EFFECT OF ANALOGY- ENHANCED INSTRUCTION ACCOMPONIED WITH CONCEPT MAPS ON UNDERSTANDING OF ACID-BASE CONCEPT

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Approval of the Graduate School of Department of Natural and Applied Sciences.

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ABSTRACT

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This study was conducted to explore the effectiveness of analogy-enhanced instruction accompanied with concept maps over traditionally designed chemistry introduction on understanding of acid-base concept and attitude toward chemistry as a school subject.

81 8th grade students from two classes of a chemistry course taught by the same teacher in Nuh Eskiyapan Primary School in Ankara in 2003-2004 fall semesters were enrolled in the study.

There were two groups of students. During the treatment, students in the control group were instructed only with traditionally designed instruction. Students in the experimental group studied with the analogy-enhanced instruction accompanied with concept maps through teacher lecture. Both groups were administered Acid-Base Chemistry Achievement Test and Attitude Scale toward Chemistry as a School Subject as pre-tests and post-tests. Logical Thinking Ability Test was given to both groups at the beginning of the study to determine students' logical thinking ability levels.

Research data were analyzed by using (SPSS 12.0) ANCOVA and t-test. As a result of the research, it was obviously seen that analogy-enhanced instruction accompanied with concept maps caused a significantly better acquisition of scientific conception related to acid-base and produced significantly higher positive attitudes toward chemistry as a school subject than the traditionally designed chemistry instruction.

KEYWORDS: Analogy, Attitude toward Science as a School Subject, Logical Thinking Ability, Concept Mapping, Acid-Base

ÖZ

KAVRAM HARİTASI DESTEKLİ BENZETİM YÖNTEMİ İLE ÖĞRETİMİN ÖĞRENCİLERİN ASİT-BAZ KONUSUNU ANLAMALARINA ETKİSİ

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Bu çalışma, kavram haritası destekli benzetim yöntemi ile öğretimin öğrencilerin asit-baz konusunu anlamalarına ve kimya dersine karşı olan tutumlarını incelemek ve geleneksel yöntemle karşılaştırmak için yapılmıştır.

2003-2004 döneminde, Nuh Eskiyapan İlköğretim Okulunda aynı öğretmenin sorumlu olduğu iki ayrı 8. sınıftan toplam 81 öğrenci bu çalışmaya katılmıştır.

Tez çalışması süresince kontrol grubunda sadece geleneksel öğretim yöntemi buna karşılık deney grubundaki öğrencilerde ise kavram haritası destekli benzetim yöntemi ile öğretim tekniği kullanılmıştır. Her iki gruba da ön test ve son test olarak Asit-Baz Başarı Testi ve Fen Bilgisi Dersi Tutum Ölçeği uygulanmıştır. Mantıksal Düşünme Yeteneği Testi çalışmanın başında iki gruba da mantıksal düşünme düzeylerini ölçmek için verilmiştir.

Araştırma verilerinin analizi, bilgisayar ortamında "SPSS 12.0 FOR WINDOWS" kullanılarak ve t-testi ve Ortak Değişkenli Varyans Analizi (ANCOVA) yardımıyla yapılmıştır.Araştırma sonunda kavram haritası destekli benzetim yöntemi ile öğretimin, geleneksel öğretim yöntemine göre bilimsel kavramların anlaşılmasında daha etkili olduğu ve Fen bilgisine karşı daha olumlu tutum oluşturduğu gözlenmiştir.

ANAHTAR KELİMELER: Benzetim, Fen Bilgisi Dersi Tutum Ölçeği, Mantıksal Düşünme Yeteneği, Kavram Haritası, Asit-Baz

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LIST OF SYMBOLS

LTAT	: Logical Thinking Ability Test
AEI	: Analogy – Enhanced Instruction
TDCI	: Traditionally Designed Chemistry Instruction
ASTC	: Attitude Scale toward Chemistry as a School Subject
ABCAT	: Acid- Base Concept Achievement Test
df	: Degrees of freedom
SS	: Sum of squares
MS	: Mean square
n	: Sample size
X	: Mean of the sample
P, α	: Significance level
F	: F statistic

CHAPTER 1

INTRODUCTION

A currently supported view of learning is that, when students construct their own knowledge, it is both transferable to, and usable in later learning situations. A significant factor enabling teachers to create conditions where this type of learning occurs is related to teachers' subject matter understanding. Of special importance is the teacher's content-specific pedagogical knowledge of the central topics in each subject and the teacher's ability to transform the content knowledge for teaching (Shulman, 1986).

One aspect of this content–specific pedagogical knowledge is the use of analogies which can effectively communicate science concepts to students. Since students often lack the background to learn difficult and unfamiliar concepts in biology, chemistry and physics an effective way to deal with this problem is for the teacher to provide an analogical bridge between the unfamiliar concept and the knowledge which students possess. Analogies allow new material, especially abstract concepts, to be more easily assimilated with students' prior knowledge, enabling them to develop a more scientific understanding of the concept (Treagust, Harrison and Venville, 1998).

Analogy is being increasingly recognized as an important component in the teaching–learning mechanism pertaining to science. It played a key role in the historical development of scientific knowledge (Hesse, J. J., Anderson, W.C. 1992). It appears to be powerful tools for science learning in schools. Several approaches exist for using analogies in teaching. (Parida, Goswami, 2004). There are some studies of instructional analogies as used by authors in textbooks (Thiele and Treagust 1995) and teachers in classrooms (Treagust, 1989). And mole-concept in chemistry (Gabel and Sherwood 1984). Studies of the effect of analogies on pupil achievement are, however, not many (Parida, Goswami, 2004).

Analogical reasonings can be used to overcome learning difficulties and have a lot of advantages. These are,

- Provide a bridge between prior knowledge and new information

- Help students learning by providing visualization of abstract concepts (Treagust, Harrison and Venville, 1998)

- Motive students in subject-matter

- Encourage teachers to take students' prior knowledge into consideration.

With these advantages, analogies can be applied to many branches of chemistry. The purpose of this study is to investigate the effects of analogy-enhanced instruction accompanied with concepts maps on understanding of acid-base chemistry.

Such applications will be helpful for both teachers and students to teach and learn acid-base chemistry.

CHAPTER 2

REVIEW OF LITERATURE

In this chapter theoretical bases of the present study will be explained and related studies done will be reviewed. It seems logical to begin revision with the learning and cognitive structure to develop effective learning activities.

Constructivist theory describes learning as an active, continuous process in that learners take information from the enviroment and construct personal interpretation and meaning based on prior knowledge and experience (Driver &Bell, 1986).

According to constructivist theory effective learning takes place when the learner makes meaning out of the required knowledge. For new knowledge to be understood and remembered, it must be meaningful to the learner (Bruner, 1986). Meaningfulness depends on the learner's success in finding or creating connections between new information and pre-existing knowledge one way by which these connections are made is through the use of analogies (Pitman, 1997). And also learning is a kind of inquiry. It is concerned with ideas, their structure and the evidence for them. It is a process of conceptual change it concerns how students' conceptions change under the impact of new ideas and new evidence.

Inquiry and learning occur against the background of the learner's current concepts. The learner uses his current concepts to organize his investigation when he encounters a new phenomenon (Posner et al., 1982). Because of learning is a cyclic process, first new information is compared to prior knowledge. Then it is feedback into some knowledge base. During instruction the learner generates his own meaning based on his background, attitude, ability and experience (Nakleh, 1992).

All these principles have been shown that one of the factors affecting students' learning is their existing knowledge and connection between new information and pre-existing knowledge. The purpose of this study is to assess the effectiveness of analogy–enhanced instruction accompanied with concept map. On this ground, we shall examine the existing relevant literature dealing with the important variables (e.g. analogy, concept map, acid-base chemistry) that the present study has done in order to find out the importance of them.

2.1 Analogy

Analogical reasoning based on analogy occupies a pivotal position in human cognition. General lexical meaning of term analogy is: an agreement or correspondence in certain respects between things otherwise different; a resemblance of relations'. An analogy is basically a mapping mechanism which helps a learner construct new knowledge on the basis of his/ her prior knowledge in our mental frameworks and thought processes analogies play a great role, either explicitly or implicitly. We often use them in our understanding of unfamiliar facts and phenomena, in grasping abstract ideas, in creative thinking and in communicating our ideas to others (Parida, Goswami, 2004).

