerleştirecektir ama hangi markanın hangi ürün olduğunu bilmemektedir. Aşağıda kutular ve ürünler ile ilgili bilgiler verilmiştir. Ayşe hangi ürünü hangi kutuya koymalıdır.

A marka ürünün içindekiler bölümünde sodyum lauril sülfat içerdiği ve sert sularda ve düşük ısılarda bile etkili olduğu yazılıdır.

B marka ürünün içindekiler bölümünde sodyum stearat içerdiği ve doğada kolay parçalanabileceği yazılıdır.

C marka ürünün üzerinde özellikle zor yağların temizlenmesinde kullanabileceği ve suyun sertliğini giderdiği yazılıdır.

a) A sabun kutusuna, B deterjan kutusuna, C çamaşır suyu kutusuna konmalıdır.
b) A sabun kutusuna, B deterjan kutusuna, C çamaşır sodası kutusuna konmalıdır.
c) A çamaşır sodası kutusuna, B çamaşır suyu kutusuna, C deterjan kutusuna konmalıdır.
d) A deterjan kutusuna, B sabun kutusuna, C çamaşır suyu kutusuna konmalıdır.
e) A deterjan kutusuna, B sabun kutusuna, C çamaşır sodası kutusuna konmalıdır.

18. Deterjanlar için aşağıdakilerden hangisi yanlıştır?

a) Sentetik petrol kaynaklı kimyasallardan üretilirler.
b) Sudaki minerallerden çok az etkilenirler.
c) Soğuk sularda bile etkindirler.
d) Atık sularla birlikte atılan deterjanlar çevreye zararlı değildirler.
e) Son 50 yıldır tüm dünyada oldukça yaygın olarak kullanılamaya başlanmıştır.

19. Dünya turuna çıkan bir gezgin Brezilya'dan aldığı sabunların Avrupa'nın bazı bölgelerinde kullanıldığında etkili bir temizleme özelliği göstermediğini fark ediyor. Sizce Brezilya'da üretilen bu sabunların Avrupa'da etkili bir şekilde temizleme özelliği göstermemesi ile ilgili yargılardan hangileri doğru olabilir?

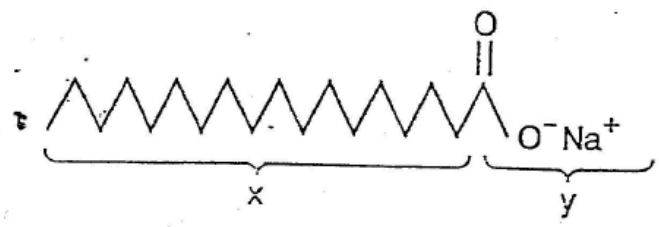
I. İklim şartları farklı olduğu için sabun etkili bir temizleme özelliği göstermemiş olabilir.

II. Avrupa'daki sular Brezilya'daki sulara göre daha fazla sert olduğu için sabun etkili temizleme yapamamış olabilir.

III. Sabunun yapısı etkili bir şekilde temizleme yapmamasına sebep oluyor olabilir.

a) I, II ve III
b) I ve II
c) II ve III
d) Yalnız II
e) Yalnız I

20.



Yukarıda bir sabun molekülünün açık yapısı modelle gösterilmiştir.

Bu molekül ile ilgili,

I. X bölümü hidrofobik kısımdır.

II. Y bölümü hidrofilik kısımdır.

III. Suda çözünen kısmı x kısmıdır.

Yargılarından hangileri doğrudur**?**

a) Yalnız I
b) I ve II
c) Yalnız III
d) I ve III
e) I, II ve III

APPENDIX B

ATTITUDE TOWARD ENVIRONMENT SCALE

ÇEVRE TUTUM ANKETİ

1. Kesinlikle Katılmıyorum 2. Katılmıyorum 3. Kararsızım

4. Katılıyorum 5. Kesinlikle Katılıyorum

	5	**4**	**3**	**2**	**1**
1. Hayvanların hayatını korumak için bazı hayvansal ürünleri satın almaktan vazgeçebilirim.					
2. Klimayı daha az kullanarak enerji tasarrufu yapabilirim.					
3. Su tasarrufu için banyo yaparken daha az su kullanabilirim.					
4. Çevre korumasına yardımcı olmak için kendi cebimden bir miktar para verebilirim.					
5. Hava kirliliğini azaltmak için mümkün olduğunca toplu taşıma araçlarına binebilirim.					
6. Evdeki atıkları geri dönüşüm için ayırabilirim. (cam, plastik, kağıt vs.).					
7. Vahşi hayvanların korunmasına yardımcı olmak için kendi cebimden bir miktar para verebilirim.					
8. Enerji tasarrufu için sarfiyatı az olan					

lambalar kullanabilirim.					
9. Su tasarrufu için ellerimi sabunlarken musluğu sürekli açık tutmayabilirim.					
10. İnsanları çevre konusunda bilgilendirmek için çeşitli faaliyetlerde bulunabilirim.					
11. İnsanlara, çevre kirliliğini azaltmakta yardımcı olmaları için mektup, e-mail yazabilirim.					
12. İnsanları geri kazanma yöntemlerini kullanmaya ikna etmeye çalışabilirim.					
13. Bir çevre sorununu çözümlemek için hiç çaba sarf etmedim.					
14. Çevre sorunlarının çözümüne nasıl yardımcı olunabileceği konusunda ailemle konuşurum.					
15. Dişlerimi fırçalarken su tasarrufu için musluğu sürekli açık tutmam.					
16. Enerji tasarrufu için evde gereksiz yanan ışıkları söndürürüm.					
17. Ailemden hayvan kürkünden yapılmış ürünleri almamalarını isterim.					
18. Aileme bazı çöpleri geri dönüşüm kutusuna atmalarını söylerim.					
19. Çevre konuları ile ilgilenen resmi örgütlere çevre kirliliğini azaltmak için ne yapabileceğimi sorarım.					
20. Çoğunlukla çevre konulu belgeselleri seyrederim.					

21. Musluğu gereksiz yere açık bırakmam.					
22. Buzdolabının kapağını uzun süre açık bırakmam.					
23. Evimizin balkonuna gelen kuşları beslerim.					
24. Geri dönüşümü sağlanabilecek olan atıkları ayırırım.					
25. İnsanların çevre konusunda duyarlı olmadıklarını düşünmek beni üzer.					
26. Kirliliğin çevreye verdiği zarar beni tedirgin eder.					
27. İnsanların şişe ve kağıtları kullandıktan sonra geri dönüşüm kutusuna attığını görünce mutlu olurum.					
28. Bazı firmaların, hayvanlar üzerinde kimyasal maddeleri denediklerini düşündüğümde üzülürüm.					
29. İnsanların enerji tasarrufu yapmaya çalıştıklarını görmek beni mutlu eder.					
30. Susuz kalmaktan korkarım.					
31. Çevre sorunlarıyla ilgilenmem.					
32. Çevre kirliliğinin bizlere verebileceği zarar beni korkutur.					
33. İnsanların geri dönüşümü mümkün olan atıkları geri dönüşüm kutularına atmadıklarını görmek beni üzer.					
34. Hayvanların yaşam alanlarına bina					

yapıldığını görünce üzülürüm.					
35. Gereğinden fazla su tüketimi beni üzer.					
36. Boşa sarf edilen enerjinin ne kadar fazla olduğunu düşünmek beni üzer.					

APPENDIX C

SCIENCE PROCESS SKILLS TEST

BİLİMSEL İŞLEM BECERİ TESTİ

AÇIKLAMA: Bu test, özellikle Fen ve Matematik derslerinizde ve ilerde üniversite sınavlarında karşınıza çıkabilecek karmaşık gibi görünen problemleri analiz edebilme kabiliyetinizi ortaya çıkarabilmesi açısından çok faydalıdır. Bu test içinde, problemdeki değişkenleri tanımlayabilme, hipotez kurma ve tanımlama, işlemsel açıklamalar getirebilme, problemin çözümü için gerekli incelemelerin tasarlanması, grafik çizme ve verileri yorumlayabilme kabiliyetlerini ölçebilen sorular bulunmaktadır. Her soruyu okuduktan sonra kendinizce uygun seçeneği işaretleyiniz.

1. Bir basketbol antrenörü, oyuncuların güçsüz olmasından dolayı maçları kaybettiklerini düşünmektedir. Güçlerini etkileyen faktörleri araştırmaya karar verir. Antrenör, oyuncuların gücünü etkileyip etkilemediğini ölçmek için aşağıdaki değişkenlerden hangisini incelemelidir?

a. Her oyuncunun almış olduğu günlük vitamin miktarını.

b. Günlük ağırlık kaldırma çalışmalarının miktarını.

c. Günlük antreman süresini.

d. Yukarıdakilerin hepsini.

2. Arabaların verimliliğini inceleyen bir araştırma yapılmaktadır. Sınanan hipotez, benzine katılan bir katkı maddesinin arabaların verimliliğini artıdığı yolundadır. Aynı tip beş arabaya aynı miktarda benzin fakat farklı miktarlarda katkı maddesi konur. Arabalar benzinleri bitinceye kadar aynı yol üzerinde giderler. Daha sonra her arabanın aldığı mesafe kaydedilir. Bu çalışmada arabaların verimliliği nasıl ölçülür?

a. Arabaların benzinleri bitinceye kadar geçen süre ile.

b. Her arabanın gittiği mesafe ile.

c. Kullanılan benzin miktarı ile.

d. Kullanılan katkı maddesinin miktarı ile.

3. Bir araba üreticisi daha ekonomik arabalar yapmak istemektedir. Araştırmacılar arabanın litre başına alabileceği mesafeyi etkileyebilecek değişkenleri araştırmaktadırlar. Aşağıdaki değişkenlerden hangisi arabanın litre başına alabileceği mesafeyi etkileyebilir?

a. Arabanın ağırlığı.

b. Motorun hacmi.

c. Arabanın rengi

d. a ve b.

4. Ali Bey, evini ısıtmak için komşularından daha çok para ödenmesinin sebeplerini merak etmektedir. Isınma giderlerini etkileyen faktörleri araştırmak için bir hipotez kurar. Aşağıdakilerden hangisi bu araştırmada sınanmaya uygun bir hipotez değildir?

a. Evin çevresindeki ağaç sayısı ne kadar az ise ısınma gideri o kadar fazladır.

b. Evde ne kadar çok pencere ve kapı varsa, ısınma gideri de o kadar fazla olur.

c. Büyük evlerin ısınma giderleri fazladır.

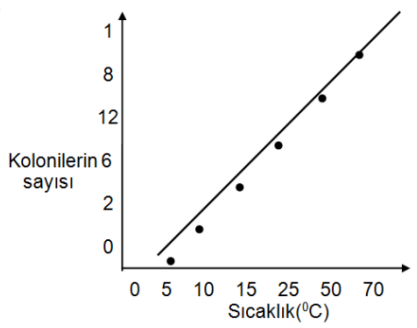
d. Isınma giderleri arttıkça ailenin daha ucuza ısınma yolları araması gerekir.

5. Fen sınıfından bir öğrenci sıcaklığın bakterilerin gelişmesi üzerindeki etkilerini araştırmaktadır. Yaptığı deney sonucunda, öğrenci aşağıdaki verileri elde etmiştir:

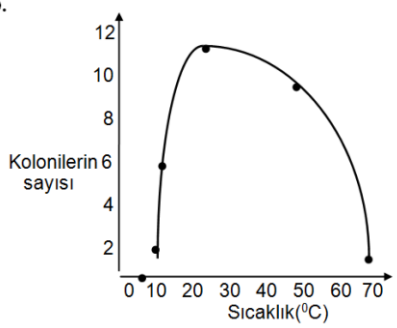
Deney odasının sıcaklığı (^{0}C)	Bakteri kolonilerinin sayısı
5	0
10	2
15	6
25	12
50	8
70	1

Yandaki grafiklerden hangisi bu verileri doğru olarak göstermektedir?

