# THE EFFECTS OF TEXTBOOK STYLE AND READING STRATEGY ON STUDENTS' ACHIEVEMENT AND ATTITUDES TOWARDS HEAT AND TEMPERATURE

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

BY

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

JULY 2004

Approval of Graduate School of Natural and Applied Sciences

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# ABSTRACT

## THE EFFECTS OF TEXTBOOK STYLE AND READING STRATEGY ON STUDENTS' ACHIEVEMENTS AND ATTITUDES TOWARDS HEAT AND TEMPERATURE

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July 2004, 96 pages

The aim of this study is to investigate the effect of textbook style and reading strategy on 9th grade students' achievement and attitude towards heat and temperature at Ereğli district of Zonguldak. Textbook style was means that whether textbook written in conceptual style or traditional style. The reading strategy was taken as K-W-L vs. reading without K-W-L. The study uses factorial design to investigate partial and combined effects of these methodologies.

In the study convenience sampling was used. The participants were 123 9th grade students at Zonguldak Ereğli Super High School in four different classes. Then selected classes were randomly assigned into four groups. The groups were conceptual physics text with K-W-L reading strategy, conceptual physics text with reading without K-W-L, traditional physics text with K-W-L reading strategy and traditional physics text with reading without K-W-L. Achievement and attitude tests were administered before and after the treatment.

The data was analyzed by Multiple Analysis of Covariance (MANCOVA) to find out individual and combined effects of conceptual physics texts and K-W-L reading strategy. The results has shown that conceptual physics texts were effective in increasing students' attitude, K-W-L was effective in increasing achievement, and their combination was effective in increasing both achievement and attitude of the students.

Keywords: Physics education, conceptual physics, K-W-L, textbook style, reading strategy, heat and temperature.

# ÖZ

## DERS KİTABININ SİTİLİNİN VE OKUMA STRATEJİSİNİN ÖĞRENCİLERİN ISI VE SICAKLIK KONUSUNDA BAŞARI VE TUTUMUNA ETKİSİ

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Temmuz 2004, 96 sayfa

Bu çalışmanın amacı ders kitabının sitilinin ve okuma stratejisinin Zonguldak Ereğli'deki 9. sınıf öğrencilerinin ısı ve sıcaklık konusundaki başarı ve tutumlarına etkisini incelemektir. Ders kitabının üslubundan kastedilen kavramsal mı yoksa geleneksel bir üslupla yazıldığıdır. Okuma stratejisi olarak K-W-L yönteminin geleneksel okumadan farkı ele alınmıştır. Çalışma belirtilen metotların kısmi ve birleştirilmiş etkilerini gözlemlemek için faktörsel dizayn kullanmaktadır.

Çalışmada örneklem araştırmacıya uygunluğuna göre seçilmiştir. Katılımcılar Zonguldak Ereğli Süper Lisesi'nde okumakta olan dört farklı sınıftaki 123 9. sınıf öğrencisidir. Seçilen sınıflar rasgele dört ayrı gruba ayrıldı. Bunlar kavramsal fizik metni ve K-W-L okuma stratejisi, kavramsal fizik metni ve geleneksel okuma, geleneksel fizik metni ve K-W-L okuma stratejisi, geleneksel fizik metni ve geleneksel okuma gruplarıydı. Uygulamaya başlamadan önce ve uygulamanın ardından başarı ve tutum ölçekleri uygulandı.

Veriler kavramsal fizik metninin ve K-W-L stratejisinin kısmi ve birleşik etkisinin ölçülmesi için MANCOVA istatiksel tekniği ile incelenmiştir. Sonuçlar kavramsal fizik metninin öğrencilerin tutumlarını yükselttiğini, K-W-L okuma stratejisinin öğrencilerin başarılarını arttırdığını, her ikisinin beraber uygulanmasının da hem başarıyı hem de tutumu arttırdığını göstermektedir.

Anahtar Kelimeler: Fizik eğitimi, kavramsal fizik, K-W-L, okuma stratejisi, ısı ve sıcaklık.

# ACKNOWLEDGEMENT

I would like to express my gratitude to Assist. Dr. Ali ERYILMAZ. I owe a special word of gratitude to him for his patient guidance, sound advice and constructive criticism. He has been always there whenever I need him and helped me in every stage of my work. He is more than a mere teacher to me, instead a pioneer, a conductor, a valuable supervisor and a close friend. If he hadn't accepted to me as his students, the realization of this study would not have been possible.

Likewise I am also grateful to teachers Erkan Özden, Mustafa Kula, Nejdet Elmas, Erkan Deniz, Harun Kuku who gave assistance and support at the certain stages of the study. Especially, I want to add my thanks to Paul Hewitt, who gave permission to use his sources and provided precious guidance for me.

I would like to extend my gratitude to examining committee Assist. Prof. Dr. Erdinç ÇAKIROĞLU, Assist. Prof. Dr. Ceren TEKKAYA, Assoc. Prof. Dr. Behiye UBUZ, Assist. Prof. Dr. Esen UZUNTİRYAKİ for their helpful criticisms and comments.

Throughout the MS period there was power that provided me with the moral support and the encouragement to successfully fulfill this thesis. Thanks and claps are to you-my dear family. A special thanks to Mustafa Kerim, C. Bulut, Y. Şimşek and H. İ. Atila. Thank you all very much indeed.

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# CHAPTER 1

## INTRODUCTION

Although physics is an everyday concept, many of teachers, like Hewitt (1972) and Reinstein (1990), indicate reluctance of students towards physics courses. Students often treat physics as an incomprehensive concept. In their respects, it is difficult to go with full of equations and hundreds of algebraic calculations. Especially, the students who struggle with mathematics often complain about the algebraic nature of physics (Hewitt, 1972). Therefore results of many studies simply indicate that mathematics achievement is one of the prerequisite conditions for the achievement in physics (Hart & Cottle, 1993). When achievement in physics strongly needs mathematical ability, in Turkey, however, these physics courses are given to all students no matter whether the student will select the area of science or not, at ninth grade. As a result, it is unavoidable to see the students struggle with physics, although they are not well in related mathematics concepts. In this case, we should treat students in an appropriate manner.