Today, the use of analogies in science teaching is an instructional strategy that is often taken for granted. Generally, analogies function by explicitly comparing to domains are often referred to as the base (the familiar domain from which the comparison is initiated) and the target (the unfamiliar to be explained) (Mastrilli, 1997). Also Glynn (1991) called unfamiliar science concept as target but the familiar concept is called the analog.

As Duit (1991) stated analogies are believed to help student learning by providing visualization of abstract concepts, by helping compare similarities between objects or events in the students' world and the phenomenon under discussion. Analogies can be motivational in that, as the teacher uses ideas from the students' real world experience, a sense of intrinsic interest is generated. Also Bilgin and Geban(2001) stated that analogies are more effective on the students with lower thinking ability.

Teachers' analogies exhibit a rich variety of form and content (Dagher, 1995). From a teaching perspective, the use of analogies can enhance conceptual change learning since they open new perspectives (Tregaust, Harrison, Venville 1998). In their study Parida and Goswami (2004) mentioned about the usefulness of analogy. They stated that analogies are abundantly used in textbooks as well as in classroom as an aid to the teaching-learning process. Some teachers also like to generate analogies spontaneously in order to facilitate student's perception and understanding. Pittman (1997) explained that analogies can play a control role in the restructuring of students' conceptual frameworks. Successful analogies are systematic, include multiple mappings and utilise relational thinking (Gentner & Medina, 1998).

Analogies have limitations as well as great virtues. These limitations are mentioned is many studies. Gilbert (1989) said that sometimes analogies have facilitated text learning, and other times they have not. It is argued that this inconsistency is due largely to weak operational definitions of analogies, to constructions of analogies that have failed to map analog features systematically onto target features, and to analogies that have largely ignored the important role that visual imagery can play in the learning process (Glynn, Takahashi 1998). According to Gaswami and Parida (2004) analogies need to be handled with care or else they may mislead the learners and make the learning ineffective. Improper usage of analogies can lead to undesirable learner effects like alternative conceptions or misconceptions. Learner at school level are particularly susceptible to such effects. Also Gabel and Sherwood (1980) emphasized that if students lack visual imagery, analogical reasoning may be limited. Students already functioning at a formal operational level may have an adequate under standing of the target and the inclusion of an analogy might add unnecessary information or “noise” (Johnstone & Al- Naeme, 1991). Unshared attributes between analog and target are often a cause of misunderstanding for learners who attempt to transfer or map unshared attributes from the analog shares all its attributes with the target, or by definition, it would become an example; therefore every analogy breaks down somewhere (Treagust , Harrison and Veniville 1998).

With these advantages and disadvanteges analogy is studied in acid-base chemistry.

2.2 Research on Analogy-Enhanced Instruction in Acid-Base Chemistry

One of the analogy studies is done by Kramer (1986). He used "bricklayer analogy". In this analogy the students are given the description of three different bricklayers. Than he asked to the students to rank these bricklayers in order of inherent brick laying ability. After mentioning average jobs for a day, he asked them "what kind of bricklayer is the bricklayer who needs to do more? and what kind of bricklayer is bricklayer who do not need to the more even if they are able to do more?". By this time the students have caught on and answer. "A weak acid bricklayer!"

At the beginning of his study he found that the students have had difficulty understanding how a given solvent might "disguise" that difference for some acids and not for others. Thus, his general chemistry students have appreciated the following analogy of protons to bricks and seem to understand the concept of a leveling solvent better because of it.

Another analogy about acid-base concept is done by Last (2003). In this analogy, use is made of the practice of one well-known Canadian retail chain in returning to its customers a small percentage of an item's purchase price in the form of imitation bank notes that can subsequently be spent in the chain's stores. An analogy is drawn between this practice and the determination of the pK_a of a weak acid by titrating it with a strong base, taking into account the hydrolysis of the anion produced.

Like Last (2003), DeLorenzo (1995) also studied on acid –base titrations. He employed with "a dating analogy". He has used a combination of expanded dimensional analysis and dating analogies to alleviate this

confusion. Many students have trouble calculating titration problems quickly in chemistry classes. DeLorenzo gives a few tips for how two answer a titration problem example. In his dating analogy, he considered two dormitories, one for male students and one for female students. The concentration of men in the dorm for males is one man per room, and there are four rooms of women in the dorm for females. The following balanced equation tells that exactly one man (M) reacts with one women (W) to become a dating pair (MW) in much the same way that are gram equivalent of acid reacts with exactly one gram equivalent weight of base. He said that he has used this combination of dimensional analysis and dating analogy with his general chemistry classes for many years. The students have found that it gives them a better grasp of these titration problems.

In chemistry there are a number of a phenomena that are the net result of competition between two chemical species. Felty (1985) studied about Bronsted-Lowry acid-base reaction. During his studies he used “competition analogy”. In his analogies fluorine is analogous to the top-ranked football team in the league (assuming that such rankings are an accurate ordering with respect to ability).

When playing the second –ranked team (oxygen), there is stiff competition with little scoring because the two teams are rather closely matched. The top-ranked team eventually triumphs, but by a slim margin, say, by a score of 7 to 3. Then he considered the game between the same second–ranked team and the tenth–ranked team (hydrogen). In football as in bonding, both the winner and the margin of victory depend a greater deal on one’s competitor.

In literature football analogy is not used only Felty (1985) but also Silverstein used “football analogy” to explain weak and strong acid-base. In

his study, he said that partial ionization is a difficult concept for some to comprehend; the phrase may not evoke much in the mind of a “visual learner”. Visual analogies are often helpful when difficulties like these arise. Hence in his analogy he liken an acid, which is a proton donor, to a quarterback. The quarterback is a football “donor”, whose job is to deliver the ball by either passing it to a receiver or handing it off to a running back. With all the details of analogy he added that a similar analogy may be drawn between a base and a wide receiver. Also in another study, Silverstein (1999) used the "big dog-puppy dog" analogy. In this analogy, puppy dogs are restricted to a specific dog run; they represent □-bond electron pairs. Big dogs are allowed to roam freely over several consecutive dog runs; they represent delocalized □-bond electron pairs. By adding a bunny rabbit who is chased by the big dog, the analogy can be expanded to account for delocalized formal charge in a resonance hybrid.

2.3 Concept Maps

A concept map is a diagram consisting of nodes that represent concepts and labeled lines that indicate the relationship between those concepts. The combination of two nodes and a labeled line is called a proposition. In the concept maps, the notes are circles with words indicating the name of the concept (Robinson, 1999).

From Dorough and Rye (1997) point of views, concept maps are diagrams constructed to represent an individual’s understanding of a particular topic or area. These maps typically have a hierarchical structure, working downward from general to more specific ideas with appropriate relationship linkages along the way.

This hierarchical structure of concept map is also studied by Ausubel (1968) according to his theory, cognitive structure is organized hierarchically, the most new learning occurs through derivative or correlative subsumption of new concept meanings under existing concepts/prepositional ideas. Also in the study of Pendley, Bretz and Novak (1994) they said that hierarchical structures of concepts and prepositions and convenient and concise representations of knowledge. In their paper, besides the structure of concept map, they mentioned which problems can be overcome by the help of concept map. The problems are

1) students are learning predominantly by rote, rather than actively seeking to construct their own meanings for the subject matter;

2) the chemistry subject matter remains largely "conceptual opaque" to students, and they do not recognize the key concept relationships needed to understand the subject matter; and

3) The instruction may fail to present these key concept or concept relationship and thus remains "conceptually opaque" to the students.