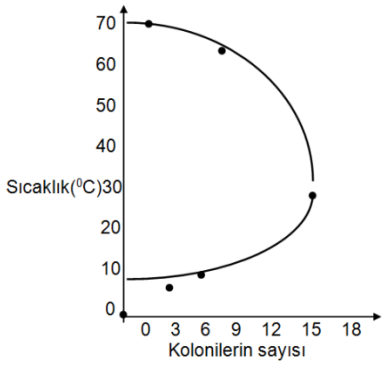
a.



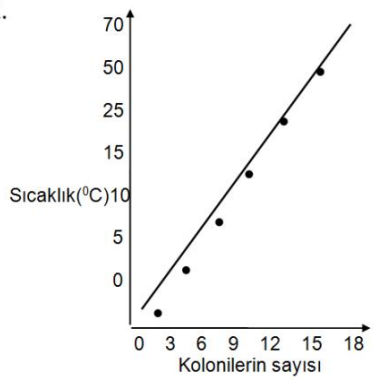
b.



c.



d.



6. Bir polis şefi, arabaların hızının azaltılması ile uğraşmaktadır. Arabaların hızını etkileyebilecek bazı faktörler olduğunu düşünmektedir. Sürücülerin ne kadar hızlı araba kullandıklarını aşağıdaki hipotezlerin hangisiyle sınayabilir?

a. Daha genç sürücülerin daha hızlı araba kullanma olasılığı yüksektir.

b. Kaza yapan arabalar ne kadar büyükse, içindeki insanların yaralanma olasılığı o kadar azdır.

c. Yollarde ne kadar çok polis ekibi olursa, kaza sayısı o kadar az olur.

d. Arabalar eskidikçe kaza yapma olasılıkları artar.

7. Bir fen sınıfında, tekerlek yüzeyi genişliğinin tekerleğin daha kolay yuvarlanması üzerine etkisi araştırılmaktadır. Bir oyuncak arabaya geniş yüzeyli tekerlekler takılır, önce bir rampadan (eğik düzlem) aşağı bırakılır ve daha sonra düz bir zemin üzerinde gitmesi sağlanır. Deney, aynı arabaya daha dar yüzeyli tekerlekler takılarak tekrarlanır. Hangi tip tekerleğin daha kolay yuvarlandığı nasıl ölçülür?

a. Her deneyde arabanın gittiği toplam mesafe ölçülür.

b. Rampanın (eğik düzlem) eğim açısı ölçülür.

c. Her iki deneyde kullanılan tekerlek tiplerinin yüzey genişlikleri ölçülür.

d. Her iki deneyin sonunda arabanın ağırlıkları ölçülür.

8. Bir çiftçi daha çok mısır üretebilmenin yollarını aramaktadır. Mısırların miktarını etkileyen faktörleri araştırmayı tasarlar. Bu amaçla aşağıdaki hipotezlerden hangisini sınayabilir?

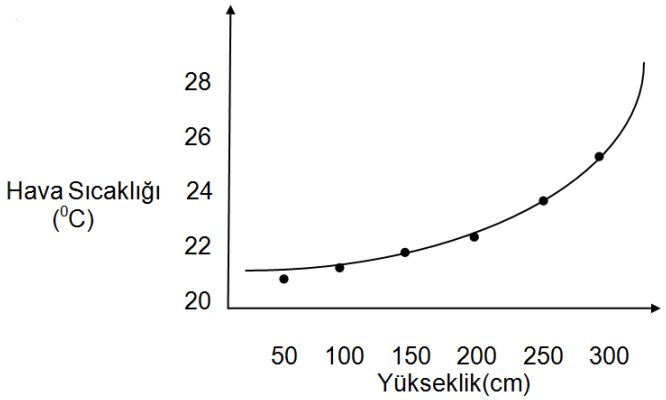
a. Tarlaya ne kadar çok gübre atılırsa, o kadar çok mısır elde edilir.

b. Ne kadar çok mısır elde edilirse, kar o kadar fazla olur.

c. Yağmur ne kadar çok yağarsa, gübrenin etkisi o kadar çok olur.

d. Mısır üretimi arttıkça, üretim maliyeti de artar.

9. Bir odanın tabanından itibaren değişik yüzeylerdeki sıcaklıklarla ilgili bir çalışma yapılmış ve elde edilen veriler aşağıdaki grafikte gösterilmiştir. Değişkenler arasındaki ilişki nedir?



a. Yükseklik arttıkça sıcaklık azalır.

b. Yükseklik arttıkça sıcaklık artar.

c. Sıcaklık arttıkça yükseklik azalır.

d. Yükseklik ile sıcaklık artışı arasında bir ilşki yoktur.

10. Ahmet, basketbol topunun içindeki hava arttıkça, topun daha yükseğe sıçrayacağını düşünmektedir. Bu hipotezi araştırmak için, birkaç basketbol topu alır ve içlerine farklı miktarda hava pompalar. Ahmet hipotezini nasıl sınamalıdır?

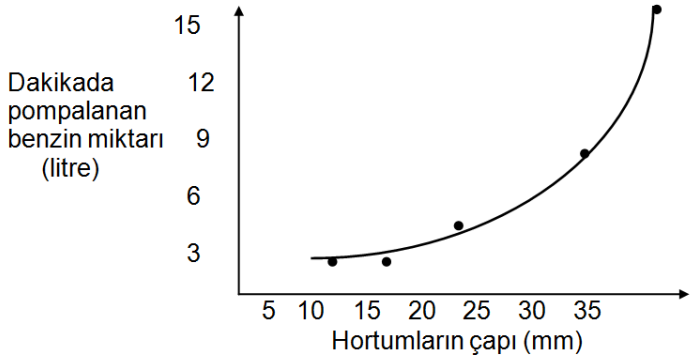
a. Topları aynı yükseklikten fakat değişik hızlarla yere vurur.

b. İçlerinde farlı miktarlarda hava olan topları, aynı yükseklikten yere bırakır.

c. İçlerinde aynı miktarlarda hava olan topları, zeminle farklı açılardan yere vurur.

d. İçlerinde aynı miktarlarda hava olan topları, farklı yüksekliklerden yere bırakır.

11. Bir tankerden benzin almak için farklı genişlikte 5 hortum kullanılmaktadır. Her hortum için aynı pompa kullanılır. Yapılan çalışma sonunda elde edilen bulgular aşağıdaki grafikte gösterilmiştir.



Aşağıdakilerden hangisi değişkenler arasındaki ilişkiyi açıklamaktadır?

a. Hortumun çapı genişledikçe dakikada pompalanan benzin miktarı da artar.

b. Dakikada pompalanan benzin miktarı arttıkça, daha fazla zaman gerekir.

c. Hortumun çapı küçüldükçe dakikada pompalanan benzin miktarı da artar.

d. Pompalanan benzin miktarı azaldıkça, hortumun çapı genişler.

Önce aşağıdaki açıklamayı okuyunuz ve daha sonra 12, 13, 14 ve 15 inci soruları açıklama kısmından sonra verilen paragrafı okuyarak cevaplayınız.

Açıklama: Bir araştırmada, bağımlı değişken birtakım faktörlere bağımlı olarak gelişim gösteren değişkendir. Bağımsız değişkenler ise bağımlı değişkene etki eden faktörlerdir. Örneğin, araştırmanın amacına göre kimya başarısı bağımlı bir değişken olarak alınabilir ve ona etki edebilecek faktör veya faktörler de bağımsız değişkenler olurlar.

Ayşe, güneşin karaları ve denizleri aynı derecede ısıtıp ısıtmadığını merak etmektedir. Bir araştırma yapmaya karar verir ve aynı büyüklükte iki kova alır. Bunlardan birini toprakla, diğerini de su ile doldurur ve aynı miktarda güneş ısısı alacak şekilde bir yere koyar. 8.00 - 18.00 saatleri arasında, her saat başı sıcaklıklarını ölçer.

12. Araştırmada aşağıdaki hipotezlerden hangisi sınanmıştır?

a. Toprak ve su ne kadar çok güneş ışığı alırlarsa, o kadar ısınırlar.

b. Toprak ve su güneş altında ne kadar fazla kalırlarsa, o kadar çok ısınırlar.

c. Güneş farklı maddeleri farklı derecelerde ısıtır.

d. Günün farklı saatlerinde güneşin ısısı da farklı olur.

13. Araştırmada aşağıdaki değişkenlerden hangisi kontrol edilmiştir?

a. Kovadaki suyun cinsi.

b. Toprak ve suyun sıcaklığı.

c. Kovalara koyulan maddenin türü.

d. Her bir kovanın güneş altında kalma süresi.

14. Araştırmada bağımlı değişken hangisidir?

a. Kovadaki suyun cinsi.

b. Toprak ve suyun sıcaklığı.

c. Kovalara koyulan maddenin türü.

d. Her bir kovanın güneş altında kalma süresi.

15. Araştırmada bağımsız değişken hangisidir?

a. Kovadaki suyun cinsi.

b. Toprak ve suyun sıcaklığı.

c. Kovalara koyulan maddenin türü.

d. Herbir kovanın güneş altında kalma süresi.

16. Can, yedi ayrı bahçedeki çimenleri biçmektedir. Çim biçme makinasıyla her hafta bir bahçedeki çimenleri biçer. Çimenlerin boyu bahçelere göre farklı olup bazılarında uzun bazılarında kısadır. Çimenlerin boyları ile ilgili hipotezler kurmaya başlar. Aşağıdakilerden hangisi sınanmaya uygun bir hipotezdir?

a. Hava sıcakken çim biçmek zordur.

b. Bahçeye atılan gübrenin miktarı önemlidir.

c. Daha çok sulanan bahçedeki çimenler daha uzun olur.

d. Bahçe ne kadar engebeliyse çimenleri kesmekte o kadar zor olur.

17, 18, 19 ve 20 nci soruları aşağıda verilen paragrafı okuyarak cevaplayınız.

Murat, suyun sıcaklığının, su içinde çözünebilecek şeker miktarını etkileyip etkilemediğini araştırmak ister. Birbirinin aynı dört bardağın her birine 50 şer mililitre su koyar. Bardaklardan birisine 0 ^{0}C de, diğerine de sırayla 50 ^{0}C, 75 ^{0}C ve 95 ^{0}C sıcaklıkta su koyar. Daha sonra her bir bardağa çözünebileceği kadar şeker koyar ve karıştırır.

17. Bu araştırmada sınanan hipotez hangisidir?

a. Şeker ne kadar çok suda karıştırılırsa o kadar çok çözünür.

b. Ne kadar çok şeker çözünürse, su o kadar tatlı olur.

c. Sıcaklık ne kadar yüksek olursa, çözünen şekerin miktarı o kadar fazla olur.

d. Kullanılan suyun miktarı arttıkça sıcaklığı da artar.

18. Bu araştırmada kontrol edilebilen değişken hangisidir?

a. Her bardakta çözünen şeker miktarı.

b. Her bardağa konulan su miktarı.

c. Bardakların sayısı.

d. Suyun sıcaklığı.

19. Araştırmanın bağımlı değişkeni hangisidir?

a. Her bardakta çözünen şeker miktarı.

b. Her bardağa konulan su miktarı.

c. Bardakların sayısı.

d. Suyun sıcaklığı.

20. Araştırmadaki bağımsız değişken hangisidir?

a. Her bardakta çözünen şeker miktarı.

b. Her bardağa konulan su miktarı.

c. Bardakların sayısı.

d. Suyun sıcaklığı.

21. Bir bahçıvan domates üretimini artırmak istemektedir. Değişik birkaç alana domates tohumu eker. Hipotezi, tohumlar ne kadar çok sulanırsa, o kadar çabuk filizleneceğidir. Bu hipotezi nasıl sınar?

a. Farklı miktarlarda sulanan tohumların kaç günde filizleneceğine bakar.

b. Her sulamadan bir gün sonra domates bitkisinin boyunu ölçer.

c. Farklı alnlardaki bitkilere verilen su miktarını ölçer.

d. Her alana ektiği tohum sayısına bakar.