Throughout reviewing the literature there are two methods that may help overcoming mathematical difficulty in physics courses. One is the coordination between mathematics teachers and physics teachers (Reinstein, 1990); the other way is giving concepts before mathematical calculations (Hewitt, 1990). Although Reinstein's model is found to be a bit helpful, satisfying this coordination with another area is difficult. The other solution provided by Hewitt is "conceptual physics".

To Hewitt (1990), instead of mathematical calculations and manipulations, using mathematical structure of physics to show relationships between the ideas and concepts will not intimidate students, and this is called “conceptual physics”. The equations are used only to show the relationships, and are guides to critical thinking.

Hewitt (1990) claims that it will be helpful for the students, if conceptual aspect is given before the mathematical side. However, it is difficult to activate conceptual physics in classrooms. There will be following problems when using it. First, for an effective use, teacher must be informed with all of the system they will use in the class. Second, because science and technology is the one of the bases of conceptual physics (Hewitt, 1972), teachers should have a broad range of general knowledge. Third, there must be enough material to support effective learning. Concerning all of these points, conceptual physics seems difficult to be applied for the first time. As a result, the current study aimed to use one of the steps that will contribute to all other steps. That is using conceptual physics in a text. The expected uses of this text material are giving an idea about conceptual approach to physics, supporting teachers with general knowledge and providing some materials before using the methodology. That means conceptual physics in a text will be the first step to put conceptual physics into practice.

Students’ another difficulty is their lack of reading achievements. The study of Progress in International Reading Literacy Study (PIRLS) conducted by the International Association for the Evaluation of Educational Achievement (IEA), 2001, has shown that Turkey was the 28th of 35 countries in terms of the reading achievement (Anadolu Ajans, 2003).

Reading Assessment Advisory Committee (RMC) defines reading as;

“Reading is a dynamic process in which the reader interacts with the text to construct meaning. Inherent in constructing meaning is the reader’s ability to activate prior knowledge, use reading strategies and adapt to the reading situation (Marinak, 1998, p. 2).”

That is, reading includes interaction with the text, activating prior knowledge, using reading strategies and their adaptations to reading. There are many reading strategies like anticipation guide (Head & Readence, 1986), expectation scheme (Ribovich, 1977), and Graphic Organizer (Barron &

Earle, 1973). Among them K-W-L reading strategy (K-W-L) suggested by Ogle (1986) seems the most easy and flexible one (Wilhelm, 2002).

K-W-L (What I Know, What I Want to Learn, What I Learned) is designed to help students learn from expository text in any content area. It has three steps: brainstorming and categorizing, questioning to set purpose to read, and examining answers to those questions. Each step is recorded on the related column of K-W-L chart. The first step is for the students to tell or write what they already know about the topic in the first column, the K column. When all known information has been recorded in K column, the information is categorized to indicate what types of information that will be found during the learning phase. And the second step is to generate a list of questions that reflect what the student wants to know about the topic. At the same time, these questions are listed on the W column of K-W-L chart. This list then becomes a guide for the upcoming reading. Then text material is read with the purpose of seeking answers to the questions listed. The last step is to list the information learned about the topic. The student may have discovered answers to all questions asked, or may find that some still need to be answered. This procedure is intended to help teachers become more responsive to helping students to access appropriate knowledge when reading expository text. K-W-L is also intended to support student learning before, during, and after reading as most of reading techniques. 0gle has noted that as students use this procedure over time they become more actively involved in their reading of expository text (Ogle, 1986).

There are various studies that use different forms of K-W-L. Some examples are extended K-W-L (Sampson, 2002), K-W-W-L (Bryan, 1988), and K-W-LA (Mandeville, 1994). Instructor can modify the strategy according to the concept.

In addition to mathematical language of physics and the difficulties in reading, there is a common difficulty in heat and temperature concept among students. Researches indicate that students' everyday experiences are one of the important sources of misconceptions (U.S. National Academic Press, 1997). Therefore, students can carry many kinds of misconceptions in heat and temperature (Albert, 1978; Bar, & Travis, 1991; Başer, 1996; Erickson, 1979; 1980; Harrison, Grayson, & Treagust, 1999; Rogan, 1988; Shayer & Wyllam, 1981).

In the light of these points, the purpose of this study is to investigate the effects of Conceptual Physics Texts (CPT) and K-W-L Reading Strategy (K-W-L) with respect to Traditional Physics Text (TPT) and Reading without K-W-L (Non-K-W-L) on ninth grade students' achievement and attitude toward heat and temperature.

## 1.1 Problem

What are the effects of CPT vs. TPT and K-W-L vs. Non-K-W-L on 9th grade students' achievement and attitude towards heat and temperature at Ereğli district of Zonguldak?

### 1.1.1 Subproblems

What is the effect of CPT on 9th grade students' achievement in heat and temperature when compared with traditional text?

What is the effect of CPT on 9th grade students' attitude towards heat and temperature when compared with traditional text?

What is the effect of K-W-L on 9th grade students' achievement in heat and temperature when compared with Non-K-W-L?

What is the effect of K-W-L on 9th grade students' attitude towards heat and temperature when compared with Non-K-W-L?

What is the combined effect of CPT with K-W-L on 9th grade students' achievement in heat and temperature when compared with TPT with Non-K-W-L?

What is the combined effect of CPT with K-W-L on 9th grade students' attitude towards heat and temperature when compared with TPT with Non-K-W-L?

## 1.2 Hypotheses

### 1.2.1 Research Hypotheses

Through analyses following research hypotheses will be tested.