Using concept map as a tool to assess learninng in chemistry also has some advantages;

- by using concept maps, the students can see the structure of the subject

- the students can learn how to learn easily

- the students can organize and understand new subject matter by the help of concept map

- the students can divide into categorizes and subcategorizes so that it can be remembered and retrieved easily

- the students think actively and motivate themselves in the construction of concept map

- teacher becomes more effective by using concept maps

- concept maps help students learn meaningfully

- concept map can be seen as a fun activity by the student

In spite of these advantages concept maps have some disadvantages: There may be problem in teaching students how to use the technique, in convincing students to accept the strategy or engaging them in the strategy. Complex concept maps may confuse students due to the many lines and connections. Constructing and evaluating concept maps may be time consuming process for teachers who have limited teaching time. However all these advantages may be overcome by training and practice (Ebenzer,1992).

It can be said that the main difference of the present study when compared to the other related studies is due to the instruction effect on understanding of acid-base concept. There is no study investigating the effectiveness of analogy –enhanced instruction accompanied with concept map in acid-base chemistry generally and in detail.

CHAPTER 3

PROBLEMS AND HYPOTHESES

In this chapter, the main problem, subproblems and hypotheses are presented.

3.1 The Main Problem and Subproblems

3.1.1 The Main Problem

The main purpose of this study was to investigate the effectiveness of analogy-enhanced instruction accompanied with concept maps through teacher lecture over traditionally designed instruction on 8 th grade students' understanding of acid –base concept and attitudes toward chemistry as a school subject.

3.1.2 The Subproblems

1) Is there a significant difference between analogy-enhanced instruction accompanied with concept maps through the instruction (TDCI) on students' an understanding of acid – base concept, when the effects of students' logical thinking ability are controlled as a covariate?

2) What is the effect of students' logical thinking ability on understanding of acid-base concept?

3) Is there a significant difference between the effects of analogy-enhanced instruction accompanied with concept maps through the instructor lecture and TDCI on students' attitudes toward science as a school subject?

3.2. Hypotheses

H_o 1: There is no significant difference between post-test mean scores of the students taught with analogy-enhanced instruction and those taught with respect to acid-base concept achievement when the students' logical thinking ability controlled.

H_o 2: There is no significant contribution of students 'logical thinking ability to the variation in their achievement related to the acid - base concept.

H_o 3: There is no significant difference between the post-test mean scores of the students receiving analogy-enhanced instruction and those receiving TDCI with respect to attitudes towards chemistry as a school subject.

CHAPTER 4

DESIGN OF THE STUDY

In this section, the experimental design, subjects, variables, instruments, treatment, the assumptions and the limitations are discussed.

4.1 The Experimental Design

Table 4.1. Research design of the study

Groups	Pre-test	treatment	Post-test
EG	ABCAT ASTC LTAT	AEI	ABCAT ASTC
CG	ABCAT ASTC LTAT	TDCI	ABCAT ASTC

In Table 4.1., EG represents the experimental group instructed by analogy-enhanced instruction accompanied with concept maps through teacher lecture. CG represents the control group instructed by traditionally designed chemistry instruction.

ABCAT is the Acid-Base Chemistry Achievement Test. ASTC is the Attitude Scale towards Chemistry as a school subject.

AEI represents Analogy-Enhanced Instruction. TDCI is the Traditionally Designed Chemistry Instruction. LTAT represents Logical Thinking Ability Test.

The two instrument (ABCAT and ASTC) were administered to students in both groups to determine the effect of treatment on the dependent variables and to control students' previous learning in acid-base chemistry concepts and attitudes toward chemistry before treatment. Also these two instruments (ABCAT and ASTC) were administered at the beginning of the study to control students' logical thinking ability levels.

4.2 Subjects of the Study

This study consisted of 81, 8 th grade students from two classes of science course taught by the same teacher. Two instruction methods used in study were randomly assigned to groups.

The data analyzed for this research were taken from 42 students participating in Analogy-Enhanced Instruction and 39 students participating in the traditionally chemistry instruction.

4.3 Variables

The variables are classified as dependent and independent variables.

4.3.1 Independent Variables

In this study, two different types of treatments (AEI and TDCI) were independent variables. LTAT was also independent variable was taken to determine the students' logical thinking ability.

4.3.2 Dependent Variables

Students' understanding of acid-base concept measured by ABCAT and their attitudes towards chemistry as a school subject measured by ASTC were dependent variables.

4.4 Instruments

4.4.1 Acid – Base Chemistry Achievement Test (ABCAT)

This test was developed by the researcher. The test consisted of 20 multiple-choice questions. The content of the test was prepared from the lesson curriculum. Each question had one correct answer and three distracters. The items were related acid-base concept. Some distracters contained common misconceptions which were assigned in literature.

During the constructional stage of the test, the instructional objectives of the acid-base unit were determined to find out if the students achieved to behavioral objectives of the course and the study.

The test was controlled by a group of experts in science and chemistry education and by the course teacher for the appropriateness of the items. The reliability of the test which was given both CG and EG at the beginning of the treatment as a pre-test and at the end of the lesson as a post–test was found 0.72 (See Appendix A)

4.4.2 Attitude Scale toward Science as a School Subject (ASTC)

Attitude Scale toward Chemistry as a school subject was developed previously (Geban et al. 1992) was used to measure students' attitudes.

This scale consisted of 15 item in 5 point likert type scale (fully agree, agree undecided, partially agree, fully disagree).The reliability was found to be 0.83. This test was given before and after treatment both groups (see Appendix B)

4.4.3 Logical Thinking Ability Test (LTAT)

This test was developed by Tobin and Capie (1981). It was translated and adopted into Turkish by Geban et al. (1992). It consists of 10 items. The reliability of the test was found to be 0.81 (see Appendix C)

4.5 Treatment (AEI vs TDCI)

This study was conducted over three weeks in the 2003-2004 fall semester at Nuh Eskiyapan Primary School. 81 8th grade students in two general science classes of the same teacher were enrolled in the study.

There were two groups of student; control and experimental group. Both groups were administered ABCAT, ASTC, and LTAT as a pre-test at the beginning of the treatment.

In the control group, the teacher instructed traditionally. During the instruction he only used lecture and discussion methods.

The experimental group was thought by using analogy-enhanced instruction. At the beginning of the treatment students were given all details of analog (see Appendix D). The analog was about three imaginary countries from chemistry planet and the football match between them. These countries were Asitanya, Bazikistan and Tuzikistan. Asitanya (see Appendix D fig.2). was a country stated at the skirts of a volcano. It was famous with its fruits garden. Neighbourhood was well-developed and people were fanatics of football. The National Football Team had red uniforms. The second country was named as Bazikistan(see Appendix D.fig.3). Bazikistan was surrounded with blue oceans and huge icebergs. Skiing and football were the most popular hobies. The neighbourhood was as sincere as in Asitanya. Their National Football Teams had blue uniform. All supporters cheered except one who was the shiest supporter(see Appendix D fig.4).. There had been competition between these countries for a long time. Because of this competition they hated each other. To prevent hooligans from giving harm TuMeFa Commission(see Appendix D fig.7). was charged. TuMeFa Commission grouped the supporters according to their nationalities and placed them in the stadium. But there were some couples who were in love one from Asitanya and the other from Bazikistan. And they were looking for a country to live happily. Tuzikistan (see Appendix D fig.5). was the country looked for. These in-loved couples could immigrate to Tuzikistan only when they abonded all their properties except their neighbourhood. They chose to immigrate to Tuzikistan with tears in their eyes. But the shiest supporter of Bazikistan left his country without any tear. This was the Kimyavole's breaking-news (see Appendix D fig.6) about the immigration.

The analogies were used for these targets respectively:

- Chemistry Planet : Chemistry,
- Asitanya : Acids,
- Bazikistan : Bases,
- Tuzikistan : Salts,
- Skirts of the Volcano : Used to remind students that acisds affect to metals as heat did,
- Fruit Gardens : Acidity of fruits,
- Neighbourhood : Conductivity of acid base and salt solutions
- Red Uniform :Change the colors of litmus paper to red,
- Blue Uniform :Change the colors of litmus paper to blue,
- Blue Ocean :used to confirm to effect of bases to litmus paper
- Huge Icebergs :used to remind students that
- bases affect to metals as cold did,
- Skiing :Slippery characteristics of bases,
- The shiest supporter :NH_3 not contaning OH^- groups,
- TuMeFa Commission :the word was composed of letters of common indicators' Turkish names (litmus paper, methyl orange, phenolphataline),
- Couples in-love : Acid and base which react with eachother,
- Abandonment all properties :used for loosing of acidic and basic properties after reaction,
- Tears :used for water comes out after acid base reaction,

- Breaking news about the shiest supporter:refers to the reaction of NH3 at the end of which no water comes out.