22. Bir bahçıvan tarlasındaki kabaklarda yaprak bitleri görür. Bu bitleri yok etmek gereklidir. Kardeşi "Kling" adlı tozun en iyi böcek ilacı olduğunu söyler. Tarım uzmanları ise "Acar" adlı spreyin daha etkili olduğunu söylemektedir. Bahçıvan altı tane kabak bitkisi seçer. Üç tanesini tozla, üç tanesini de spreyle ilaçlar. Bir hafta sonra her bitkinin üzerinde kalan canlı bitleri sayar. Bu çalışmada böcek ilaçlarının etkinliği nasıl ölçülür?

a. Kullanılan toz ya da spreyin miktarı ölçülür.

b. Toz ya da spreyle ilaçlandıktan sonra bitkilerin durumları tespit edilir.

c. Her fidede oluşan kabağın ağırlığı ölçülür.

d. Bitkilerin üzerinde kalan bitler sayılır.

23. Ebru, bir alevin belli bir zaman süresi içinde meydana getireceği ısı enerjisi miktarını ölçmek ister. Bir kabın içine bir litre soğuk su koyar ve 10 dakika süreyle ısıtır. Ebru, alevin meydana getirdiği ısı enerjisini nasıl ölçer?

a. 10 dakika sonra suyun sıcaklığında meydana gelen değişmeyi kayeder.

b. 10 dakika sonra suyun hacminde meydana gelen değişmeyi ölçer.

c. 10 dakika sonra alevin sıcaklığını ölçer.

d. Bir litre suyun kaynaması için geçen zamanı ölçer.

24. Ahmet, buz parçacıklarının erime süresini etkileyen faktörleri merak etmektedir. Buz parçalarının büyüklüğü, odanın sıcaklığı ve buz parçalarının şekli gibi faktörlerin erime süresini etkileyebileceğini düşünür. Daha sonra şu hipotezi sınamaya karar verir: Buz parçalarının şekli erime süresini etkiler. Ahmet bu hipotezi sınamak için aşağıdaki deney tasarımlarının hangisini uygulamalıdır?

a. Her biri farklı şekil ve ağırlıkta beş buz parçası alınır. Bunlar aynı sıcaklıkta benzer beş kabın içine ayrı ayrı konur ve erime süreleri izlenir.

b. Her biri aynı şekilde fakat farklı ağırlıkta beş buz parçası alınır. Bunlar aynı sıcaklıkta benzer beş kabın içine ayrı ayrı konur ve erime süreleri izlenir.

c. Her biri aynı ağırlıkta fakat farklı şekillerde beş buz parçası alınır. Bunlar aynı sıcaklıkta benzer beş kabın içine ayrı ayrı konur ve erime süreleri izlenir.

d. Her biri aynı ağırlıkta fakat farklı şekillerde beş buz parçası alınır. Bunlar farklı sıcaklıkta benzer beş kabın içine ayrı ayrı konur ve erime süreleri izlenir.

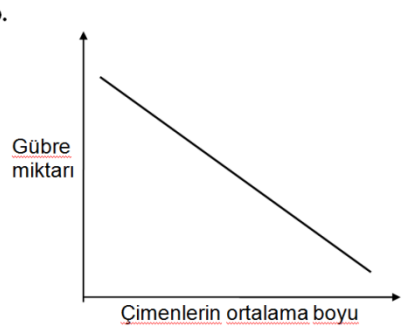
25. Bir araştırmacı yeni bir gübreyi denemektedir. Çalışmalarını aynı büyüklükte beş tarlada yapar. Her tarlaya yeni gübresinden değişik miktarlarda karıştırır. Bir ay sonra, her tarlada yetişen çimenin ortalama boyunu ölçer. Ölçüm sonuçları aşağıdaki tabloda verilmiştir.

Gübre miktarı (kg)	Çimenlerin ortalama boyu (cm)
10	7
30	10
50	12
80	14
100	12

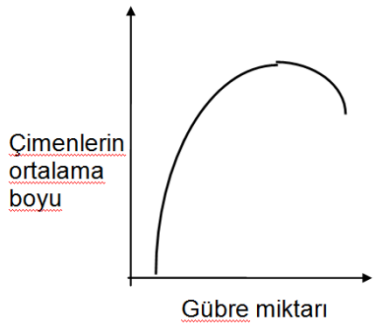
Tablodaki verilerin grafiği yandakilerden hangisidir?

a.

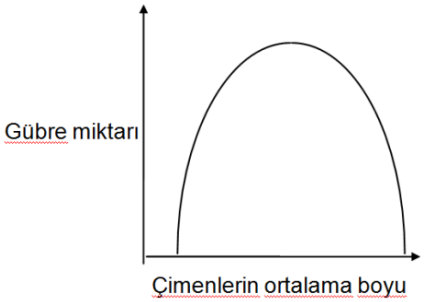
b.



c.



d.



26. Bir biyolog şu hipotezi test etmek ister: Farelere ne kadar çok vitamin verilirse o kadar hızlı büyürler. Biyolog farelerin büyüme hızını nasıl ölçebilir?

a. Farelerin hızını ölçer.

b. Farelerin, günlük uyumadan durabildikleri süreyi ölçer.

c. Her gün fareleri tartar.

d. Her gün farelerin yiyeceği vitaminleri tartar.

27. Öğrenciler, şekerin suda çözünme süresini etkileyebilecek değişkenleri düşünmektedirler. Suyun sıcaklığını, şekerin ve suyun miktarlarını değişken olarak saptarlar. Öğrenciler, şekerin suda çözünme süresini aşağıdaki hipotezlerden hangisiyle sınayabilir?

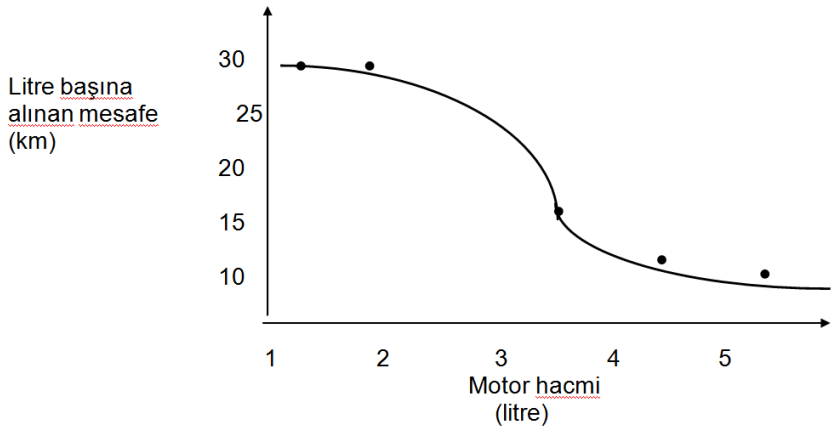
a. Daha fazla şekeri çözmek için daha fazla su gereklidir.

b. Su soğudukça, şekeri çözebilmek için daha fazla karıştırmak gerekir.

c. Su ne kadar sıcaksa, o kadar çok şeker çözünecektir.

d. Su ısındıkça şeker daha uzun sürede çözünür.

28. Bir araştırma grubu, değişik hacimli motorları olan arabaların randımanlarını ölçer. Elde edilen sonuçların grafiği aşağıdaki gibidir:



Aşağıdakilerden hangisi değişkenler arasındaki ilişkiyi gösterir?

a. Motor ne kadar büyükse, bir litre benzinle gidilen mesafe de o kadar uzun olur.

b. Bir litre benzinle gidilen mesafe ne kadar az olursa, arabanın motoru o kadar küçük demektir.

c. Motor küçüldükçe, arabanın bir litre benzinle gidebileceği mesafe artar.

d. Bir litre benzinle gidilen mesafe ne kadar uzun olursa, arabanın motoru o kadar büyük demektir.

29, 30, 31 ve 32 inci soruları aşağıda verilen paragrafı okuyarak cevaplayınız.

Toprağa karıştırılan yaprakların domates üretimine etkisi araştırılmaktadır. Araştırmada dört büyük saksıya aynı miktarda ve tipte toprak konulmuştur. Fakat birinci saksıdaki toprağa 15 kg., ikinciye 10 kg., üçüncüye ise 5 kg. çürümüş yaprak karıştırılmıştır. Dördüncü saksıdaki toprağa ise hiç çürümüş yaprak karıştırılmamıştır.

Daha sonra bu saksılara domates ekilmiştir. Bütün saksılar güneşe konmuş ve aynı miktarda sulanmıştır. Her saksıdan elde edilen domates tartılmış ve kaydedilmiştir.

29. Bu araştırmada sınanan hipotez hangisidir?

a. Bitkiler güneşten ne kadar çok ışık alırlarsa, o kadar fazla domates verirler.

b. Saksılar ne kadar büyük olursa, karıştırılan yaprak miktarı o kadar fazla olur.

c. Saksılar ne kadar çok sulanırsa, içlerindeki yapraklar o kadar çabuk çürür.

d. Toprağa ne kadar çok çürük yaprak karıştırılırsa, o kadar fazla domates elde edilir.

30. Bu araştırmada kontrol edilen değişken hangisidir?

a. Her saksıdan elde edilen domates miktarı

b. Saksılara karıştırılan yaprak miktarı.

c. Saksılardaki toprak miktarı.

d. Çürümüş yapak karıştırılan saksı sayısı.

31. Araştırmadaki bağımlı değişken hangisidir?

a. Her saksıdan elde edilen domates miktarı

b. Saksılara karıştırılan yaprak miktarı.

c. Saksılardaki toprak miktarı.

d. Çürümüş yapak karıştırılan saksı sayısı.

32. Araştırmadaki bağımsız değişken hangisidir?

a. Her saksıdan elde edilen domates miktarı

b. Saksılara karıştırılan yaprak miktarı.

c. Saksılardaki toprak miktarı.

d. Çürümüş yaprak karıştırılan saksı sayısı.

33. Bir öğrenci mıknatısların kaldırma yeteneklerini araştırmaktadır. Çeşitli boylarda ve şekillerde birkaç mıknatıs alır ve her mıknatısın çektiği demir tozlarını tartar. Bu çalışmada mıknatısın kaldırma yeteneği nasıl tanımlanır?

a. Kullanılan mıknatısın büyüklüğü ile.

b. Demir tozlarını çeken mıknatısın ağırlığı ile.

c. Kullanılan mıknatısın şekli ile.

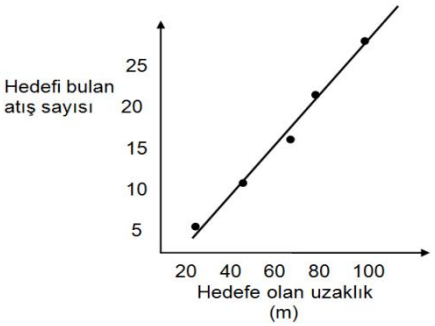
d. Çekilen demir tozlarının ağırlığı ile.

34. Bir hedefe çeşitli mesafelerden 25 er atış yapılır. Her mesafeden yapılan 25 atıştan hedefe isabet edenler aşağıdaki tabloda gösterilmiştir.

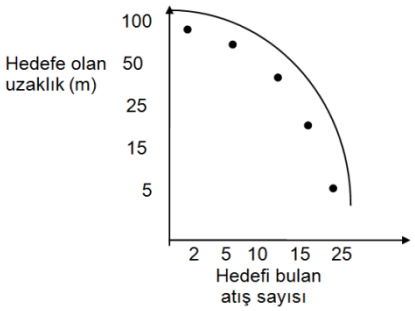
Mesafe(m)	Hedefe vuran atış sayısı
5	25
15	10
25	10
50	5
100	2

Yandaki grafiklerden hangisi verilen bu verileri en iyi şekilde yansıtır?

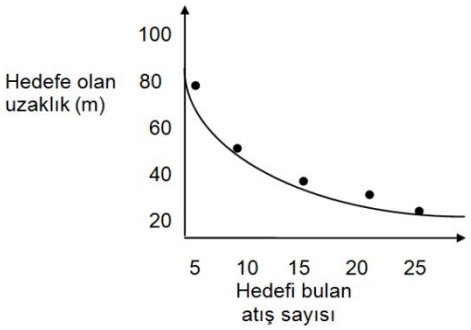
a.