1. When prior achievement, prior attitude, gender and age are controlled, there is no significant main effects of textbook style and reading strategy, and interaction effects on the collective dependent variables of ninth grade students' physics achievement and physics attitude through heat and temperature concepts.

2. When prior achievement, prior attitude, gender and age are controlled, there will be interaction effect on students' achievement between two treatments. The students experiencing CPT and K-W-L will have higher physics achievement than students in other groups.

3. When prior achievement, prior attitude, gender and age are controlled, students experiencing CPT will have higher physics achievement as compared to students experiencing TPT.

4. When prior achievement, prior attitude, gender and age are controlled, students experiencing K-W-L will have higher physics achievement as compared to students experiencing Non-K-W-L.

5. When prior achievement, prior attitude, gender and age are controlled, there will be interaction effect on students' attitude between two treatments. The students experiencing CPT and K-W-L will have better physics attitude than students in other groups.

4. When prior achievement, prior attitude, gender and age are controlled, students experiencing CPT will have a better attitude as compared to students experiencing TPT.

5. When prior achievement, prior attitude, gender and age are controlled, students experiencing K-W-L will have a better attitude as compared to students experiencing Non-K-W-L.

1.2.2 Null Hypotheses

Therefore following null hypotheses will be tested.

H1: There will be no significant main effects of CPT, K-W-L, and interaction effects on the population mean of the collective dependent variables of; ninth grade students' physics achievement and physics attitude through heat and temperature concepts when the effects of prior achievement, prior attitude, gender, and age are controlled.

$H_{0\,[ACH,\,ATT]}$: $\mu_{CPT}-\mu_{TPT}=0$; $\mu_{K\text{-}W\text{-}L}-\mu_{Non\text{-}K\text{-}W\text{-}L}=0$; no interaction exists

H2: No population means difference exists among students classified by the product of CPT and K-W-L on ninth grade students' achievement in heat and temperature concepts when prior achievement, prior attitude, gender, and age have been accounted for.

$H_{0\,[ACH]}$: no interaction effects exist.

H3: No population means difference exists between the achievement scores in heat and temperature concepts of the ninth grade students' treated with CPT and those of the ninth grade students' treated with TPT when prior achievement, prior attitude, gender, and age have been accounted for.

$H_{0\,[ACH]}$:$\mu_{CPT} - \mu_{TPT}=0$

H4: No population means difference exists between the achievement scores in heat and temperature concepts of the ninth grade students' treated with K-W-L and those of the ninth grade students' treated with Non-K-W-L when prior achievement, prior attitude, gender, and age have been accounted for.

$H_{0\,[ACH]}$: $\mu_{K\text{-}W\text{-}L} - \mu_{Non\text{-}K\text{-}W\text{-}L} =0$

H5: No population means difference exists among students classified by the product of CPT and K-W-L on ninth grade students' attitude towards heat and temperature concepts when prior achievement, prior attitude, gender, and age have been accounted for.

$H_{0\,[ATT]}$: no interaction effects exist.

H6: No population means difference exists between the attitude scores in heat and temperature concepts of the ninth grade students' treated with CPT and those of the ninth grade students' treated with Non-K-W-L when prior achievement, prior attitude, gender, and age have been accounted for.

$H_{0\,[ATT]}$: $\mu_{CPT} - \mu_{TPT}=0$

H7: No population means difference exists between the attitude scores in heat and temperature concepts of the ninth grade students' treated with K-W-L and those of the ninth grade students' treated with TPT when prior achievement, prior attitude, gender, and age have been accounted for.

$H_{0\,[ATT]}$: $\mu_{K\text{-}W\text{-}L} - \mu_{Non\text{-}K\text{-}W\text{-}L} =0$

## 1.3 Definitions of Important Terms

Throughout the study, these terms have special meanings: conceptual physics text, K-W-L, traditional physics text, Non-K-W-L, physics achievement, physics attitude, gender, and age.

Conceptual physics means “putting the concept before computation” (Hewitt, 1990, p.55). Therefore, using conceptual physics text is using a text which explains the physical event before mathematical manipulations. In this study, Paul Hewitt’s book named “Conceptual Physics” was used. In his approach students are engaged with the analogies and imaginary real-world situations to provide strong understanding of physical principles. In this way students are expected to understand physics equations and formulas better, and they can link the physics with everyday world. The book skillfully uses pictures and images to make understanding easier. Misconceptions cover another important part in Hewitt’s books. He stresses the common misconceptions for many times. The book includes review questions at the end of the chapter and these questions are strongly related with the things expressed through the chapter inside. Most of these questions remind the facts behind the misconceptions.

Traditional physics text refers to the currently used physics texts instructed currently in high-schools. They are approved by the Ministry of Education and present concept and the computation at the same time. The authors of traditional physics textbooks were Y. ÇAKMAK and C. ŞAHİN. Book used was the fifth edition, published in 2003.

The characteristics of traditional physics textbooks are;

- Concepts are given at the same time with computation.
- No emphasis on real-world situations, and there is no so many analogies to explain the events.
- Formulas are used for solution of complex computational problems and have more role than showing the relationships between the variables.
- Figures inside just to show laboratory action or simple images refers to one of the words stated in the text, and that is not a part of a discussion.
- Most of review questions are quantitative questions, and the goal is to make students get practice of the problem solution.
- Eliminating misconceptions is not one of the major objectives of the text.

K-W-L is the abbreviation of “what I Know, what I Want to know, and what I Learned”. It is firstly suggested by Ogle (1996). It is a three column chart procedure. That is, a three column chart

having the titles “what I know”, “what I want to know”, “what I learned” is filled by the interaction of teacher with the students. First, before reading, readers begin to brainstorming about the concept and their reactions are written on the board. These reactions are also saved on the “what I know” column of the chart. Then these reactions are grouped. After that, considering the responses given before, students ask questions about the topic, about what they want to know. Their questions, then, written to “what I want to know” column of the table. At last, students read the text and try to find the answers inside the text (Ogle, 1996). In this study, this reading strategy will be a bit modified and the third column will be completed at home as an assignment.