The teacher also emphasized common misconceptions by asking questions. At the end of the period they were given concept map with only questions on arrows about acid-base concept and asked to fill in the boxes.

After the treatment, both groups were administered ABCAT and ASTC as a post test to determine students' understanding of acid-base concept and attitudes towards chemistry as a school subject.

4.6 Analysis of Data

ANCOVA was used to investigate the effectiveness of two different instructional methods on the achievement related to acid-base concept.

Logical thinking ability was accepted as a covariant. Independent t-test statistics was used to determine the difference between the post – scale mean scores of the students taught by AEI and taught by TDCI with respect to their attitudes toward chemistry as a school subject.

4.7 Assumptions and Limitations

4.7.1 Assumptions

- Students in one group did not interact with the students in the other group.

- The teacher was not biased during the treatments.

- The tests were administered under standard conditions.

- The subjects answered the questions in the instruments sincerely.

4.7.2 Limitations

- This study was limited to 8 th grade students from Nuh Eskiyapan Primary School during 2003-2004 fall semester.

- This study was limited to only 81 students.

- This study was limited to the unit of “acid-base”.

CHAPTER 5

RESULT AND CONCLUSIONS

Result obtained through testing each of the hypothesis stated earlier are presented in this chapter. The hypotheses are tested at a significant level of 0.005. ANCOVA and t-test was used to test hypotheses. In this study, statistical analyses were carried out by using the SPSS 12.0

5.1 RESULT

In order to identify the relative performances of the students' previous learning in the acid-base concept, prior attitude toward science as a school subjects were administered three pre-tests that were LTAT, ASCT, and ABCAT.

The result showed that there was no significance differences between AEI group and TDCI group in terms of acid-base concept achievement (AEI : X=4.33, sd=2.49 ; TDCI: X=5.61, sd=3.07, t=0.38 $p \geq 0.005$) ;attitudes towards chemistry as a school subject (AEI : X= 52.04, sd=10.98 ; TDCI : X= 58.15 , sd= 9.86 , t= 0.096 , $p \geq 0.05$) ; and Logical Thinking Ability Test (AEI: X= 2,69 , sd = 1.45 ; TDCI : X= 2, 33 , sd= 1.43 , t= 0.87, $p \geq 0.05$).

Hypothesis 1:

To answer the question posed by hypothesis 1 stating that there is no significance difference between the post test mean scores of the students taught by AEI and taught by TDCI with respect to achievement related to acid-base concept analysis of covariance was used , by controlling the effect of students ' logical thinking ability . The measures obtained are present in Table 5.1.

Table 5.1. ANCOVA summary (Achievement)

Source	df	SS	MS	F	p
Covariate (LTAT)	1	126.056	126.056	12.823	0.001
Treatment	1	601.496	601.496	61.189	0.000
Error	78	766.752	9.830		

The result showed that there was a significant difference between the post-test mean scores of the students taught by AEI and those taught by TDCI with respect to the achievement related to acid-base concept. AEI group scored significantly higher than TDCI group (X (AEI) = 12.16, X (TDCI) = 6.35.

As a result ,the students in the experimental group instructed by AEI understood acid-base concept better than the students in the control group instructed by TDCI.

Hypothesis 2:

To answer the question posed by hypothesis 2 stating that there is no significant contribution of Logical Thinking Ability to the variation in students' achievement related to acid-base concept, analysis of covariance was used.

Table 5.1. also represent the contribution of logical thinking ability to the achievement. The F Value was significant (F=12,823 p=0,001). Logical Thinking made a significant contribution to the variation in achievement.

Hypothesis 3:

To answer the question posed by hypothesis 3 stating that there is no significant difference between post-test mean scores of the students who received AEI and those who received TDCI with respect to attitudes toward chemistry as a school subject, t-test was used. The measures obtained are given in Table 5.2.

Table 5.2. The Analysis of Data for Group Comparison with Respect to Attitude Scale toward Chemistry as a School Subject (ASTC) Results.

Group	N	X	S	df	t-value	P
AEI	42	62.16	8.59	42	1.87	.000
TDSI	39	58.43	9.58			

The results showed that there was a significance difference between the mean scores of the students taught by AEI and those taught by TDCI with respect to the ASTC scores. The AEI group showed more positive attitude.

5.2. Conclusions

The following conclusions can be deduced from the results:

1. The AEI caused a significantly better acquisition of scientific conceptions related to acid-base concept than the TDCI.

2. The AEI produced significantly higher positive attitudes toward chemistry as a school subject than the TDCI.

3. Logical thinking ability was a strong predictor for the achievement related to acid-base concepts.

CHAPTER 6

DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

6.1 Discussion

The main purpose of this study was to compare effects of analogy-enhanced instruction accompanied with concept maps and traditionally designed chemistry instruction on 8th grade students' understanding of acid-base chemistry and attitudes toward chemistry as a school subject.

In the light of the result obtained by analyses, it may be concluded that the analogy–enhanced instruction accompanied with concept maps caused a significantly better acquisition of acid-base concept than the traditionally designed instruction. This finding support the findings of Roletto, Regis and Albertazzi (1996) Robinson, (1999); Wilson and Stensvold, (1992); Novak, Bendly and Bretz (1994); Silverstein, (2000); Felty, (1985); Kramer, (1986); De Lorenzo, (1995) Parida nad Goswami, (2004); Mastrilli, (1987); Pitman, (1998); Treagust, Harrison and Venville, (1998) and Glynn and Takahashi, (1997) that analogy–enhanced instruction and concept mapping were more effective when compared to tradionally designed teaching method.

In this study, the analogy was used in order to make a meaningful connection between familiar knowledge of students and unfamiliar acid-base concept, to activate students' prior knowledge. On the other hand tradionally designed instruction did not provide a bridge between pre-existing and knowledge. Thus tradionally designed instruction did not help students learn by providing visualization of abstract concepts, by helping compare similarities of the students real world with the new concepts. It may be concluded that a reason for the poor progress of the students in traditionally designed chemistry instruction to acquire acid-base concept lies with the poor connection between unfamiliar and familiar knowledge. The analogy–enhanced instruction required students to be active thinkers by encouraging them to motivate in this subject.

The other technique to organize and learn all detail of subject used in this study was concept, features mapping. The distinctions among target concept features of the concept, examples of the concept and an analogy become blurred in students' minds. To overcome these difficulties concept mapping were designed and used to caused students learn in meaningful way.

In both strategies in this study, there was interaction between the teacher and students. While using analogy the teacher emphasized similarities and paid attention to students having difficulties with understanding analogy. It made teacher more active than in traditional methods.

Moreover, after treatment attitudes of both groups towards acid-base concept changed positively but statistically analogy–enhanced instruction produced more positive attitudes.

On the other hand student may have scan the concept maps a scientific game. These may have produced more positive attitude toward acid-base concept as a school subject.

The main purpose of chemistry education is to teach chemistry concept in a meaningful and enjoyable way. The analogy–enhanced instruction can be integrated into school system in the manner argued earlier.

6.2. Implications

Result of the present study had some implications for science teachers, curriculum planners and the researchers who deal with science education program in Turkey The findings of the present study have the following implications:

Science teacher should have a knowledge of students' prior knowledge They should examine how student learn to develop teaching methods which eliminate learning difficulties.

Analogy can be used in science class. It is effective technique to understand related concepts.

Concept maps can be used for many purposes and at many stages of learning process effectively. They can cause a better acquisition of scientific conceptions.

Science teachers become more effective if they use analogy–enhanced instruction.

Science teachers must be informed about the usage and importance of analogy–enhanced instruction.

Science teacher must be warned about the weak points of analogy.

Logical thinking ability is a strong predictor of science achievement. The science teacher must realize that difficulties in comprehending material requiring the use of this reasoning pattern is strongly related with logical thinking ability. In the light of this realization teacher can adjust their teaching strategies to help students.