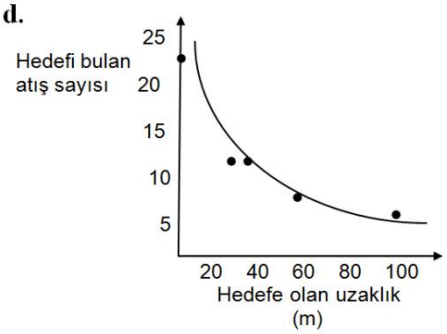
b.



c.



d.



35. Sibel, akvaryumdaki balıkların bazen çok haraketli bazen ise durgun olduklarını gözler. Balıkların hareketliliğini etkileyen faktörleri merak eder. Balıkların hareketliliğini etkileyen faktörleri hangi hipotezle sınayabilir?

a. Balıklara ne kadar çok yem verilirse, o kadar çok yeme ihtiyaçları vardır.

b. Balıklar ne kadar hareketli olursa o kadar çok yeme ihtiyaçları vardır.

c. Su da ne kadar çok oksijen varsa, balıklar o kadar iri olur.

d. Akvaryum ne kadar çok ışık alırsa, balıklar o kadar hareketli olur.

36. Murat Bey'in evinde birçok elektrikli alet vardır. Fazla gelen elektrik faturaları dikkatini çeker. Kullanılan elektrik miktarını etkileyen faktörleri araştırmaya karar verir. Aşağıdaki değişkenlerden hangisi kullanılan elektrik enerjisi miktarını etkileyebilir?

a. TV nin açık kaldığı süre.

b. Elektrik sayacının yeri.

c. Çamaşır makinesinin kullanma sıklığı.

d. a ve c.

APPENDIX D

LESSON PLAN (SAMPLE)

Ünite: HAYATIMIZDA KİMYA

1. Bölüm Temizlik Maddeleri

Amaç

Bu ders planları bağlam temelli kimya eğitimi yaklaşımı temel alınarak hazırlanmıştır. Bağlam birçok alanda kullanımı olan bir kelime olduğu için tanımlanması biraz güçtür. Kimya eğitimi alanında kullanıldığında genel manada bireyin günlük hayatında karşılaştığı olayları, olguları ve tecrübeleri kullanılarak bu kavramların içine yerleştirilmiş kimya kavramlarını bir örüntü şeklinde öğrenciye sunan bir yapı şeklinde tanımlanabilir. Bağlam temelli kimya eğitimi yaklaşık 20 yıldır yaygın bir yaklaşım olarak dünyanın birçok yerinde uygulanmaktadır. Bu kadar yaygın bir şekilde tercih edilmesinin nedeni öğrenciler için kimyayı hayatın içinden seçilmiş bağlamlar üzerinden sunmasıdır. Günümüzde öğrenciler okul bilgisi ile günlük hayattaki olaylar arasındaki bağlantıları çoğunlukla görememektedirler. Bu sebeple öğrenciler okulda öğrendikleri kimya kavramlarının gerçek hayatla olan bağlantılarını anlayamamakta ve buda kimya derslerine olan ilginin düşmesine neden olmaktadır. Bununla birlikte ilginin düşmesine neden olan diğer nedenler olarak öğretilmek istenen kimya bilgisinin yoğunluğu, ders kitaplarının yeterince ilgi çekici olmaması, gibi farklı nedenler de sayılabilir.

Bağlam temelli kimya eğitimi yaklaşımı bu sorunların üstesinden gelmek için kullanılmaya başlanmıştır. Mesela bağlam

temelli kimya eğitimi yaklaşımı kimya kavramlarının bağlamlar içinde öğretilmesini teşvik ederek kimyanın öğrencilerin günlük hayatları ile olan ilişkilerini vurgulamakta ve öğrenciler için okulda öğrenilen kimya bilgisine amaç ve anlam kazandırmaktadır. Bir diğer örnekte bağlam temelli yaklaşım için kullanılan ders kitaplarının kullanılan klasik kimya kitaplarına göre öğrencilerin daha çok ilgisini çektiğidir. Bunun da temel nedeni genellikle bağlam temelli kimya eğitimi yaklaşımının öğrencileri bağlama çekmek için gerçek olayları anlatan hikâyelerle başlaması ve öğrencileri bu hikâyelerle yakalayıp ilgilerini o bağlam içerisindeki kimyasal kavramlara odaklamaya çalışmasıdır. Öğrencilerin bu süreçte bağlamın içindeki birçok kimya kavramını içeren bağlam bilgisi ile ilgili merakının uyanması ve kimya kavramlarını olayı anlamak için öğrenmeye motive olacağı varsayılmaktadır. Bu bağlam içinde öğrendikleri kavramların yeni soruları gündeme getireceği ve öğrencinin belli bir doygunluğa ulaşıncaya kadar bu süreçte ilerleyeceği var sayılmaktadır. Bu sırada birçok soru ortaya çıkmakta bu soruların bir kısmını öğrencilerin araştırması ve bölüm sonuna doğru bu kavramların sunulmasının ders içeriğini zenginleştireceği düşünülmektedir.

Bağlam temelli kimya eğitimi birden çok öğrenme kuramı ile anılmakla birlikte daha çok yapılandırıcı öğrenme kuramı ile birlikte kullanılmaktadır. Bu yaklaşımın başarılı olmasında öğretmenin üstleneceği rehber rolü çok önemlidir. Öğretmen öğrencilerin bilgiyi yapılandırmasına olanak tanımalı onlara bilgiyi direk verenden ziyade bilgiye ulaşmaları için onlara yol gösteren bir lider rolünde olmalıdır. Öğretmen farklı zekâ tiplerinde olan öğrencilere uygun zengin içerikler üretebilmelidir. Öğrenciler aktif olmalı bağlamın günlük hayatta ilgisini kurmaya çalıştığı kimya kavramlarını tartışmalı, araştırmalı ve sonuçlarını paylaşmalıdırlar. Öğrencilerin günlük hayatları ile ilişkisini fark ettikleri bağlamlar içinde sunulan kavramları öğrenmeye daha yüksek bir motivasyonla yaklaştıkları bilinmektedir. Temizlik maddeleri konusunun dört alt bölümü dört bağlam içerisinde işlenmesi

için ders planları hazırlanmıştır. Bağlamlar içinde temizlik maddeleri konusu işlenirken öğrencilerin bazı kimya kavramları ve olayları hakkında akıllarına yeni soruların getirmesi amaçlanmaya çalışılmış ve çocukların bu sorular üzerinde düşünecekleri ve bu konular üzerinde bilgilerini daha motive olmuş bir şekilde artırmak isteyecekleri varsayımı üzerinden ders planları hazırlanmıştır.

Bağlamlar, çocukların kimyayı öğrenmelerini öğrenciler için anlamlı kılmalı ve öğrenme isteklerini artırmalıdır. Bağlamların aynı zamanda amacı öğrencilere toplumda kimyanın ve bilimin nasıl işlediğini göstermek, onları günlük hayattaki olayları bilimsel bir gözle de bakabilmelerini sağlamaya çalışmak ve onlarda kişisel olarak bilime ve bilimselliğe karşı sempati uyandırmaktır.

Bazı araştırmacılar bağlam temelli kimya eğitimi derslerini 5 temel evrede gerçekleştiğini ve geliştiğini düşünmektedirler.

1 evre: Öğrencilerin bağlamları ve bağlam ile ilgili kavramları anlamaları, bağlam ile ilgili akıllarına takılan soruları düşünmeleri ve bu soruların öğrencilerde araştırma isteği uyandırması

2. evre: Öğrenciler akıllarındaki problemi revize ederler ve araştırmaya uygun hale getirirler. Daha sonra bu problemi çözmek için yeterli bilgilerinin olmadığını fark edip sorun hakkında daha detaylı bilgi edinme isteği duyarlar.

3. evre: Öğrenciler sorunun çözümünün basamaklarını belirler ve sorunun çözümü için bu basamaklarda ilerlerler ve sorunla ilgili bilgilerini genişletirler. Gerekirse sorunun çözümü ile ilgili basamakları tekrar gözden geçirirler.

4. evre: Öğrenciler bu tip bir problemi çözmenin basamaklarını kavrarlar ve açıklarlar. Benzer problemleri çözmenin de yolunun bu tip bir çalışmanın eseri olacağının farkına varırlar.

5. evre: Bundan sonra karşılarına çıkacak benzer problemler içinde çözüm önerileri ve planları sunabilirler.

Konu bu evrelerden uyarlanan ve dersin etkili olabilmesi için belirlenen altı temel nokta dikkate alınarak hazırlanan ders planları ile işlenecektir. Bu altı temel nokta öğrencilerin bağlamı keşfetmesi için onlara imkân ve zaman tanınması, bağlama öğrencinin ilgisinin çekilmesi, öğrencinin bağlam ve bağlam içerisindeki kimya kavramları ve bilgisi ile ilgili bilme ve araştırma isteğinin artırılması, bu isteğin sürdürülebilir olması, bu devam eden ilgiden dolayı kazanılan bilgilerin arkadaşları veya diğer kişiler ile paylaşılması ve en son olarakta edinilen kimya bilgisinin benzer problemler durumlarında uygulanması basamaklarını içermektedir. Çalışmada öğrencilere verilen kimya kavramlarını bağlamın içinde düşünmelerini amaçlayan ve onlara öğrendikleri bilgilerin günlük hayatla ilişkisini veya sosyal değerini göstermeye çalışan materyaller hazırlanmıştır.

1. Evre: Bağlamın Keşfi ve Anlaşılması

2. Evre: Bağlama Öğrenci İlgisinin Çekilmesi

3. Evre: Bağlamla İlgili Kimya Kavramlarını Öğrenme İsteğinin Oluşması

4. Evre: Bağlamla İlgili Kimya Kavramlarını Öğrenme İsteğinin Sürdürülmesi

5. Evre: Bağlam İlgili Öğrenilen Kimya Bilgisinin Paylaşılması

6. Evre: Bağlamla ilgili Kimya Bilgisinin Benzer Problemlere ve Diğer Alanlara Taşınması

Konu Başlığı: Temizlik maddeleri

Konun Genel Amaçları

1. Temizlikte kullanılan kimyasal maddelerin hayatımızda çok önemli bir yerinin olduğunun kavratılması.

2. Sabun, deterjan, çamaşır suyu, tuz ruhu vb. kullanımı yaygın olan temizlik maddeleri ve yapıları hakkında öğrencilerin bilgi sahibi olması.
3. Temizlik kimyasallarının insana zararları hakkında öğrencilerin bilgi sahibi olmasının sağlanması.
4. Temizlik maddelerinin çevre ile olan yarar zarar ilişkisinin öğrenciler tarafından sorgulanmasının sağlanması.

Konunun Temel Kavram Listesi

1. Sabun
2. Deterjan
3. Çamaşır suyu
4. Çamaşır sodası
5. Tuz ruhu
6. Kir
7. Aktif molekül

Konunun Kazanımları (Müfredat programından alınmıştır)

Ders planları hazırlanırken bu kazanımları kapsamına dikkat edilmiştir.

1. Temizlik maddelerinin kimyası ile ilgili öğrenciler;

1.1. Farklı temizlik maddelerinin yapısal özellikleri arasındaki benzerlikleri fark eder.

1.2. "Kir" oluşturan maddelerin su ile neden karışmadığını açıklar.

1.3. Sabun ve deterjan aktif moleküllerinin, kirin suya karışmasını nasıl sağladığını açıklar.

1.4. Çamaşır sodasının kir çıkarma özelliğini açıklar.

1.5. Çamaşır suyunun ağartıcı özelliğini yapısı ile ilişkilendirir.

Önümüzdeki derslerimizde kullanacağımız 4 kimya hikâyesi ve bu kimya hikâyeleri ile ilgili kimyasal kavram ve bağlamları gösteren tablo aşağıda verilmiştir.