The other term, Reading without K-W-L (Non-K-W-L), refers to reading a text without using K-W-L. In general, people are unwilling to read with special techniques, unless they are encouraged. Control for this type of reading is only answering the chapter-end questions.

Prior achievement was the pre-test scores obtained from the physics achievement test. This test was developed by the researcher by using the questions of previous university examinations. The test includes equal number of quantitative and qualitative questions.

Physics achievement was the post-test scores obtained from the physics achievement test. This test only differs from the previously used test with its appearance.

Prior attitude was the pre-test scores obtained from the 24-item physics attitude scale (PAS). This scale was obtained from study of Taşlıdere (2002) and adopted to heat and temperature. Enjoyment, self-efficacy, importance of physics, achievement motivation, and interest related behavior were the factors in the scale.

Physics attitude was the post-test scores obtained from the PAS.

Gender is the answers of the students given to this question. Gender distribution was similar to all of the groups and in female’s favor. Age is the ages of each participant. The ages are important during these years. Because, these are the ages that the students pass from concrete-operational level to formal-operational level (Gredler, 1992). For this reason, both genders and ages were controlled during the study.

## 1.4 Significance of This Study

The significance of the current study will be explained in terms of student, teacher, instructors, authors, Ministry of Education, and researchers. The significance of this study can be given as follows:

1. This study will help student to increase reading comprehension ability by using K-W-L strategy. In addition students can overcome their physics difficulty by conceptual physics texts. Thus physics will become a more understandable and enjoyable course.

2. Teachers can use conceptual physics text in their lectures. By using conceptual physics texts, they can draw the interest of students, and so the productivity. Moreover, that can increase their general knowledge about science and technology for beginning with conceptual physics approach. At the same time, the study provides a source that teaches physics conceptually. By this reading strategy, teachers can increase the effectiveness of the text.

3. It is good for instructors to see there are different approaches to eliminate physics anxiety and improve reading comprehension. This study combines both of these approaches. The study shows the need for training pre-service students with reading strategy and textbook evaluation. In the guidance of this study, instructors can develop their courses that teach these techniques to pre-service teachers and, they can encourage pre-service teachers to the use of conceptual physics text, and K-W-L reading strategy. Study also shows the importance of reading techniques in different subject areas.

4. Authors can enhance their books according to findings of this study. Especially for physics textbooks, the “language” of the book is important. As stated earlier, too much mathematical language to teach physics for the first time decreases interest and motivation of the students, therefore, the success of the students. At this point authors can use conceptual approach in their books, and includes discussion questions that lead to reading techniques.

5. For the Ministry of Education, this study will present another aspect of science textbook problem. That is conceptual approach should be applied in the preparation of the texts. Study also implies the need for using conceptual physics approach, and demonstrates a way to begin conceptual physics.

6. Study shows the importance of conceptual physics approach and the ways of passing to approach through curricular system rather that just using directly. The reason behind this indirect application is the difficulty of adaptation of the system for the new methodologies. Reading strategies and their effects on textbook comprehension was discussed. In this way, study supports for future research that cares effects of textbook style, methods to passing one educational method to another, reading strategies and increasing textbook efficiency through usage. In addition, the study will use a valuable research design, factorial design, in terms of efficiency, control over additional variables and the study on the interaction between the independent variables (Hinkle, Wiersma & Jurs, 1988) as it will be stated later.

# CHAPTER 2

# REVIEW OF LITERATURE

This chapter is devoted to the presentation of theoretical and empirical background of the current study. The headings mainly includes following concerns; the reason for the students' obscurity in physics, the way to increase attraction - conceptual physics, the attiributes of current textbooks, reading difficulties of the students, K-W-L reading strategy, students' perception of heat and temperature concept.

## 2.1 Trouble with the Physics Courses

### 2.1.1 Physics with Mathematical Language

The reason for the need of physics is best explained by Hewitt's terms: "You can't fully enjoy a game unless you know its rules. Whether it's a ball game, computer game, or party game- if you don't know the rules, it can be boring. You miss out on what others enjoy… Richness in life is not only seeing the world with open eyes, but knowing what to look for. We begin by looking at some of nature's basic rules-physics" (Hewitt, 1999, pp. XI). Therefore, the physics is to understand, and then, enjoy the nature.

When Hewitt's terms imply some excitement, physics is often not preferred among the students (Hewitt, 1972; Reinstein, 1990). Hewitt (1972) and Reinstein (1990) explain this problem with the algebraic structure of physics. The physics differs from other academic disciplines by its algebraic nature. A letter by Eleanor (2001) expresses the difficulty of achieving a physics course because of the high level of mathematics needed and adds "as a math graduate working as a university

research associate I should be well qualified to support my daughter, who has just started AS-level physics, with the maths she needs for the science" (p. 89). This comment well explains the situation through the physics courses. The physics courses are full of mathematics, and needs complex processes.

The relation between physics and mathematics achievement is a well-known fact. The study by Hart and Cottle (1993) is one of the researches that investigate mathematical background of physics students. To conduct the study, questionnaires were distributed to all students who attending a course called Collage Physics A at Florida State University throughout the semesters Fall 1990, Fall 1991, and Fall 1992. There were 508 questionnaires which were analyzed. Throughout the analysis Whitney U test is used and significance levels were selected as .05. However, the significance levels for the study generally can reach to p=.0001. For the study, most recent mathematics grades were asked to the students. Their mathematics grades were compared with the grades taken from first semester physics courses. Results show that students who get $B^-$ or better from the mathematics have physics grade of 2.4 on average, and the students lower than $C^+$ mathematics achievement has 1.8 of physics achievement on average. That means physics achievement directly related with mathematics achievement, if the course is an algebra-based physics course as in Florida State University.