6.3 Recommendations

On the basis of findings from this study, the researcher recommends that:

A study can be conducted with different age and grade groups.

Similar research studies can be conducted with different chemistry subject.

The sample size can be increased for further studies to obtain more accurate results.

The instructional time using the analogy and concept mapping can be increased.

A study can be conducted to assess the effectiveness of analogy–enhanced instruction and traditionally designed instruction and traditionally designed instruction as compared with the other instructional methods.

Computer Assisted Instruction can be used to teach the scientific concept in such a way that the analogy is applied.

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APPENDIX A

ACID-BASE CHEMISTRY ACHIEVEMENT TEST

Ad-Soyadı :

Sınıfı:

No:

ASİTLER, BAZLAR, TUZLAR VE ÖZELLİKLERİ

Sevgili öğrenciler ,

Bu test sizin asitler ,bazlar , tuzlar ve özellikleri konusundaki başarınızı ölçmek için hazırlanmıştır. Soruları dikkatlice okuyarak cevaplandırınız. Doğru seçeneği cevap anahtarına işaretleyiniz.

1) Aşağıdakilerden hangisi asit özelliği göstermez?
   a) sabunlu su
   b) limon suyu
   c) mide öz suyu
   d) sirke

2) Aşağıdaki maddelerden hangileri baz özelliği gösterir?
   I. alkol çözeltisi
   II. çamaşır suyu
   III. kireç suyu
   IV. sabunlu su

a) II , III b) II , IV , III c) II , IV d) I , II , III

3) Aşağıdaki maddelerden hangisi sulu çözeltilerine H iyonu verir?
   a) HCl
   b) NH3
   c) KOH
   d) NaOH

4) Aşağıdakilerden hangisi kırmızı turnusol kağıdını maviye çevirir?
   a) CH3COOH
   b) C2H3O2
   c) Mg (OH)2
   d) HCl

5) Aşağıdakilerden hangisinin sulu çözeltisi elektriği iletmez?
   a) sülfürik asit
   b) şeker
   c) tuz
   d) sodyum hidroksit

6) Verilen karışımlardan hangileri elektriği iletir?
   I. şekerli su
   II. mandalina suyu
   III.kolonya
   IV. sirkeli su

a) II , III b) I , III c) I , IV d) II , IV

7) saf su içine aşağıdakilerden hangisi konulursa ampul ışık verir?
   a) Alkol
   b) Şeker
   c) Tuz

d) saf su

8) Verilen üç kapta asit , baz ve tuz çözeltileri bulunmaktadır. Hangisinin asit , hangisinin baz , hangisinin tuz olduğunu anlamak için verilen işlemlerden hangisini veya hangilerini uygulamak gerekir?

I. çözeltilere sırayla mavi turnusol batırmak
II. elektriği iletip iletmediğine bakmak
III. renksiz fenol ftalein damlatmak

a) II , III b) I , III c) I , II d) I , II , III

9) Aşağıdaki çözeltilerden hangisi mavi turnusol kağıdına etki eder?

a) kalsiyum hidroksit
b) potasyum hidroksit
c) amonyak
d) nitrik asit

10) $KOH + HCl \rightarrow KCl + H_2O$ Tepkimesi ile ilgili olarak hangisi yanlıştır?

a) KCl kırmızı turnusolu maviye çevirir.
b) asit baz tepkimesidir.
c) KOH ın tadı acıdır.
d) HCl nin tadı ekşidir.

11) Aşağıda verilen özelliklerden hangisi tuzlu su , asit ve bazların ortak özelliğidir?

a) çözeltisine fenol ftalein damlatılınca pembe renk vermesi.
b) Ametal oksitlerle tepkime vermesi.
c) Turnusol kağıdına etki etmesi.
d) Elektriği iletir.

12) Verilen madde çiftlerinden hangilerinin tepkimesi sonucu tuz ve su açığa çıkar.

a) NaOH – KCl
b) $Al(OH)_3$ – NH_3
c) NH_3 – HCl
d) CH_3COOH – HCl

13) Balık etinde bulunan aminler bazik maddelerdir. Bu nedenle balığın tadı hafif acımsıdır. Balığın taadındaki bu acılığı gidermek için aşağıdaklerden hangisinin yapılması uygundur?

a) yağ damlatmak
b) limon sıkmak
c) şeker atmak
d) tuz atmak

14) Mide ekşimelerine doktorların içeriğinde Ca(OH)2 bulunan ilaçlar önermesini aşağıdaki gerçeklerden hangisi ile izah edebiliriz?

a) $Ca(OH)_2$ mide yaralarına iyi gelir.
b) $Ca(OH)_2$ ile nötrleşme tepkimesi gerçekleşir.
c) $Ca(OH)_2$ midede indikatör etkisi yapar.
d) $Ca(OH)_2$ yiyeceklerden gelen metal artıklarla tepkimeye girer.

15) Asitlerle karıştırıldığında , asitlerin elektrik akımını iletme dışındaki tüm özelliklerini yok eden madde aşağıdakilerden hangisidir?

a) bazlar
b) ayıraçlar
c) tuzlar
d) çözeltiler

16)Aşağıdakilerden hangisi bazların ayıraçlarından biridir?

a) sodyum hidroksit
b) asetik asit
c) amonyak
d) fenol ftalein

17)Bir parça çinko metali aşağıdaki hangi çözeltinin içine atıldığında H2 gazı açığa çıkmaz?

a) CH_3COOH
b) H_2SO_4
c) HNO_3
d) NH_3

18)içinde sıvı bulunan kaba çinko metali atıldığında çıkan gaz yandığına göre , sıvı ve gaz sırasıyla nedir?

a) baz , oksijen
b) asit , oksijen
c) baz , hidrojen
d) asit , karbondioksit

19)Birinde asit , diğerinde amonyak bulunan iki şişe ağzı açık olarak yan yana bırakıldıklarında , asit şişesinin ağzında oluşan pamuk görünüşündeki katı madde nedir?

a) baz
b) tuz
c) kireç taşı
d) asit buharı

20) $Mg + 2HCl \rightarrow MgCl_2 + H$ verilen tepkimede maddelerin neler oldukları sırasıyla hangi şıkta doğru olarak verilmiştir?

a) Metal , baz , metal tuzu , gaz
b) Metal , asit , metal tuzu , gaz
c) Ametal , baz , tuz , gaz
d) Ametal , asit , tuz , gaz

APPENDIX B

FEN BİLGİSİ DERSİ TUTUM ÖLÇEĞİ

Açıklama: Bu ölçek, Fen Bilgisi dersine ilişkin tutum cümleleri ile her cümlenin karşısında; TAMAMEN KATILIYORUM, KATILIYORUM, KARARSIZIM, KATILMIYORUM, ve HİÇ KATILMIYORUM olmak üzere beş seçenek verilmiştir. Her cümleyi dikkatle okuduktan sonra kendinize uygun seçeneği işaretleyiniz.

		Tamamen katılıyorum	katılıyorum	karasızım	katılmıoyrum	Hiç katılmıyorum
1	**Fen Bilgisi çok sevdiğim bir alandır.**					
2	**Fen Bilgisi ile ,ilgili kitapları okumaktan hoşlanırım.**					
3	**Fen Bilgisinin günlük yaşantıda çok önemli yeri yoktur.**					
4	**Fen Bilgisi ile ilgili ders problemlerini çözmekten hoşlanırım**					
5	**Fen Bilgisi konularıyla ilgili daha çok şey öğrenmek isterim.**					
6	**Fen Bilgisi dersine girerken sıkıntı duyarım.**					
7	**Fen Bilgisi derslerine zevkle girerim**					
8	**Fen Bilgisi derslerine ayrılan ders saatinin daha fazla olmasını isterim.**					
9	**Fen Bilgisi dersine çalışırken canım sıkılır.**					
10	**Fen Bilgisi konularını ilgilendiren günlük olaylar hakkında daha fazla bilgi edinmek isterim.**					
11	**Düşünce sistemimizi geliştimede Fen Bilgisi öğrenimi önemlidir.**					
12	**Fen Bilgisi Çevremizdeki doğal olayların daha iyi anlaşılmasında önemlidir.**					
13	**Dersler içinde Fen Bilgiis dersi sevimsiz gelir.**					
14	**Fen Bilgisi konuları ile ilgili tartışmaya katılmak bana cazip gelmez.**					
15	**Çalışma zamanımın önemli bir kısmını Fen Bilgisi dersine ayırmak isterim**					

APPENDIX C

MANTIKSAL DÜŞÜNME YETENEK TESTİ

AÇIKLAMA: Bu test, çeşitli alanlarda, özellikle Fen ve Matematik dallarında karşılaşabileceğiniz problemlerde neden-sonuç ilişkisini görüp, problem çözme stratejilerini ne derece kullanabileceğinizi göstermesi açısından çok faydalıdır. Bu test içindeki sorular mantıksal ve bilimsel olarak düşünmeyi gösterecek cevapları içermektedir.