Tablo 1. Kimyasal Hikayeler, Kimyasal Fikirler ve Bağlamlar

Kimya Hikayeleri	Kimyasal fikirler	Bağlam
KÖPÜK KÖPÜK SABUN	❖ Sabunlar ve Deterjanlar ❖ Yüzey gerilimi ❖ Yüzey aktif maddeler ❖ Sabunun kimyasal yapısı (Hidrofilik / Hidrofobik) ❖ Sert sular ve temizlik maddeleri etkileşimi ❖ Temizlik maddeleri ve kirin etkileşimi ❖ Temizlik maddelerinin çevreye etkileri	↳ Sabunun ve deterjanın ortaya çıkış hikayesi ve bunların gelişim süreci ✓ Sabun ve deterjanın tarihçesi ve gelişim süreci ✓ Nasıl sabun yaparım? ✓ Elbiselerimin üzerindeki bir lekeyi nasıl çıkarırım?
KALİTELİ SABUN SEÇİMİ	❖ Sabun çeşitleri ❖ Değişik sabun kokuları ❖ Çeşitli sabunların PH değerleri ❖ Çeşitli sabunların suda erime hızları	↳ Kullanım amacına uygun kaliteli sabun seçebilme ✓ Sabunların kalitesini ve yapısını etkileyen değişkenler
	❖ Çamaşır suyu (NaOCI) ❖ Temizlik	↳ Evde kullanılan temizlik maddelerinin

EVİMİZDEKİ TEHLIKE	maddelerinin uygun olmayan şekillerde karıştırılması (Klor ve Kloraminler) ❖ Çamaşır suyu kullanımı sonucu ortaya çıkan karbon tetra klorür ve kloroformun (triklormetan) sağlığa etkileri ❖ Temizlik maddelerinin birbirleriyle karıştırılması sonucu ortaya çıkan klor ve kloraminler ❖ Aşırı derecede çamaşır suyu kullanımının ozon tabakasına ve küresel ısınmaya etkileri	(Çamaşır suyu) aşırı tüketiminin sağlımıza etkileri ✓ Ev temizlik malzemesi olarak çamaşır suyu ✓ Temizlik maddelerinin kullanımı sırasında dikkat edilecek hususlar ✓ Tercihen kokusuz ve konsantre olmayan ürünlerin kullanımının teşvik edilmesi
SUYA SABUNA DOKUNMADAN TEMİZLENENLER	❖ Temizliğin sağlıklı bir yaşam için en önemli koşullardan biri olması ❖ Kirli ve temiz	↳ Hayvanlar kendilerini nasıl temizlerler? ✓ Temizliğin tüm canlılar için önemi ✓ Hayvanlarda temizlikte yardımlaşma

Bu çalışma tarafından geliştirilmesi ve güçlendirilmesi beklenen özellikler;

1. Açık uçlu araştırma sorusu hazırlayabilme, araştırabilme ve sonuçlandırma: Öğrenciler kendi istedikleri bir araştırma problemini 4 haftalık sure içerisinde araştıracaklar ve sonuçlarını poster sunumu şeklinde sunacaklardır.

2. Bir çok kaynaktan bilgi toplayabilme: Öğrenciler araştırma sorularını hazırlarken muhtemel olarak ders kitapları, kaynak kitaplar, internet, yada kendilerinden daha tecrübeli kişilerle görüşerek farklı kaynaklardan bilgi toplama becerisini kullanacaklardır.

3. Teknoloji kullanımı: Araştırma soruları hazırlanırken en çok kullanılan kaynaklardan biri muhtemelen internet olacaktır. Öğrencilerin teknolojiyi kullanarak doğru bilgiye ulaşması konusunda yardımcı olunacak ve bu süreçte onlarında farklı arama motorlarını kullanarak güvenilir ve geçerli bilgiye ulaşma becerileri geliştirilecektir.

4. Bağımsız öğrenme: Öğrenciler araştırma soruları ile araştırma yaparken hem grup çalışması yapacaklar hem de kendi başlarına üstlerine düşen görevleri yerine getirmeye çalışılacaktır. Çok istenmese de bireysel çalışmak isteyen öğrencilere araştırma sorusu verilecek ve onlarında bu araştırmayı tek başlarına yapmaları da desteklenecektir.

5. Sunum, poster veya rapor hazırlama ve sunabilme: Öğrenciler araştırma sonuçlarını poster sunumları şeklinde sunacaklardır. Bu da öğrencilerdeki poster hazırlama ve sunma becerisini geliştirecektir.

6. Grup tartışması: Dersin birçok aşamasında grup tartışmalarına yer verilecek ve öğrencilerin gruplar halinde çalışması ve birbirlerinde öğrenmeleri desteklenecektir.

7. Bilgi toplama ve analiz edebilme: Öğrencilerin araştırma problemleri ile ilgili topladıkları bilgileri analiz etmesi ve uygun şekilde posterlerde sunması bu özelliklerinin gelişmesine katkıda bulunacaktır.

8. Model oluşturabilme, hipotez kurma: Her araştırma sorusu için olmasa bile bazı araştırma soruları için öğrencilerin hipotezler kurması ve bazı modeller oluşturmaları gerekebilir. Bu gruplardaki öğrencilerde bu becerilerin gelişmesini beklenmektedir.

9. Çalışma becerilerini geliştirme: Öğrencilerin grup halinde çalışma ve hazırlanan bir plana göre üzerlerine düşen görevleri yerine getirmeleri çalışma becerileri üzerinde olumlu katkılar yapacaktır.

Uygulamadan bir Önceki Hafta Yapılacaklar

- ✓ Ön testtin uygulanması

- ✓ Öğrenciler için hazırlanan materyallerin dosyalar içinde dağıtılması

- ✓ Materyaller ile ilgili açıklamaların yapılması: Dosya içerisinde dağıtılan materyallerin hangi amaçlar için nasıl kullanılacağının öğretmenler tarafından öğrencilere aktarılması.

- ✓ Öğrencilerin derse karşı ilgilerinin uyanması için başlangıç aktivitesinin yapılması. Bu aktivitenin amacı öğrencilerin konuya ilgilerinin artmasını sağlamak ve konuya olan dikkatlerini çekmektir. Bu aktivitede sabunların nasıl temizlediği ve sabunun yapısına (Hidrofilik/Hidrofobik) yapıya vurgu yapmaktır. Bu aktivite yapıldıktan sonra öğrencilerin tartışmalarına izin verilmeli ve konu hakkındaki fikirleri alınmalıdır.

- ✓ Öğrencilere sorulacak ve üzerinde tartışma ortamı oluşması hedeflenen sorular

  - ➢ Su ve yağın karışmasında sabunun nasıl bir etkisi vardır?
  - ➢ Sabunun yapısındaki hangi unsurlar bu karışmada etkilidir?
  - ➢ Bir kirin temizlenmesi işlemi sizce nasıl oluyor?

I. HAFTA (2 ders saati)

Ders Öncesi Yapılacaklar

Öğrencilere temizlik maddeleri ile ilgili ilk kimya hikâyesini (Köpük Köpük Sabun) okumaları istenmişti. Öğrenci çalışma notlarının ilgili bölümündeki soruları cevaplamaları ve bunları öğrenci çalışma not kâğıdındaki uygun yerlere yazmaları istenir. Bağlamların ders içinde etkili kullanılabilmeleri için 4 temel özelliği kullanılan her bağlam için ortaya koymalıyız. Bu özellikler birinci haftaki kimya hikâyesi ile başlayan ders için aşağıda belirtilmiştir.

Ders Planları

- Derse köpük köpük sabun kimya hikâyesinin okunması ile başlanacak ve ders boyunca kimya hikâyesinin içindeki kimya kavramları ve kimya fikirleri ile ilgili tartışmalar yapılacaktır. Bu kimya hikâyesi ile oluşturulmak istenen bağlamın ders işlemede rehber olacak dört özelliği aşağıda belirtilmiştir.

1. Çerçeve (Setting): Buradaki odak olayımız sabunun tarihteki şans eseri bulunuşu olayını anlatarak başlıyor. Bu aradan insanların hayatlarını kolaylaştırmasına rağmen sabunun ilk etapta çok hızlı yaygınlaşamamasının nedenlerine geçiyoruz. Bundan sonra deterjanların ortaya çıkışında toplumsal olarak etkili ve verimli temizlik maddelerine olan ihtiyaç ve arayışın etkisi üzerinden konu devam ediyor. Burada tarihsel gelişimden başlanarak öğrencilere toplumsal ihtiyaçların kimya biliminin ilerlemesine nasıl yön verdiği ve sosyal problemlere kimyanın nasıl çözümler bulduğunu göstermiş oluyoruz. Kimya biliminin toplumsal gelişime nasıl önemli katkılar yaptığını makale üzerinden öğrencilerin fark etmesi sağlanıyor.

2. Beklenen Davranışlar (Behavioral Environment): Aşağıda öğrencilerin göstermesi muhtemel davranışlardan bazıları örnek olarak verilmiştir.

Öğrencilerin bir kısmı okul laboratuarında farklı renk ve kokularda sabunlar yapmak isteyebilirler. Ders kitabında ve kimya hikâyesinde sabunun nasıl yapılacağı ile ilgili bölümlerden öğrencilerin bu nokta da yararlanması sağlanabilir.

İlk sabun yapımında hangi maddelerin kullanıldığı ve ilk sabun üretimin nasıl yapıldığı yine öğrenciler tarafından araştırılmak istenebilir. Özellikle sanayileşmeden önce sabun yapımının nasıl olduğu konusu ile ilgili araştırma düzenlenebilir.

Çevreye bahsi geçen farklı sabunların etkileri üzerine araştırma yapmak isteyebilirler. Çevreye farklı sabun tipleri farklı şekillerde kirleticilik etkileri göstermektedirler, doğal ve çevreye zarar vermeyen sabunlara arap sabunu örnek verilebilir ve arap sabunun yapısı ile ilgili araştırma yapmak isteyen öğrenciler olabilir. Deterjanları çevreye etkileri de yine üzerinde tartışma ve araştırılma yapılabilecek bir diğer konudur.

Deterjanın yapısı ve sabuna göre neden daha etkili bir temizleme sağladığı ile ilgili bir araştırma yapmak isteyen öğrenciler olabilir.

Sert sular ve temizlik maddelerinin etkileşimi üzerinde araştırmalar ve tartışmalar yapılabilir.

Kirlerin temizlik maddeleri yardımı ile nasıl rahatlıkla çıkartılabildiği üzerinde araştırmalar ve tartışmalar yapılabilir.

Bazı öğrenciler kuru temizlemenin nasıl yapıldığını merak edebilir ve bununla ilgili bir araştırma yapabilirler.

3. Kimyasal Tartışma (Chemical Talk): Yukarıda örnek verilen tartışmalar veya benzerleri yapılırken aşağıdaki kimya kavramlarının ve bilgilerinin konuşmalara dâhil edilmesi ve tartışma ve konuşmalarda bu kavramların geçmesi ve öğrencilerde anlamlandırılması için gayret

gösterilmelidir. Kimyasal tartışmaları sabunun tarihsel gelişimi ile başlanarak kimya hikâyesi üzerinde devam etmelidir. Bu süreçte üzerinde durulması gereken temel kimya kavram ve bilgileri şunlardır: sabuna alternatif maddeler (süt, bitki özleri, kül, kil), sabunların yapısı (Hidrofilik/Hidrofobik yapı), sabunlaşma olayı (Yağların bazik ortamda hidrolizlenmesi sonucu oluşan uzun zincirli karboksilli asitlerin sodyum veya potasyum tuzlarının oluşması olayı), sabun yapımında kullanılan maddeler ve bunları sabunun yapısında bulunma nedenleri (silikatlar, talk) sabun çeşitleri, yüzey gerilimi, sert ve yumuşak sabunlar, sabun ve deterjanların benzerlikleri ve farkları, çamaşır sodası (Na_2CO_3) ve kirlerin yapısı (yağ ve benzeri apolar organik maddeler içerirler).

4. Durumsal Arka Plan Bilgisi (Extra Situational Background Knowledge): Bu konun anlaşılabilmesi için yağlar, asitler, bazlar, tuzlar, kimyasalların adlandırılması ve yazılması gibi konular hakkında temel bilgiye sahip olunması gerekmektedir. Ayrıca polar, apolar, hidrofob, hidrofil gibi kimya kavramlarının bilindiği ya da konu sırasında pratikçe öğrenileceği kabul edilmektedir. Bu hafta öğrenilen bir çok bilgi ilerleyen haftalarda diğer temizlik maddeleri ile ilgili çalışmalar yaparken de kullanılabilir.