2.1.2. Alternative Methods for Attraction to Physics

There are numerous studies to make physics more attractive. Kashy et al. (1995) used a computer programming to support education, Newel and Ross (1996) get used to analogy of woolen hat in elimination of some misconceptions related with temperature, Lee (1995) tried to have a better understanding of circular motion by a toy car, Volchok (1997) used an interesting way to make clear force and motion concepts-juggling, Hildreth and Matthews (1997) used Tae Kwon Do in illustrating Newton's second law of motion. However, these approaches were tied to specific concepts.

Reinstein (1990) designed a coordinated calculus and physics program with a calculus teacher. Through the study, the algebraic nature of the concept was taught by the calculus teacher, and then the related topic is presented by the physics teacher. Like, before teaching slope relationships of position vs. time and velocity vs. time graphs provide student with limit and derivative. He stated one

of the advantages of this method as it provides immediate reinforcement of concepts and methods. He claims this method could be more developed among concepts and probably increases the power of success. However, he indicates coordination between teachers is a difficult concept.

Another approach for eliminating mathematical barrier is conceptual approach. Conceptual physics is the way of teaching without relying on mathematical terms. It introduces physics by means of daily life experiences, logical reasoning and critical thinking. The mathematical formulation is only for showing the relationship between ideas and concepts, instead of "intimidating" learner with complex algebraic manipulations, calculations and so on (Hewitt, 1972; 1990).

## 2.2. Conceptual Physics

### 2.2.1 Development of Conceptual Physics

Conceptual physics is the studying the physical concepts qualitatively by emphasizing on mental imagery (Hewitt, 1983). That is, studying physics concepts are related to the events familiar to everyday environment (Taşlıdere, 2002). Hewitt (1990) believes the importance of mathematics as a language of physics, but he claims that conceptual physics should be given before complex algebraic manipulations. Because, such manipulations can be a negative stimulus to new, especially for non-science, students. Conceptual understanding is important. He implies this with the following sentence "A physics student who lack a conceptual understanding of physics and who is with physics problems is a kin to deaf person writing music or blind person painting" (Hewitt, 1983, p. 309).

Although conceptual physics is become famous with Hewitt, there were other conceptual studies before him. Richard Feynman was a famous physicist and his books *The Feynman Lectures on Physics* include no numeric problems (Hewitt, 1994). Ed North, a physics teacher at Connecticut, developed a conceptual-based physics courses in the late 1960's. More than 20 years, approximately 90 percent of Taft School, in Watertown has taken his physics courses (Hewitt, 1990). In the year 1969, a physics textbook with the name "*Conceptual Physics*" is published by Ballif and Dibble (1969). It was only about the mechanics course. The goal stated by Ballif and Dibble is quite similar to those of Hewitt's. They indicate "Our approach to the principles of physics essentially conceptual rather than mathematical. Although simple equations appear throughout the text, they have mainly for

the precise statement of important principles" (Ballif & Dibble, 1969). After that, Hewitt has prepared first edition of his conceptual physics textbook in 1971. It was including only a few numbers of equations. Now many teachers use conceptual physics in their course (Hewitt, 1990).

Hewitt (1990) states some successful applications of conceptual physics. Some of people owner of these successes are Elaine Robinson, Nancy Watson, and Paul Hickman. When Robinson, a high school teacher at Washington, has only twelve students in her first semester, after the principal's recommendation on using conceptual approach, the number of students taken the course tripled. To see the effect of conceptual approach, Watson, treated half of her classes with conceptual physics. After having 30 to 50 percent of increase in success following year she began to teach students with conceptual physics only. Paul Robinson, recipient of 1987 Presidential Award for Excellence in Science Teaching, used computers in his conceptual physics course. Almost hundred percent student of his school has taken the course. There are many others other than Hewitt expressed, Madsen et al. (1992), Brouwer (1994), Taşlıdere (2002) are the examples.

2.2.2. Fundamentals of Conceptual Physics

There are three primary objectives in conceptual physics. First is to teach hardcore physics emphasizes everyday environment. Second is to shape critical thinking. Third is to relate physics with technology.

2.2.2.1. Hardcore Physics. Hewitt (1972) indicates that there is an opinion that non-science students cannot be taught with physics. Therefore, instead, physics instructors give history of physics or say what it is talking about. Hewitt strongly disagree with this opinion. According to him, everything can be taught to the student by simply giving the hardcore of the physics, rather than complex forms of algebra. When the relationships between the concepts considered, he uses formulas and exaggerated symbols through them. This kind of approach both time saving and not confuses the students.

Instruction with hardcore is not discussing mechanical advantages of various machines, the blocks on top of each with an inclined plane, the conversations between temperatures, right-hand rule

for magnetic field. Hardcore should be more simple and everyday related examples (Hewitt, 1972), like the examples in his book; a man in the bathroom or a girl sleeping with a blanket (Hewitt, 1999).

Hewitt (1972) also indicates in his article that using mathematics when teaching physics first time is a kind of negative stimulus, and causes to hinder completion of other instructional objectives. He explains the situation with this analogy. "A salesman will not get a favorable attitude toward his product presenting it to customer in a negative setting" (p. 523).

2.2.2.2. Shaping Critical Thinking. Understanding a concept is not stating, or paraphrasing, the same fact given before. It mainly includes using different cognitive manipulations. According to Gagné, cognitive strategies are the activities undertaken by the learner to facilitate understanding (Gredler, 1992). As an example to teach critical thinking, Hewitt (1972) provides some examples, one of which "it is common to say that air rises because it is less dense than cold air. Warm air rises, however, principally because it is pushed upward from below with more force than it is pushed with more force than it is pushed downward from above. The fact that it is less dense than cold air simply means that per unit volume its weight will be small enough for the difference in upward and downward pushes of surrounding air to be effective" (p. 273).