NOT: Soru Kitapçığı üzerinde herhangi bir işlem yapmayınız ve cevaplarınızı yalnızca cevap kağıdına yazınız. CEVAP KAĞIDINI doldururken dikkat edilecek hususlardan birisi, 1 den 8 e kadar olan sorularda her soru için cevap kağıdında iki kutu bulunmaktadır. Soldaki ilk kutuya sizce sorunun uygun cevap şıkkını yazınız, ikinci kutucuğa yani AÇIKLAMASI yazılı kutucuğa ise o soruyla ilgili soru kitapçığındaki Açıklaması kısmındaki şıkları okuyarak sizce en uygun olanını seçiniz. Örneğin 12 ci sorunun cevabı sizce b ise ve Açıklaması kısmındaki en uygun açıklama ikinci şık ise cevap kağıdını aşağıdaki gibi doldurun:

12. | b | AÇIKLAMASI | 2 |

9 ve 10 uncu soruları ise soru kitapçığında bu sorularla ilgili kısımları okurken nasıl cevaplayacağınzı daha iyi anlayacaksınız.

SORU 1: Bir boyacı, aynı büyüklükteki altı odayı boyamak için dört kutu boya kullandığına göre sekiz kutu boya ile yine aynı büyüklükte kaç oda boyayabilir?

a. 7 oda

b. 8 oda

c. 9 oda

d. 10 oda

e. Hiçbiri

Açıklaması :

1. Oda sayısının boya kutusu sayısına oranı daima $\frac{3}{2}$ olacaktır.

2. Daha fazla boya kutusu ile fark azalabilir.

3. Oda sayısı ile boya kutusu sayısı arasındaki fark her zaman iki olacaktır.

4. Dört kutu boya ile fark iki olduğuna göre, altı kutu boya ile fark yine iki olacaktır.

5. Ne kadar çok boyaya ihtiyaç olduğunu tahmin etmek mümkün değildir.

SORU 2: Onbir odayı boyamak için kaç kutu boya gerekir? (Birinci soruya bakınız)

a. 5 kutu

b. 7 kutu

c. 8 kutu

d. 9 kutu

e. Hiçbiri

Açıklaması :

1. Boya kutusu sayısının oda sayısına oranı daima $\frac{2}{3}$ dür.

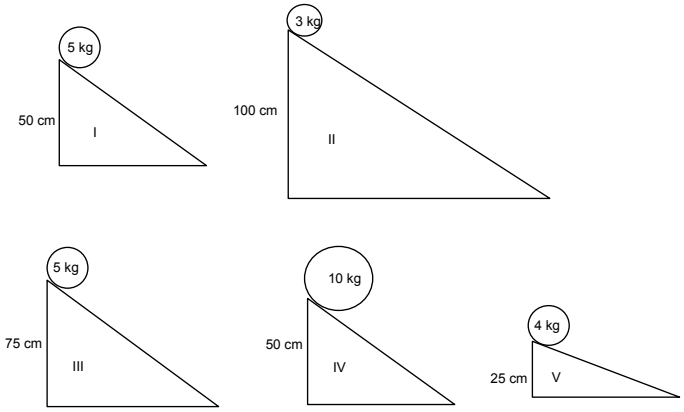
2. Eğer beş oda daha olsaydı, üç kutu boya daha gerekecekti

3. Oda sayısı ile boya kutusu arasındaki fark her zaman iki dir.

4. Boya kutusu sayısı oda sayısının yarısı olacaktır.

5. Boya miktarını tahmin etmek mümkün değildir.

SORU 3: Topun eğik bir düzlemden (rampa) aşağı yuvarlandıktan sonra katettiği mesafe ile eğik düzlemin yüksekliği arasındaki ilişkiyi bulmak için deney yapmak isterseniz, aşağıda gösterilen hangi eğik düzlem setlerini kullanırdınız?



a. I ve IV

b. II ve IV

c. I ve III

d. II ve V

e. hepsi

Açıklaması :

1. En yüksek eğik düzlemle (rampa) karşı en alçak olan karşılaştırılmalıdır.

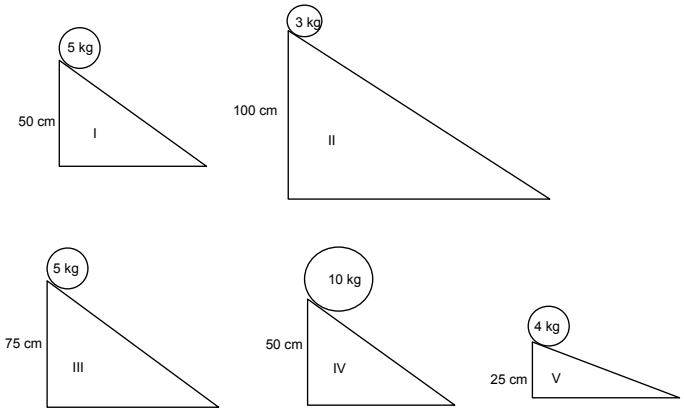
2. Tüm eğik düzlem setleri birbiriyle karşılaştırılmalıdır.

3. Yükseklik arttıkça topun ağırlığı azalmalıdır.

4. Yükseklikler aynı fakat top ağırlıkları farklı olmalıdır.

5. Yükseklikler farklı fakat top ağırlıkları aynı olmalıdır.

SORU 4: Tepeden yuvarlanan bir topun eğik düzlemden (rampa) aşağı yuvarlandıktan sonra katettiği mesafenin topun ağırlığıyla olan ilişkisini bulmak için bir deney yapmak isterseniz, aşağıda verilen hangi eğik düzlem setlerini kullanırdınız?



a. I ve IV
b. II ve IV
c. I ve III
d. II ve V
e. hepsi

Açıklaması :

1. En ağır olan top en hafif olanla kıyaslanmalıdır.
2. Tüm eğik düzlem setleri birbiriyle karşılaştırılmalıdır.
3. Topun ağırlığı arttıkça, yükseklik azaltılmalıdır.
4. Ağırlıklar farklı fakat yükseklikler aynı olmalıdır.
5. Ağırlıklar aynı fakat yükseklikler farklı olmalıdır.

SORU 5: Bir Amerika'lı turist Şark Expresi'nde altı kişinin bulunduğu bir kompartımana girer. Bu kişilerden üçü yalnızca İngilizce ve diğer üçü ise yalnızca Fransızca bilmektedir. Amerika'lının kompartımana ilk girdiğinde İngilizce bilen biriyle konuşma olasılığı nedir?

a. 2 de 1
b. 3 de 1
c. 4 de 1
d. 6 da 1
e. 6 da 4

Açıklaması :

1. Ardarda üç Fransızca bilen kişi çıkabildiği için dört seçim yapılması gerekir.
2. Mevcut altı kişi arasından İngilizce bilen bir kişi seçilmelidir.
3. Toplam üç İngilizce bilen kişiden sadece birinin seçilmesi yeterlidir.