- Bu konunun başlaması ile birlikte öğrencilerin kendilerinin bir araştırma sorusu oluşturması isteneceği için iyi bir araştırma sorusunun nasıl olması gerektiği ile ilgili bilgi verilir.

  İyi bir araştırma sorusunun özellikleri;

  1. Araştırma sorusu önemli olmalıdır: Problemin çözümü var olan bilgilerimize yeni bilgiler ekleyecek nitelikte olmalı, kafamızda yeni soru işaretleri oluşturacak ve bize bir sonraki araştırma adımına taşıyacak nitelikte olmalıdır.

  Not: Burada önemli olan saatlerce çalışılacak ve sizi yoracak önemsiz bir problem yerine daha akıllıca özellikli ve gerçekten çözümü sizde

zihinsel bir aydınlatma yaratacak bir problem üzerine gitmenizdir. Unutmayın yaptığınız işin kalitesini işin başında geçirdiğiniz saatler değil sonunda ulaştığınız sonuç belirler.

2. Araştırma sorusu o anki imkân ve şartlar dâhilinde araştırmaya uygun olmalıdır. Seçilen araştırma sorusu araştırmacının ekonomik ve zamanla ilgili sınırları içinde araştırılabilir ve sonuçlandırılabilir olmalıdır.

3. Araştırma sorusundaki değişkenlerin birbiriyle ilişkilerini araştırmalıdır. Burada anlatılmak isteyen mesela kaliteli bir sabun seçimi ile ilgili bir araştırma yaparken önümüze bir çok sabun kalitesini belirleyen faktörler ve değişkenler çıkar doğru değişkenleri belirlemek ve bunların birbirleri ile olan ilişkilerini ve sorunun çözümüne olan katkılarını iyi belirlemeliyiz.

4. Araştırılan araştırma sorusu açık ve net olmalı gerekirse araştırma sorusunda net olmayan kavram ve tanımlar açıklanmalıdır. Mesela kuru temizlemenin nasıl yapılacağını araştıran bir öğrencinin oradaki kuru kelimesinin su kullanılmadan yapılan temizlemeyi kastettiğini açıklaması gibi.

5. Araştırma sorusu etik olmalıdır. Araştırma sorusu düşünülürken bu araştırma sorusunun toplumdaki ahlaki değerleri dikkate alması, insan ilişkilerini zedelememesi veya herhangi bir zarar verici unsurunun bulunmaması gerekir.

❖ Kimya hikâyesi ile dersinizi yukarıdaki bağlam özelliklerini kullanarak işlerken öğrencileri araştırma soruları oluşturmalarına yardımcı olunuz. Öğrenciler tarafından bu bağlamı işlerken muhtemel olarak ortaya atılabilecek araştırma sorusu örnekleri:

- ✓ Çevreye zarar vermeyen sabunlar var mıdır?
- ✓ Siyah sabun var mıdır? Varsa ne işe yarar?
- ✓ Suda çözünmeyen sabunlar var mıdır?
- ✓ Deterjanlar çevreye nasıl zarar verir?

- ✓ Kuru temizleme nedir? Nasıl yapılır?
- ✓ Sabunlar ve deterjanlar arasındaki benzerlikler ve farklar nelerdir?
- ✓ Anti bakteriyel sabunlar gerçekten ne kadar etkililer?
- ✓ Sabunun kendisi renkli iken köpüğü neden beyazdır?
- ✓ Sabunlar baz ise PH değeri nötr olan sabunlar nasıl üretiliyor?

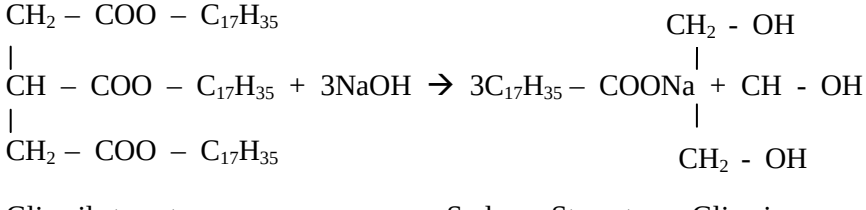
❖ Bu hafta dersi bağlamları kullanarak işlerken ihtiyaç duyulacak kimya bilgisi öğretmeni bilgilendirme amaçlı olarak aşağıda sunulmuştur. Sınıftaki tartışma ve araştırma sorularının bir kısmı hakkında öğretmene önceden bilgi vermeyi amaçlamaktadır.

➢ Sabunun kullanılmaya başlanması M.S. 200

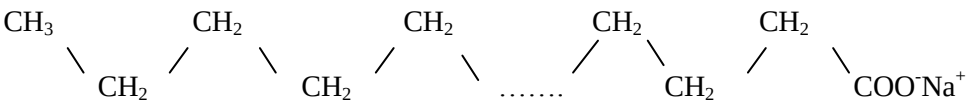
➢ Bilimsel olarak sabun üretimi 18. Yüzyılda gerekli formüllerin bulunmasından sonra başlamıştır.

➢ Yağların bazik ortamda hidrolizlenmesi sonucu oluşan uzun zincirli (C_{12}-C_{18}) karboksilli asitlerin sodyum ve potasyum tuzlarına sabun, bu olaya sabunlaşma denir.

Yağ + NaOH --> Sabun + Gliserin



Gliseril stearat (Yağ) — Sodyum Stearat (SABUN) — Gliserin



➢ Sert sabunlar Na tuzu yumuşak sabunlar K tuzudur.

- Suda çözünmeyen sert sabunlar aynı zamanda alüminyum, kalsiyum, magnezyum, baryum, lityum, çinko, kurşun, kobalt ve bakır gibi katyonların yağ asidi ile oluşturduğu tuzlardır.
- Yumuşak sabunlar suda sert sabunlara göre daha fazla çözündükleri için genellikle traş kreminde ve sıvı sabun yapımında kullanılır.
- Arap sabununda kullanılan sıvı yağlar keten, kenevir, karanfil ve balıktan çıkarılan yağlardır.
- Deterjanlarda polar uç genellikle sülfonik asit veya hidrojen sülfat grubudur.
    - Sülfonik asit – SO_2OH
    - Hidrojen sülfat – $O\text{-}SO_3H$
- Sabunun Yapısı
    1. Yağlar: Sabun yapımında kullanılan organik yağ asitlerinin en önemli olanları doğada serbest olarak bulunan 12, 14, 16 veya 18 karbon içeren yağ asitleridir. Karbon sayısı 18'den yüksek olan yağ asitlerinin çözünürlüğü az olduğu için sabun yapımında kullanılmazlar. Hayvansal veya Bitkisel yağlar kullanılabilir.
    2. Su: Sert sulardan yapılan sabundan verim alınmaz.
    3. Kireç: Yeni sistemlerde kireç yerine doğrudan sudkostik çözeltiler kullanıldığından kirecin önemi kalmamıştır.
    4. Tuz: Sabun çözeltisinde birikmiş sabunlar tuzla temizlenir. Kullanılacak tuzun kalitesi yüksek olmalıdır.
    5. KCl (Potasyum klorür) : Arap sabunu yapımında kullanılır. Tuz ile aynı işlevi görür.
    6. Silikatlar: Çamaşır sabunlarında verimi yükseltmek için kullanılır. Çünkü sodyum silikatın sabun gibi temizleme özelliği vardır. Arap sabununda potasyum silikat vardır.

7. Sodyum perborat: Sabun tozu yapımında kullanılır.
8. Talk: Sabun verimini artırmak için kullanılır.

- Kuru temizleme: Yağlı kirleri susuz ortamda benzin veya triklor etilen ile temizlemek mümkündür. Buna kuru temizleme denir.

- Sabunların istenmeyen etkisi sulardaki Ca^{2+} ve Mg^{2+} iyonlarının sabundaki Na^{+} ve K^{+} iyonlarıyla yer değiştirerek çökelek oluşturmasıdır. Deterjanlar bu iyonlarla çökelek vermez ve sert sularda bile temizleyici etkisini sürdürebilir.

- Deterjanlardaki benzen halkası mikroorganizma tarafından parçalanamaz. Oysa uzun hidrokarbon zincirleri parçalanabilir. Bu yüzden sabun daha az kirleticidir.

- Piyasada satılan deterjanlar sabun tozu yanında sentetik deterjanlar ve çoğu kez klor boraks gibi ağartıcılar da taşır.

- Çamaşır Sodası

  - Kimyasal adı Na_2CO_3 sodyum karbonattır.

  - Sodyum karbonat sularda sertlik yapan iyonları karbonat halinde çöktürüp ortamdan uzaklaştırdığı için sert sularda da rahatlıkla kullanılabilir.

  - Sodyum karbonat su ile hidroliz olarak sodyum hidroksit ve sodyum bikarbonat oluşturur.

$$Na_2CO_3 + H_2O \rightarrow NaOH + NaHCO_3$$

  - Sabunda olduğu gibi yağlar, bu NaOH ile hidrolizlenerek sabunlaşır ve çözünür hale gelir. Bu özelliğinden dolayı soda da yağı temizler. Yağ + NaOH → SABUN + GLISERIN

- Günlük hayatta kullandığımız temel temizlik malzemeleri ve yapısı

- *Sodyum hidroksit*, (lavabo açıcı) beyaz renkte nem çekici bir maddedir. NaOH formülüyle gösterilir. Suda kolaylıkla çözünür ve

yumuşak kaygan ve sabun hissi veren bir çözelti oluşturur. İnsan dokusuna kaşındırıcı bir etkisi vardır. Sodyum hidroksit (*kostik soda veya sudkostikte denir*), laboratuarda CO_2 gibi asidik gazları yakalamak için kullanılır. Endüstride birçok kimyasal maddenin yapımında, yapay ipek, sabun, kâğıt, boya, deterjan endüstrisinde ve petrol rafinelerinde kullanılır. Bir bazdır.

- *Hidroklorik asit*, hidrojen ve klor elementlerinden oluşan, oda sıcaklığı ve normal basınçta gaz halinde bulunan kimyasal bileşiktir. Halk arasında *tuz ruhu* olarak da bilinir. 9. yüzyılda Arap simyacı Cabir bin Hayyan tarafından keşfedildi ve simya alanında kullanılmıştır.

- *Çamaşır sodası*, beyaz çamaşırların yoğun veya asitli kirlerini eritmek için kullanılan *sodyum karbonat* (Na_2CO_3).

- *Çamaşır suyu*, kimyasal adı *sodyum hipoklorit* olan, temizlik ve sağlığa uygunluk amacıyla kullanılan kimyasal madde.

- *Sodyum hipoklorit*, (NaClO) bir tür tuzdur. Günlük hayatta beyazlatıcı çamaşır sularında kullanılmaktadır. Asidin canlı dokusu ile teması, canlı dokularında hasara yol açmaktadır. Çevreye büyük ölçüde zarar veren bu madde oda koşullarındaki klor ve sabunlardaki sodyum hidroksit ile birleşerek üretilmektedir. Bir sodyum hipokloritin elde edilme formülü aşağıdaki gibidir:

$$2NaOH + Cl_2 \rightarrow NaCl + NaClO + H_2O$$

APPENDIX E

ICE-BREAKER ACTIVITY

SABUN NASIL TEMİZLER?

1. 2 tane kavanoz alın, içlerini yarıya kadar su ile doldurun ve her ikisine de 2 damla gıda boyası ekleyin ve çalkalayın.

2. Üzerlerine bir miktar çiçek yağı (Mutfakta kullanılan bir başka yağda olabilir) ekleyin. (Kavanozları ileriki adımlarda sallayacağımız için kavanozları ağzına kadar doldurmamaya dikkat ediniz)

3. Kavanozlardan birine 2-3 damla sıvı sabun ekleyin, kavanozların kapağını kapattıktan sonra kavanozları 30 sn kadar çalkalayın.