2.2.2.3. Relating physics with technology. Hewitt (1972) states that people are afraid of future. Because, they see technology and advancements in science as stepping-stones to an inevitable totalitarian society. Problems with improvement of technology always the case and people continuously warned with the coming troubles. However, although such disadvantages exist, it does not mean that technology always results in unwanted situations. The dangers of fossil fuels are now avoided by the advancements in science. Therefore, science education should reflect both positive and negative parts of technology, not the dangers itself.

2.2.3. Conceptual Physics in a Text

Conceptual physics text is not as common as conceptual physics itself. On the other hand, there are some text materials which mainly introduce physics in a conceptual way. Among them, Hewitt's "conceptual physics" book is the most famous one. There are some studies that use Hewitt's texts (e.g. Linder & Hillhouse, 1996; Franceschetti et al., 2001).

Davis (1998) indicates the importance of Hewitt's books with the following sentence: "I myself have used Hewitt's books for helping high-school teachers to gain an essential knowledge of physical science, so that they and their students can discuss physics with a degree of understanding that goes beyond using definitions, rules, laws and equations to find answers to problems." (p. 171)

Similarly, Hubisz (1999) appreciates Hewitt's studies and defines Hewitt's conceptual physics book as "revolution". After that he explains Hewitt's success with the expression "Hewitt meets his proposed audience where they are, doesn't get into sophisticated arguments and doesn't get bogged down in making subtle points. He just presents the reader with what is needed to go on". (p. 502)

A book survey conducted by the Physics Teacher (Swartz, 1999) includes Hewitt's Conceptual Physics textbook in its report. The committee is composed of seven teacher at State University of New York and seven teachers around the country. The report published in the journal indicates Conceptual Physics textbook is still more appropriate for a preliminary course or the course where there is no external exam with standard topics. According to the report, the text is clear and concepts flow logically from one to another. Different examples that are related to everyday phenomena near the classical examples are included in the text. Text is supported by relevant photographs, illustrations and comic strips that students like. Through the text some inserts like "Physics of Sports", "Physics in the Kitchen", "Links to Biology" are included. The book contains variety of questions. There are mid-chapter questions and end-chapter questions. Mid-chapter questions are scattered throughout the text and answers are given. End chapter questions in different formats:

- Short conceptual review questions
- Activities that can be done with no equipment
- "Plug and chug" questions that refers one step problem solving
- Think and explain questions that requires little critical thinking
- Think and solve problems reinforce students for mathematical skills

In the report's view text presents "real" physics and does "excellent job" in explaining the physics. "Conceptual physics is different from other texts to place it in a class by itself" (Swartz, 1999, p. 286).

### 2.3. Textbook: Current Structure

It is commonly stated in the studies that textbooks covers major part of the lessons and teachers uses textbooks like a curriculum (Barrow, 1992; Başlantı, 2000; Leite, 1999; Yager & Penick, 1987). Especially Yager and Penick (1987) give a specific numbers. In their paper, 90% of science teachers spend about 95% of their lessons from textbook. Chiappetta, Fillman and Sethna (1991) claims that science textbooks are used to convey much amount of information to students in science classes, and this situation directs teachers to shape their curriculum for this goal. Soong and Yager (1993) claims that students view their textbooks as all the source of knowledge, and their parents also sees textbooks as the center of the education.

Yager (1983) indicates that science textbooks persuade teacher to see the main objective of the course is the acquire information. It affects lesson flow in the way that giving homework, listing and restating the information, testing, discussing on the test. Researcher claims that the laboratory work can be placed in the text, but that only confirms the information in the text. Therefore, the result of this excessive dependence may influence scientific literacy of students.

Chiappetta et al. (1991) emphasize that science textbooks should bring relation between the students and daily life. In this way, these books get attention of the students to show how science, technology and civilization correlate.

There are also some studies that indicate the current situation of textbooks in Turkey. Başlantı (2000) analyzed the content of an eighth grade science textbook. In this study, the contents were put into four themes of scientific literacy by the researcher and two teachers. These were science as a body of knowledge, investigative nature of science, interaction of science, and technology and society. The percentages of contents were calculated, and then put into the analysis with Cohen's Kappa. The Kappa value was found to be .61 and the measurements of three analyzers were 70.6% consistent. The category of science as a body of knowledge was the first with 65%, and other three categories come

behind with only 17%. The category science as a body of knowledge includes only the information about concepts, principles, theories etc. After these results, researcher arrives at a conclusion that our science textbooks mainly stress on conveying the knowledge rather than supporting strategic thinking, scientific philosophy, and combining science with technology. Researcher believes that development through textbooks will contribute much the educational system and will accelerate the educational improvement.

The study by Bakaç and Kesercioğlu (2000) regard textbook research and textbook improvement as an important factor for increasing the quality of education. To obtain the attitude towards science textbooks and to make a general examination of textbooks, they conducted a study with 350 students. The study was conducted at Buca Science Education Department. The participants were trainees at seventh grade classes of primary schools in İzmir. In their study, a science textbooks attitude scale was generated. Then this 12 item likert type scale was administered to students. The reliability coefficient, Cronbach Alpha, was 0.79 for the scale generated for the study. The findings were:

- About 65% believes that sources for science lessons were not enough; only 24% accepts the sufficiency of sources.
- Sixty percent says that, unlike Yager et al. (1987), students in their classes uses lecture notes and there was no suggestion related to textbooks by teachers.
- Only 40% believes that the language of the textbooks is clear and easy to understand.
- 57% claims that textbooks do not include new information and technology.
- Sixty-three percent complains about lack of figures and graphics.
- Sixty-five percent indicates the chapter-end studies as insufficient.
- A large portion (79%) claims that current textbooks are away from technological and scientific improvements.