4. Kompartımandakilerin yarısı İnglizce konuşur.

5. Altı kişi arasından, bir İngilizce bilen kişinin yanısıra, üç tanede Fransızca bilen kişi seçilebilir.

SORU 6: Üç altın, dört gümüş ve beş bakır para bir torbaya konulduktan sonra, dört altın, iki gümüş ve üç bakır yüzük de aynı torbaya konur. İlk denemede torbadan altın bir nesne çekme olasılığı nedir?

a. 2 de 1

b. 3 de 1

c. 7 de 1

d. 21 de 1

e. Yukarıdakilerden hiçbiri

Açıklaması :

1. Altın, gümüş ve bakırdan yapılan nesneler arasından bir altın nesne seçilmelidir.

2. Paraların $\frac{1}{4}$ ü ve yüzüklerin $\frac{4}{9}$ u altından yapılmıştır.

3. Torbadan çekilen nesnenin para veya yüzük olması önemli olmadığı için, toplam 7 altın nesneden bir tanesinin seçilmesi yeterlidir.

4. Toplam yirmibir nesneden bir altın nesne seçilmelidir.

5. Torbadaki 21 nesnenin 7 si altından yapılmıştır.

SORU 7: Altı yaşındaki Ahmet'in şeker almak için 50 lirası vardır. Bakkaldaki kapalı iki şeker kutusundan birinde 30 adet kırmızı ve 50 adet sarı renkte şeker bulunmaktadır. İkinci bir kutuda ise 20 adet kırmızı ve 30 adet sarı şeker vardır. Ahmet kırmızı şekerleri sevmektedir. Ahmet'in ikinci kutudan kırmızı şeker çekme olasılığı birinci kutuya göre daha fazla mıdır?

a. Evet

b. Hayır

Açıklaması :

1. Birinci kutuda 30, ikincisinde ise yalnızca 20 kırmızı şeker vardır.

2. Birinci kutuda 20 tane daha fazla sarı şeker, ikincisinde ise yalnıca 10 tane daha fazla sarı şeker vardır.

3. Birinci kutuda 50, ikincisinde ise yalnızca 30 sarı şeker vardır.

4. İkinci kutudaki kırmızı şekerlerin oranı daha fazladır.

5. Birinci kutuda daha fazla sayıda şeker vardır.

SORU 8: 7 büyük ve 21 tane küçük köpek şekli aşağıda verilmiştir. Bazı köpekler benekli bazıları ise beneksizdir. Büyük köpeklerin benekli olma olasılıkları küçük köpeklerden daha fazla mıdır?

a. Evet

b. Hayır

Açıklaması :

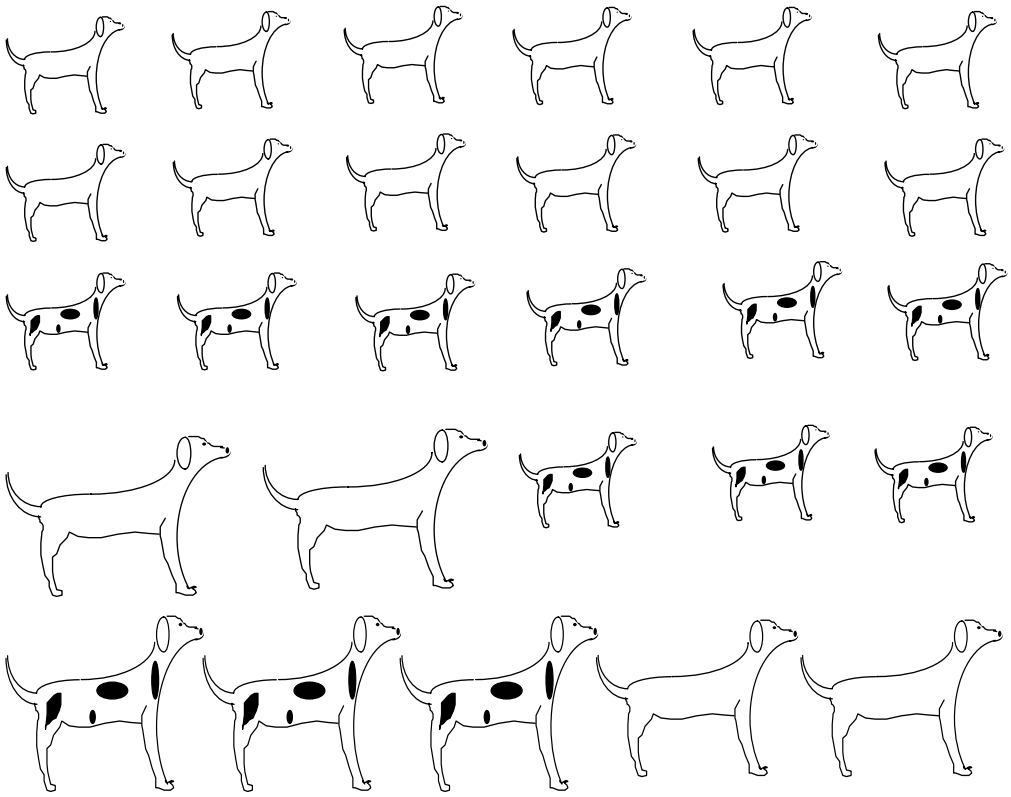
1. Bazı küçük köpeklerin ve bazı büyük köpeklerin benekleri vardır.

2. Dokuz tane küçük köpeğin ve yalnızca üç tane büyük köpeğin benekleri vardır.

3. 28 köpekten 12 tanesi benekli ve geriye kalan 16 tanesi beneksizdir.

4. Büyük köpeklerin $\frac{3}{7}$ si ve küçük köpeklerin $\frac{9}{21}$ i beneklidir.

5. Küçük köpeklerden 12 sinin, fakat büyük köpeklerden ise sadece 4 ünün beneği yoktur.



SORU 9: Bir pastanede üç çeşit ekmek, üç çeşit et ve üç çeşit sos kullanılarak sandviçler yapılmaktadır.

Ekmek Çeşitleri	Et Çeşitleri	Sos Çeşitleri
Buğday (B)	Salam (S)	Ketçap (K)
Çavdar (Ç)	Piliç (P)	Mayonez (M)
Yulaf (Y)	Hindi (H)	Tereyağı (T)

Herbir sandviç ekmek, et ve sos içermektedir. Yalnızca bir ekmek çeşidi, bir et çeşidi kullanılarak kaç çeşit sandviç hazırlanabilir?

Cevap kağıdı üzerinde bu soruyla ilgili bırakılan boşluklara bütün olası sandviç çeşitlerinin listesini çıkarın.

Cevap kağıdında gereksiniminizden fazla yer bırakılmıştır.

Listeyi hazırlarken ekmek, et ve sos çeşitlerinin yukarıda gösterilen kısaltılmış sembollerini kullanınız.

Örnek: BSK =Buğday, Salam, ve Ketçap dan yapılan sandviç

SORU 10: Bir otomobil yarışında Dodge (D), Chevrolet (C), Ford (F) ve Mercedes (M) marka dört araba yarışmaktadır. Seyircilerden biri arabaların yarışı bitiriş sırasının DCFM olacağını tahmin etmektedir. Arabaların diğer mümkün olan bütün yarışı bitirme sıralamalarını cevap kağıdında bu soruyla ilgili bırakılan boşluklara yazınız.

Cevap kağıdında gereksiniminizden fazla yer bırakılmıştır.

Bitirme sıralamalarını gösterirken, arabaların yukarıda gösterilen kısaltılmış sembollerini kullanınız.

Örnek: DCFM yarışı sırasıyla önce Dodge'nin, sonra Chevrolet'in, sonra Ford'un ve en sonra Mercedes'in bitirdiğini gösterir.

APPENDIX D

Figure D. 1.

APPENDIX D

Figure D.2.

APPENDIX D

BAZİKİSTAN

MAVİ OKYANUSLARIN
BUZULLARLA BİRLEŞTİĞİ
YERDEKİ MUHTEŞEM ÜLKE.

EN BÜYÜK
İKİ HOBİLERİ

- KAYAK
- FUTBOL

İLETİŞİMDE ASİTANYADAN GERİ KALMAYAN GELİŞMİŞ BİR ÜLKE

Figure D.3.