4. Kavanozları karıştırdıktan sonra kısa bir süre beklemeye bırakın, içinde sıvı sabun olan kavanozun hala bir karışım halinde durduğunu ama içinde sabun olmayan kavanozda fazların belirginleştiğini göreceksiniz.

APPENDIX F

CHEMICAL STORYLINE 1
(Entrance Part)

KÖPÜK KÖPÜK SABUN

Her ne kadar ilk zamanlarda bugün bizim kullandığımız amaçla kullanılmasa da, sabunun öyküsü tarih öncesine kadar gidiyor. Nasıl keşfedildiğiyle ilgili pek çok öyküden en yaygın olanına göre, Eski Roma'da Sapo Dağı'nda hayvanlar kurban edildikten sonra, erimiş hayvan yağları ve odun külleri yağmurla birlikte Tiber Nehri'ne karışırmış. Nehrin kenarında çamaşır yıkayan kadınlar, bu suyun, çamaşırlarını daha az çabayla çok daha temiz yaptığını fark etmişler. Böylece hammaddesi kül ve yağ olan doğal sabun keşfedilmiş.

İlk sabun tarifi M.Ö. 2500 yılından kalma Sümer Yazıtları'nda yer alır. Bu yazıtlarda su, odun külü ve yağın karıştırılması, sonra da kaynatılıp eritilmesiyle bir tür sabun elde edildiği anlatılır. Ancak, bu sabun, saç biçimlendirmede ya da tıbbi amaçlarla kullanılıyormuş. Daha sonralarıysa çamaşır yıkamada kullanılmaya başlanmış. Vücut temizliği içinse, süt, kum, bazı yağlar ve çeşitli bitki yaprakları kullanılırmış.

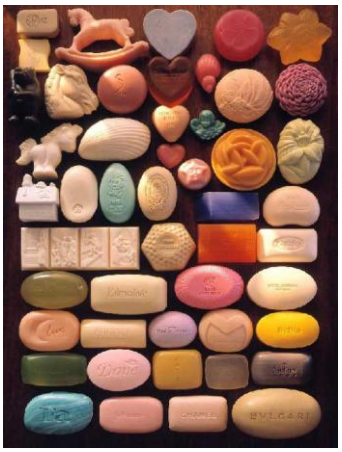
Sabunun vücut temizleme amacıyla kullanılması Romalılar dönemine rastlıyor. Ancak, hamamlarıyla ünlü Roma imparatorluğu'nun çöküşüyle insanların banyo alışkanlığı düşüyor. ……

APPENDIX G

CHEMICAL STORYLINE 2

(Entrance Part)

HANGİ SABUN EN İYİSİ



Anneniz sizi sabun almanız için markete gönderdi, marketten içeri girdiniz ve raflarda birçok markadan ve farklı fiyatlarda çok çeşitli sabunlarla karşılaştınız. Hangi sabunu alacağınıza nasıl karar verirsiniz? En iyi temizleyeni mi tercih edersiniz? Ellerinize en az zarar veren ve ellerinizi nemlendireni mi? Fiyat sizin için ne kadar önemli bir faktör? Sabunun büyüklüğü kararınızı almanızda ne kadar etkili olur?

En uygun kararı vermek…

En uygun kararı vermek için bazı adımları olan küçük bir araştırma yapalım. Öncelikle marketteki sabunları ve özelliklerini listeleyelim.

1. Sabunun Markası			
2. Fiyatı			
3. Hangi Ülkede Üretildiği			
4. Fiyatı			
5. Ağırlığı (gr) ……			

APPENDIX H

CHEMICAL STORYLINE 3

(Entrance Part)

EVİMİZDEKİ TEHLİKE

Haber Küpürü

Dokuz Eylül Üniversitesi Çevre Mühendisliği Bölümü Öğretim Üyesi Doç. Dr. Mustafa Odabaşı'nın yaptığı bir araştırma sonucu çamaşır suyu içeren temizlik ürünlerinin kanser yaptığı belirlendi. İlk kez bu araştırmayla ortaya çıkan sonuç "Environmental Science & Technology" isimli uluslararası bilimsel dergide de yayınlandı.

Doç. Dr. Odabaşı araştırmayla ilgili şunları söyledi: "Yapılan ön değerlendirmeler, çamaşır suyu içeren temizlik ürünlerinin kullanımıyla açığa çıkan karbon tetraklorür ve kloroform gibi maddeler kanser riskini önemli ölçüde arttırabileceğini göstermektedir. Bu tür temizlik maddelerini kullananlar (temizlik işinde çalışanlar ve ev kadınları) diğer insanlara göre çok daha fazla risk altında, ancak oluşan sağlık risklerinin daha detaylı olarak araştırılması gerekiyor." Odabaşı araştırma sonuçlarını şöyle değerlendirdi: "Piyasadaki çamaşır suyu içeren temizlik ürünlerinin sayısı gün geçtikçe artıyor. Katkısız, parfümlü, deterjan katkılı koyu kıvamlı sıvı, jel, ovma tozu, sprey gibi birçok ürün ……..

APPENDIX I

CHEMICAL STORYLINE 4
(Entrance Part)

SUYA SABUNA DOKUNMADAN TEMİZLENENLER

Eminiz ki, hepiniz temiz çocuklarsınız. Banyo yapıyor, her gün elinizi, yüzünüzü yıkıyor, dişlerinizi fırçalıyor ve saçlarınızı tarıyorsunuz. Peki, tüm bunlar için ne kadar zaman harcıyorsunuz? Pek çok hayvan, temiz kalmak için sizden daha fazla zaman harcıyor. Ancak, onların temiz kalmak için kullandıkları yöntemler biraz daha farklı: Yalıyorlar, kaşıyorlar, küçük ısırıklar kullanıyorlar, sürtünüyorlar, yuvarlanıyorlar, çamur banyosu yapıyorlar. Onlar, temiz kalmak için insanlardan daha fazla zaman harcıyorlar. Çünkü temizlik onlar için yalnızca iyi görünmek değil, daha önemlisi yaşamlarını sürdürmek için gerekli. Yani, ölüm kalım meselesi!

Hayvanlarda temizlik ilk olarak kürk ve deriden başlar. Onların kürk ve derilerinin temizliği, yaşamlarını sürdürebilmeleri için önemli. Çünkü onlar, çevresel etkilerden yalnızca derileri ya da kürkleri sayesinde korunabiliyorlar.

Temizliğin Binbir Yolu

Deniz samuru, dünyadaki tüm hayvanlardan daha kalın bir kürke sahip. Kürkünün kalın olması, onun okyanusların dondurucu soğuklarında yaşamını sürdürmesini sağlıyor. Ancak kürkün sıcak tutması, temiz ve düzgün olmasına bağlı. İşte bu yüzden, deniz samuru ……..

APPENDIX J

STUDENT WORKBOOK (SAMPLE)

ÖĞRENCİ ÇALIŞMA KAĞITLARI

Adı ve Soyadı: **Sınıfı:** **Okulu:**

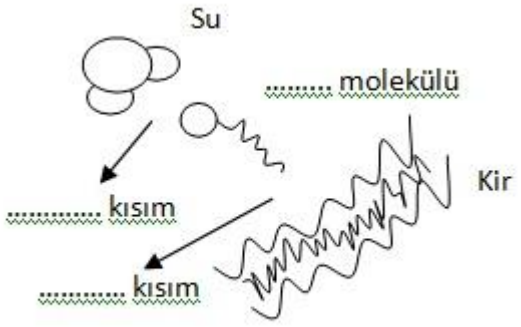
I. HAFTA

1. Aşağıdaki verilen tanımlar ile açıklamaları eşleştiriniz.

……arap sabunu yapımında kullanılır. ….sabun molekülünün suyu sevmeyen uzun hidrokarbon kısmıdır. ….. potasyum tuzudur. …….yağların bazik ortamda hidrolizlenmesi sonucunda oluşan uzun zincirli karboksilli asitlerin sodyum veya potasyum tuzlarına denir. …..kalsiyum ve magnezyum iyonları	1. Sabun 2. Yumuşak Sabunlar 3. Sert Sabunlar 4. Talk 5. Potasyum klorür 6. Kirler 7. Hidrofil 8. Hidrofob 9. Deterjanlar

ile çökelek vermediği için sert sularda bile etkilidirler. ….. sodyum tuzudur. ….sabun molekülünün suyu çeken karboksilli baş kısmıdır. …..genellikle yağ ve benzeri apolar organik maddeleri içerirler. …..sabunun verimini artırmak için kullanılır.	

2. Aşağıdaki şekilde hidrofil ve hidrofob olan kısımları altına yazınız.



3. Aşağıdaki ifadelerden doğru olanların başına yıldız (✧) işareti koyunuz.

…… Çamaşır sodasının kimyasal adı sodyum karbonattır (Na_2CO_3).

…… Suda çözünmeyen sabunlarda vardır.

……Sabunlar çevreye deterjanlardan fazla zarar verdiği için deterjanlar yaygın olarak kullanılmaya başlanmıştır.

…..Deterjanların içindeki yüzey aktif maddeler deterjanların çevreye zararlarından sorumludurlar.

…..Kirler polar yapıdadır.

…..Arap sabunu çevreye en zararlı olan sabunlardan biridir.

4. Aşağıdaki soruları yanıtlayınız

a) Deterjanlar ve sabunlar arasındaki temel farklar nelerdir?

b) Çamaşır yıkadığımız suyun sertliği ve kullandığımız deterjan miktarı arasında bir ilişki var mıdır?

c) Sabunlar kirleri nasıl çıkartır?

APPENDIX K

INQUIRY PLAN (SAMPLE)

ARAŞTIRMA PLANI

Adı ve Soyadı: **Yaş:** **Sınıf:** **Cinsiyet:**

Araştırma Planım

I. HAFTA

Araştırma probleminizi belirlemeniz. Öğretmen ve sınıf arkadaşlarınızla birlikte araştırma problemleriniz üzerinde tartışmanız.

II. HAFTA

I. Bölüm Araştırma sorusu

1. Araştırma sorum (varsa alt soruları ile birlikte):

2. Araştırma sorunuzda tanımlanması gereken terimler veya kavramlar nelerdir? Her birini teker teker tanımlayınız.

3. Araştırma sorum bana ve çevreme zarar verecek unsurlar içermez çünkü…

4. Araştırma sorum için planladığım araştırma basamakları ve zamana göre dağılımı;

- ❖ Görev dağılımı yapınız ve herkesin görevlerini ayrıntılı bir şekilde yazınız.
- ❖ Araştırdığınız kaynakları belirtiniz.
- ❖ Araştırmanız okul dışından birileri ile görüşmenizi gerektiriyorsa lütfen fotoğraf çekiniz ve görüşme planını ve amacını da bu plana ekleyiniz.
- ❖ Lütfen araştırma yaparken yaşadığınız farklı tecrübeleri de plana yazarak paylaşınız

I. Hafta	
II. Hafta	
III. Hafta	
IV. Hafta	

APPENDIX L

POSTER EVALUATION FORM

POSTER/SUNUM DEĞERLENDİRME FORMU

POSTER/SUNUM DEĞERLENDİRME FORMU						
	Zayıf	Orta	İyi	Çok İyi	Mükemmel	
1. Araştırma sorusu önemli mi?	1	2	3	4	5	
2. Araştırma sorusu gerekli zaman ve maddi imkânlar dâhilinde araştırılabilmiş mi?	1	2	3	4	5	
3. Araştırma raporu veya posteri araştırma ile ilgili bilgileri yeterince yansıtıyor mu?	1	2	3	4	5	
4. Posterinde ya da raporunda kullandığı kavramları doğru tanımlamış mı?	1	2	3	4	5	
5. Posterinde ya da raporunda kullandığı kavramları anlamış mı?	1	2	3	4	5	
6. Posterinde ya da raporunda kullandığı kavramlarla ilgili örnekler vermiş mi?	1	2	3	4	5	
7. Posterinde ya da raporunda kullandığı kavramlar arasındaki ilişkilerin farkında mı?	1	2	3	4	5	
8. Poster ya da rapor da düzen ve imla kurallarına dikkat etmiş mi?	1	2	3	4	5	

9. Araştırmayı sonuçlandırabilmiş mi?	1	2	3	4	5	
10. Posterindeki ya da raporundaki araştırmayı etkili bir şekilde sunabildi mi?	1	2	3	4	5	
					Toplam	

APPENDIX M

CLASSROOM OBSERVATION CHECK LIST

SINIF GÖZLEM FORMU

Olaylar	Gerçekleşti	Kısmen Gerçekleşti	Gerçekleşmedi
Kimya hikayeleri öğrencilerin ilgisini uyandırdı mı?			
Kimya hikayeleri öğrencilere bağlamlar içinde kimya kavramlarını tartıştırabiliyor mu?			
Kimya hikayesinde verilen bağlam konunun öğretimi için uygun mu?			
Öğrenciler aktif bir şekilde tartışma yapabiliyorlar mı?			
Öğrenciler çalışma kağıtlarındaki etkinlikleri yapmışlar mı?			
Öğrenciler derse ilgili görünüyorlar mı?			
Ders öğrenci merkezli olarak mı işleniyor?			
Öğretmen tartışmaları yönlendiriyor mu?			