A similar study was conducted by Ayvacı, Çepni and Akdeniz (1999). This time participants were six physics teachers, and 200 students at a high school. The results are interpreted by frequency analyses. Results are just similar to those of Bakaç and Kesercioğlu (2000). In this study, content and

style of the current physics textbooks were evaluated. The findings were as follows: textbooks were insufficient in pictures and figures; the language was not clear, generally results in memorizing rather than advance thinking. In addition, the experiments in textbooks were inconsistent with the laboratory materials in the schools. After the analysis, they propose following suggestions to improve textbook structure:

- Language of textbooks should be clear and easy to understand.
- The explanations should be given from concrete to abstract.
- Appearance of the book should draw the interest of the students.
- More figures, pictures, images and schemas should be included.
- Content should direct students to investigation rather than force to memorize.
- There should be summary at the end of each chapter.
- There should be some hints to solve problems.
- Formulas should be explained in detail.
- Texts should enable discussions.

Sılay, Çallıca and Kavcar (1999) administered a questionnaire to 450 students from 25 high school around different regions in Turkey. The findings were almost the same with the study of Ayvacı et al. (1999). In addition to given recommendations, they adds two suggestions; including newest technology, and stating objectives inside the textbook.

In his article, Özgen (1993) states the general view of current textbooks and suggest some solutions to current problems. In the article he generally expresses the deficiencies of the contents, incorrect information, inconsistency with students' level of compression, and isolated structure with students' environment. The suggestions to those problems related to textbooks are:

- The content should be appropriate to level of students
- Information given in the text should relate with daily life
- They should be revised continuously
- Textbooks should be thought not by itself, but as a part of all of the curricular system
- Information should be given in a logical way

- They should be supported by teacher manuals, auxiliary books etc.
- Books should be written by the experts of each area from writing to design

He also suggests some technical information:

- Textbooks should be printed on a quality paper
- Lines should be loosely placed
- For the ages from six to seven 24 points, from seven to eight 18 points, from eight to nine 12 points, from nine to twelve 11points, and for elders 10 points should be used
- Content should be clarified by pictures, figures etc.
- Coverage should be clearly defined

## 2.4. Reading Comprehension

Progress in International Reading Literacy Study (PIRLS) is conducted by the International Evaluation of Educational Achievement (IEA) in 2001. There were 35 countries joined to this study. Turkey participated with 5,390 students from 62 cities. The result shows that the reading achievement of Turkey was below the average and Turkey is 28th of 35 countries. The questionnaire in the PIRLS study indicated that in Turkey reading studies were much dependent on textbook, the other text material were not used in students daily life. On average, more than 25 books referring to children in each family, but Turkey only 19% of families have that many of books in their homes. Among the countries joined to this study, only in Iran and Turkey, number of preschoolers is too small. In addition, girls are significantly better readers than boys. Indicating the similar findings of Eğitim Araştırma ve Geliştirme Derneği (EARGED), study arrives at a conclusion that reading skills are the base for the school achievement and daily life and, therefore, some precautions must be taken to avoid reading disabilities (Anadolu Ajans, 2003).

Pennsylvania Reading Assessment Advisory Committee (RMC) defines reading as (Marinak, 1998);

> Reading is a dynamic process in which the reader interacts with the text to construct meaning. Inherent in constructing meaning is the reader's ability to activate prior knowledge, use reading strategies and adapt to the reading situation (p. 2).

It is known that most of the learning disability children also have reading disability. Therefore some strategies should be used for increasing understanding from printed material (Paris & Oka, 1989). There are some techniques for increasing reading strategy development like Anticipation Guide (Head & Readence, 1986), Expectation Scheme (Ribovich, 1977), Graphic Organizer (Barron & Earle, 1973), Guided Writing Procedure (Smith & Bean, 1980), and K-W-L (Ogle, 1986).

Effective readers, says Marinak et al. (1998), quickly previews the text and set a purpose to read it; then activate prior knowledge by considering the topic which enables global predictions about what to be read. After that go through the text and continually monitor their understanding. If they are uncertain about the meaning of passage they use some fix-up strategies. The phases in reading of effective readers, shows three categories in reading: before reading, during reading and after reading. Marinak et al. (1998) defines reading phases and the skills in them in the following list. “Before reading” is called as anticipating meaning and includes; previewing, surveying, setting a purpose to read, activating personal knowledge, and making global predictions. “During reading” is called as constructing meaning and includes the skills; assessing and revising predictions, making associations, monitoring compression, employing fix-up strategies, reading fluently. At the end, the “after reading strategies” defined as reconstructing and extending meaning and includes; retelling what was read, summarizing what was read and evaluating what was read. As a result, an instructional technique that promotes reading should care on these categories and refers to each part of these classes.

### 2.4.1. A Method of Enhancing Textbook Comprehension: K-W-L

K-W-L is firstly introduced by Ogle (1986), where K stands for “what I Know”, W stand for “what I Want to know” and L stand for “what I learned”. The method involves; activating prior knowledge, setting purpose to read by asking questions and recording the information which are the answers of questions (Marinak, 1998).

It is a three step process, and first two steps involves oral discussion and in the third step, students either fill out a form concerning what I learned or immediately after reading the article there is a discussion (Ogle, 1986).

Step1: What I Know (K). This is composed of two sub-steps. In the first part, there is a straightforward brainstorming of what the group knows about the topic. Teacher activates the background knowledge of the students brainstorming of what they know about the topic and writes all the involvements on the board. Then teacher provides with a K-W-L chart, where K-W-L chart is a three column chart that is used in K-W-L sessions. The chart includes the terms what I know, what I want to know, what I learned (Marinak, 1998). In this part, teacher should select key concept for the brainstorming as specific and pertinent as it is possible. This is necessary to keep responses inside the topic (Ogle, 1986). In the second part, students are asked to categorize their associations and write them to the "Know" column (Marinak, 1998).