APPENDIX D

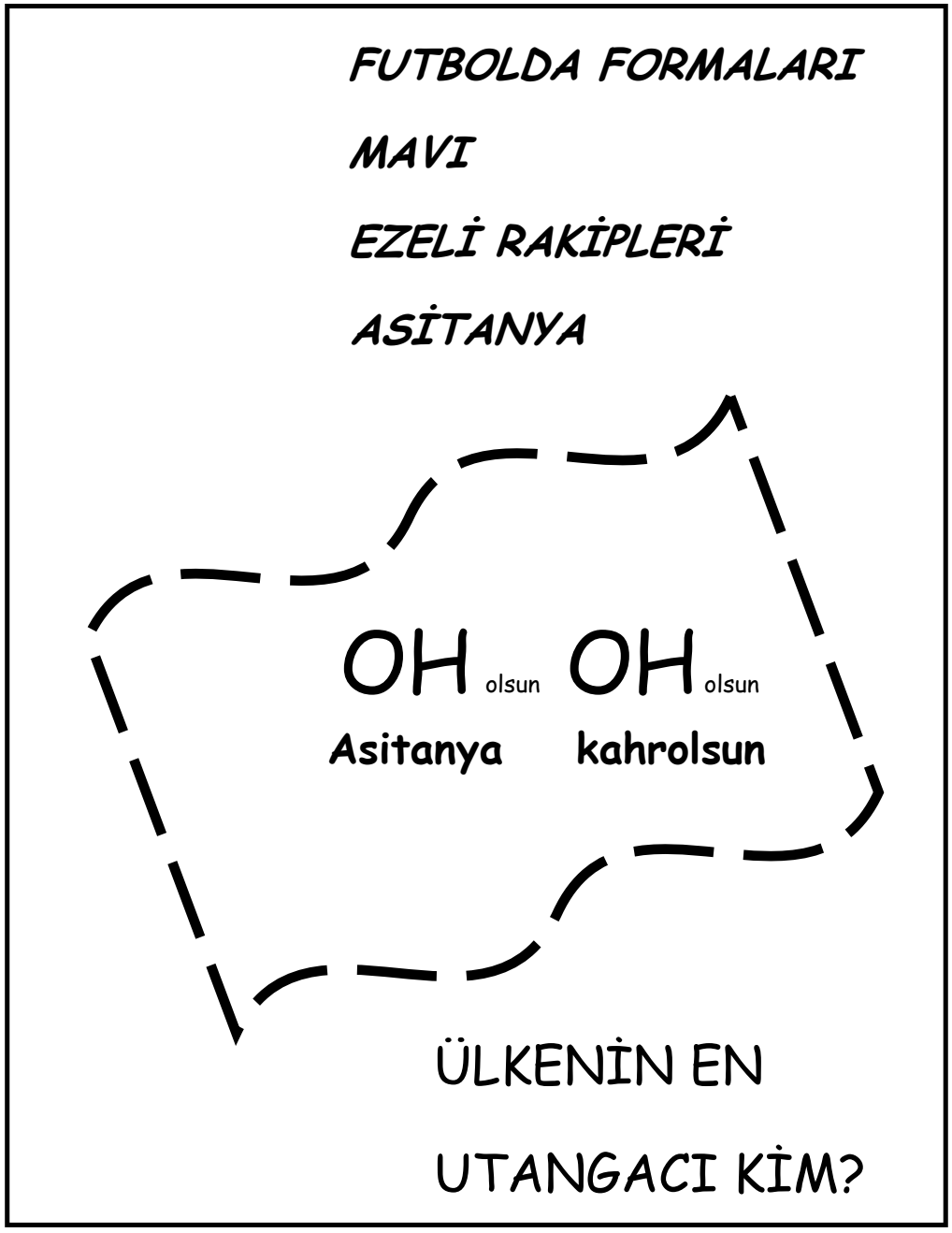


Figure D.4.

APPENDIX D

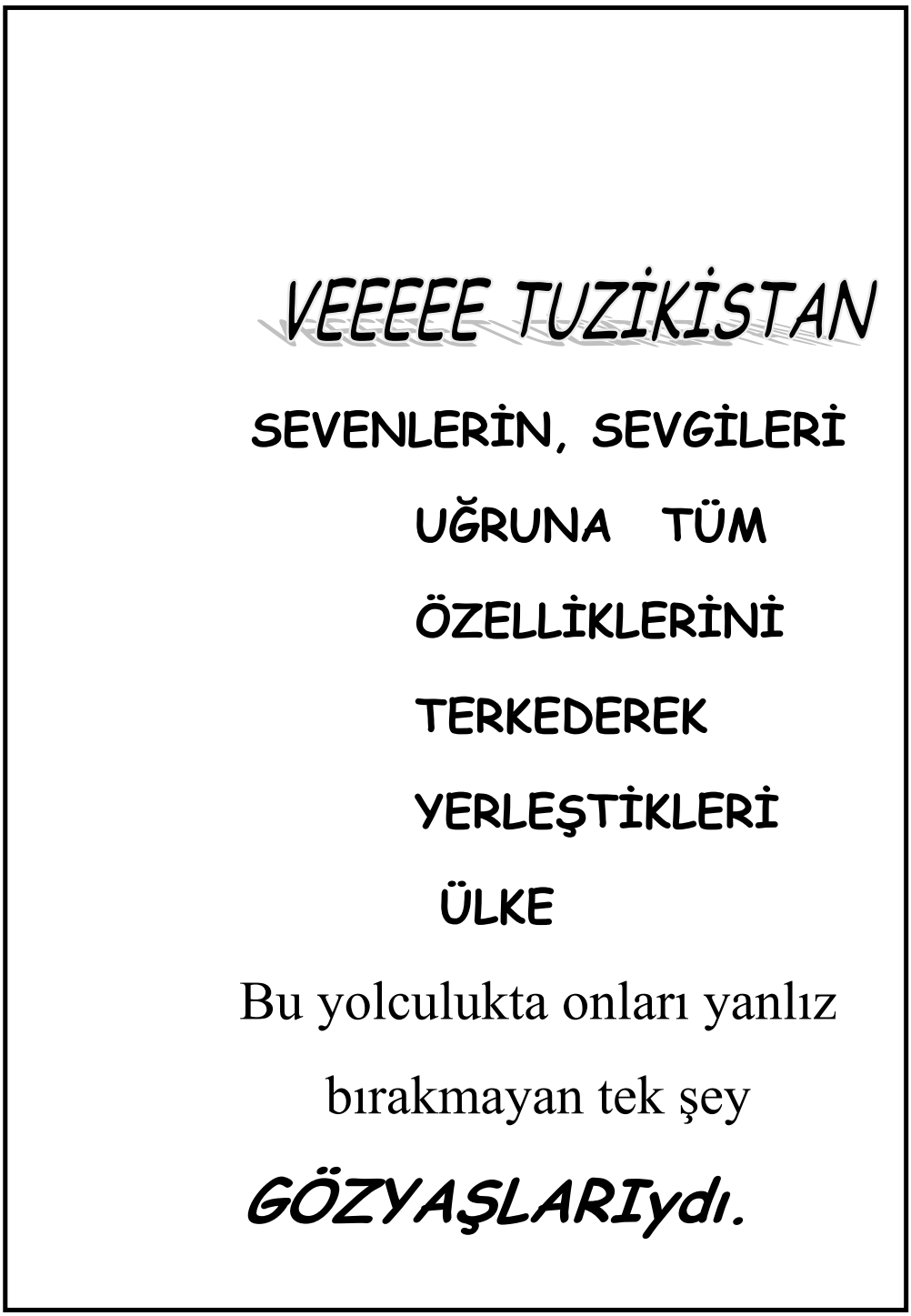


Figure D.5.

APPENDIX D

Figure D.6.

APPENDIX D

TUMEFA KOMİSYONU

Sevgili TUMEFA KOMİSYONU çalışanları, Yakanızdaki kimlik kartları size büyük bir sorumluluk yüklüyor

Bugün eğer huzur içinde bir maç izleyeceksek bu sizin sayenizde olacak

Bizler iki ülkeden gelen tüm izleyicileri tek tek gruplandıracak, onları kendi takımlarının taraftarlarıyla aynı bölüme oturtacağız.

Figure D.7.