APPENDIX N

FOCUS GROUP QUESTIONS

ODAK GRUP SORULARI

1. Dersin işlenişi ile ilgili ne düşünüyorsunuz?

   Beğendiyseniz:

   - Dersin işlenişinde neler farklıydı?
   - Kimya hikayeleri ile ilgili ne düşünüyorsunuz?

     Hangisini veya hangilerini beğendiniz?
   - Sizin merak ettiğiniz konumuzla ilgili bir kimya sorusunu araştırmak sizi nasıl etkiledi?

   Beğenmediyseniz:

   - Beğenmemenizin nedenleri ne olabilir?
   - Sizce daha başarı bir ders tasarımı için nasıl yapılmalıydı?

2. Dersin bu şekilde işlenmesi sizi çalışma ve ders motivasyonunuzu artırdı mı?

   Artırdıysa:

   - Motivasyonunuzun artmasındaki etkenler nelerdir?

3. Kendi merak ettiğiniz bir araştırma sorusunu araştırmanız ve bununla ilgili poster hazırlayıp sunmanız istendi.

- Araştırma sorunuzu araştırabildiniz mi?

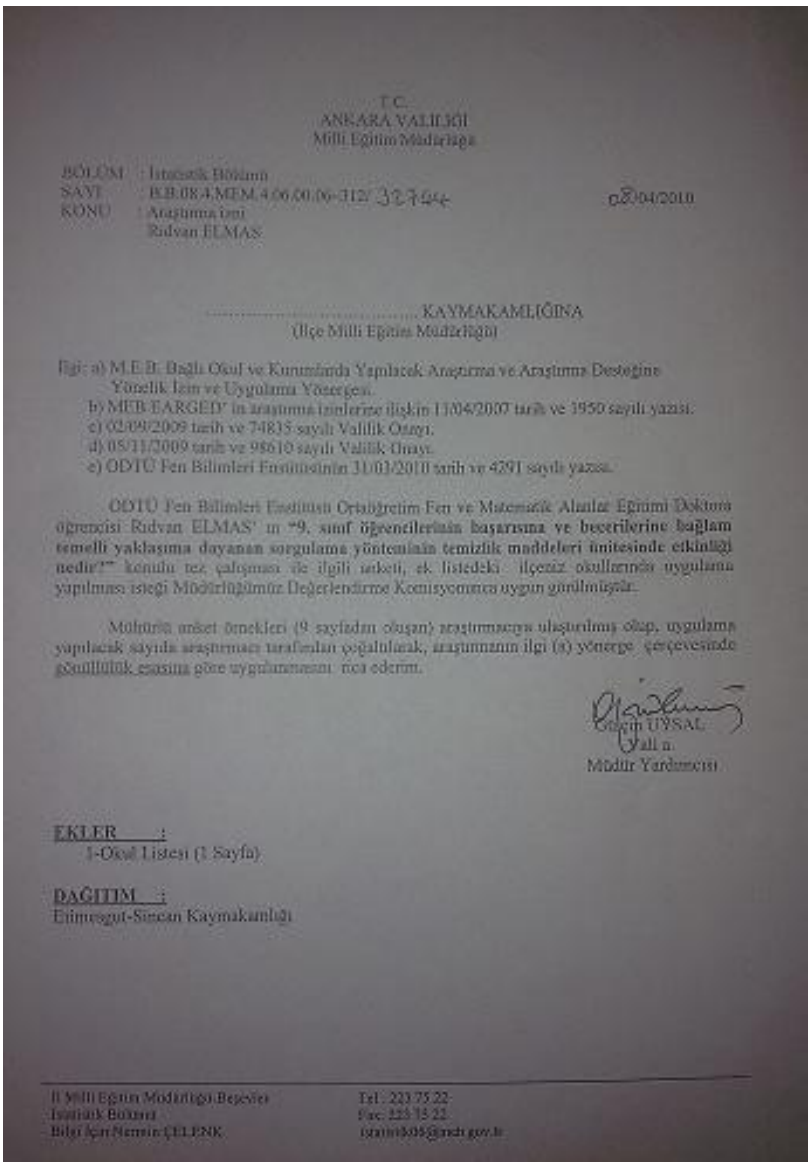
  Araştırma sorusunu araştırırken keyif aldınız ve motive oldunuz mu?

- Poster hazırlamak sizce keyifli oldu mu?

  Poster hazırlarken ne gibi zorluklarla karşılaştınız?

APPENDIX O

PERMISION FROM MONE



T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

BÖLÜM : İstatistik Bölümü
SAYI : B.08.4.MEM.4.06.00.06-312/ 32704 08/04/2010
KONU : Araştırma İzni
Rıdvan ELMAS

.....KAYMAKAMLIĞINA
(İlçe Milli Eğitim Müdürlüğü)

İlgi: a) M.E.B. Bağlı Okul ve Kurumlarda Yapılacak Araştırma ve Araştırma Desteğine Yönelik İzin ve Uygulama Yönergesi.
b) MEB EARGED' in araştırma izinlerine ilişkin 13/04/2007 tarih ve 1950 sayılı yazısı.
c) 02/09/2009 tarih ve 74815 sayılı Valilik Onayı.
d) 05/11/2009 tarih ve 98610 sayılı Valilik Onayı.
e) ODTÜ Fen Bilimleri Enstitüsünün 31/03/2010 tarih ve 4291 sayılı yazısı.

ODTÜ Fen Bilimleri Enstitüsü Ortaöğretim Fen ve Matematik Alanlar Eğitimi Doktora öğrencisi Rıdvan ELMAS' ın **"9. sınıf öğrencilerinin başarısına ve becerilerine bağlam temelli yaklaşıma dayanan sorgulama yönteminin temizlik maddeleri ünitesinde etkinliği nedir?"** konulu tez çalışması ile ilgili istekli, ek listedeki ilçeniz okullarında uygulama yapılması isteği Müdürlüğümüz Değerlendirme Komisyonunca uygun görülmüştür.

Mahiirün emekleri (9 sayfadan oluşan) araştırmacıya ulaştırılmış olup, uygulama yapılacak sayıda araştırmacı tarafından çoğaltılarak, araştırmanın ilgi (a) yönerge çerçevesinde gönüllülük esasına göre uygulanmasını rica ederim.

Özgür UYSAL
Vali a.
Müdür Yardımcısı

EKLER :
1-Okul Listesi (1 Sayfa)

DAĞITIM :
Etimesgut-Sincan Kaymakamlığı

İl Milli Eğitim Müdürlüğü Beşevler
İstatistik Bölümü
Bilgi İşl. Memuru ÇELENK

Tel: 223 75 22
Fax: 223 75 22
istatistik06@meb.gov.tr

APPENDIX P

CURRICULUM VITAE

PERSONEL INFORMATION

Surname, Name: Elmas, Rıdvan
Nationality: Turkish (TC)
E-mail: relmas@gmail.com

EDUCATION

Degree	Institution	Year of Graduation
MS	100. Yıl University	2004
BS	100. Yıl University	2004
High School	Balıkesir Sırrı Yırcalı Anatolian High School	1998

WORK EXPERIENCE

Year	Place	Enrollment
2006 -2011	Middle East Technical University	Research Assistant
2005-2006	Middle East Technical University	Student Assistant
2004-2005	100. Yıl University, Faculty of Medicine	Graduate Student

PUBLICATIONS

Articles

- ✓ Elmas, R., & Geban, O (2012). 21. Yüzyıl Öğretmenleri için web 2.0 araçları- "Web 2.0 tools for 21st century teachers", International Online Journal of Educational Sciences, 4(1), 243-254.

- ✓ Elmas, R., Demirdogen, B., & Geban, O. (2011). Pre-service Chemistry Teachers' Images about Science Teaching in Their Future Classrooms, Hacettepe University Journal of Education, 40, 164-175.

Conference Papers

- ✓ Akın, F., Elmas, R., & Geban, O. (2012). Emerging the Trends in Chemistry Questions: Ask a Scientist Website. 22nd International Conference on Chemistry Education & 11th European Conference on Research in Chemical Education (ICCE/ECRICE), 15-20 Temmuz, Roma, İtalya. (Oral Presentation)

- ✓ Elmas, R., Bulbul, M. S., & Eryilmaz, A. (2011). "Thematic Classification of Eligible Contexts for a Holistic Perspective in Curriculum Development" European Science Education Research Association (ESERA), Lyon, France. (Proceeding)

- ✓ Savas, M., Elmas, R., & Ozturk, N. (2011). "A Curriculum Reflection: New Science and Technology Curriculum in Turkey" European Science Education Research Association (ESERA), Lyon, France. (Proceeding)

- ✓ Ozturk, N., Elmas, R., & Savas, M. (2011). "Private School Elementary Teachers' Reflections on New Science and Technology Curriculum" International Conference on New Trends in Education and Their Implications (ICONTE), Antalya, Turkey. (Proceeding)

- ✓ İpekcioglu, S., Elmas, R., Geban, O., & Yesilyurt, H. (2011). "Effectiveness of Conceptual Change Instruction on Fluid Force Topic" International Technology, Education and Development Conference (INTED), Valencia, Spain. (Proceeding)

- ✓ İpekcioglu, S., Elmas, R., Geban, O., Dogruoz, P., & Ertepinar, H. (2010). "Effectiveness of Problem Solving Oriented Instruction on Fluid Force Topic" International Conference on Education and Educational Psychology (ICEEPSY), Kyrenia, Cyprus. (Oral Presentation)

- ✓ İpekcioglu, S., Elmas, R., Geban, O., & Gunay, B. (2010). "Effect of Conceptual Change Instruction on Understanding of Atoms and Molecules Topic" International Conference on Education and Educational Psychology (ICEEPSY), Kyrenia, Cyprus. (Oral Presentation)

- ✓ Elmas, R. & Geban, O. (2010). "High School Chemistry Teachers' Views Related to the New Chemistry Curriculum" XIV World Congress of Comparative Education Societies (WCCES), Istanbul, Turkey. (Oral Presentation)

- ✓ Elmas, R. & Demirdogen, B. (2009). "Investigating Pre service Chemistry Teachers' Mental Images about Science Teaching" The European Conference on Educational Research (ECER), Vienna, Austria. (Oral Presentation)

- ✓ Elmas, R. & Pilot, A. (2009). "Exploring the Design Principles of Context Based Chemistry Education in Turkish High Schools", European Science Education Research Association Conference (ESERA), Istanbul, Turkey. (Interactive Poster Presentation)

- ✓ Elmas, R., Demirdogen, B., & Geban, O. (2008). "A Content Analysis of 6th and 7th Grade Science and Technology Textbook and 10th Grade Chemistry Textbook about Environmental Issues" 13th World Council for Curriculum and Instruction Conference (WCCI), Antalya, Turkey. (Oral Presentation)

- ✓ Demirdogen, B., Elmas R. & Uzuntiryaki E. (2007). "An Analysis of Two 10th Grade Chemistry Textbooks On The Topic of Gases and Evaluating Them By Using Concept Maps", International Organisation for Science and Technology Education (IOSTE) Conference, Hammamet, Tunisia. (Oral Presentation)