Step2: What I Want to Know (W). Using the information that is stated as known, students generate questions they want to be answered about the topic. Some students may be in conflict with other students about some information. This will generate their own reasons to read and they can ask about this challenging information. The questions are written to second column (Ogle, 1986).

Want to know part is a group discussion, but before reading students should write their own questions on their worksheets, by doing this, they develop a personal commitment which guides reading (Ogle, 1986).

Step3: What I Learned (L). Teacher asks students to find whether the text deals with the students' questions. During reading, students write the answers to their questions on their charts. After reading, students discuss what they learned through reading. If students cannot find the information they want to know, teachers suggests for further reading. Each student should have an opportunity to find their questions to be answered or addressed (Ogle, 1986).

Why K-W-L? K-W-L is a simple, elegant technique (Willhelm, 2003). In addition, it is very flexible technique, therefore, many variations exist. For example, K-W-L-S is suggested by Sippola (1995) by adding the component "what I still want to know". K-W-L with H component, recommended by Ogle (1996), has a fourth column of "how we find out". K-W-L Plus, by Carr and Ogle (1987) adds mapping, summarizing and reorganizing the information. Adaptation of K-W-L by

Richardson and Morgan (1997) shows the importance of asking students what they feel about reading. And Huffman (1998) combines focus questions “Who? When? What? Where? Why and How?”

## 2.5. Heat and Temperature

The study conducted by Çepni, Aydın and Ayvacı (2000) administered open–ended questions to 254 forth and fifth grade students to find their level of understanding of different physics concepts. The study shows that the concepts having minimum understandings are heat 9%, electric current %9, boiling %11 and evaporation %13. Study claims that result of this picture is because of teaching concepts traditionally, not caring students’ previous knowledge level and their misconceptions, do not reflecting alternative conceptions of students develops through learning, do not using modern educational techniques.

Textbooks are one of the major sources of misconceptions (Yager, 1987). In addition, the studies about heat and temperature ratify the findings of Çepni et al. (2000) that students have difficulties and too many misconceptions on heat and temperature. Therefore any study that uses textbooks as a tool should take misconceptions into account. Following section expresses the studies conducted about heat and temperature concepts and states the misconceptions that students have.

Erickson (1979) has conducted a research in order to see the children’s conceptions about heat and temperature. Throughout interviews and open-ended questions with the students of age from 6 to 10 following misinterpretations have been found:

- Heat makes things rise.
- Cold is opposite of the heat
- Like heat, cold is transferred between the media
- Heat is collected at one point, and then spread out to the other parts of the metal rod
- Soft things melt more easily then hard things
- Temperature of a body is related with the size or the amount of material present in it
- Heat is a substance something like air or stream
- Temperature is a measure of the mixture of heat and cold inside an object

- All objects contain a mixture of heat and cold

One year after his first study, Erickson (1980) has continued to his study. There are three objectives in his study: confirming hypothesized misconceptions in the first study, finding out different misconceptions, and developing a classroom instrument to assess students' belief patterns. The participants of this study were 76 fifth-grade, 117 seventh-grade, and 83 ninth-grade students. First, the researcher carries out three experiments in front of the class, and then students are asked to summarize the demonstration with a statement. Throughout the study following conceptions of children appear.

- Large rod heated up faster than the small one, because there are more air spaces in a large rod for the transfer of the heat than the small rod.
- When heated whole of the rod gets hot, because heat is accumulated at one side until it cannot hold anymore heat than heat moves along the rod.
- Wax cube melted when metal cubes remains the same, because it is a soft material.
- Metal cubes are hotter than wood or sugar, because it is difficult for air to get inside of the metals and cool them.
- Metal cubes didn't melt when heated with candle, because it is not heated long enough.
- Water to become cooler when ice is added, because some of cold get into water.
- Large ice cube melted late, because it was colder than the small one.
- When heated, the red liquid went up, because heat makes liquid lighter.

In her thesis, Kalem (2002) states some of the problems with the textbooks when talking about heat and temperature concepts. In her findings, definition of heat is given scientifically wrong in current physics textbooks. When some textbooks states heat as an internal energy, there is no such definition of internal energy before heat concept. Another definition, "heat is the energy as a result of thermal difference" is not seen as an enough definition of heat, because this definition does not reflect facts through phase changes. Another point is the expression of "heat flow" may cause the idea that heat is a thing like liquids. Again, the expression "when heat is given to an object, the temperature increase" should be changed with the expression "when heat is given to an object, temperature increase

or phase change occurs". In short, textbook should be written with carefully selected words. Otherwise, textbook itself can be a cause of misconception.

Through the review of Web, a site that summarizes misconceptions in physics appeared (Beaty, 2003). The page lists the findings of American Institute of Physics (AIP) Operation Physics Project about the misconceptions. According to the study, students have following misconceptions:

- Heat is a substance
- Heat is not an energy
- Temperature is a particular property of an object (metals are always cooler than plastic)
- Temperature of an object is dependent to its size
- Heat and cold are different, rather than being opposite ends of a continuum
- There is a problem with statement "temperature is constant during boiling"
- Boiling is the maximum temperature for a subject to reach
- Ice cannot change in temperature
- Objects of different temperatures, does not have to reach a common temperature
- Heat only travels upward
- Heat rises
- Kinetic theory cannot really explain heat transfer
- Object that readily become warm do not readily become cold
- The bubbles in boiling water contain air, oxygen, or nothing rather than water vapor.

## 2.6. Summary

As a summary of the literature review following ideas comes to being:

1) The major problem of students' failure in physics courses comes from mathematical perspective of physics lessons. When concepts are given at the same time with computation, students enters into complexities of physics before their understanding strongly established (Hewitt, 1972; Reinstain, 1990).

2) Therefore, concepts should be given before the computation to introduce physics. When the concept is established, students will be ready to the mathematical language of physics. This is called conceptual physics (Hewitt, 1972; 1983; 1990).

3) Conceptual physics has three components; hardcore physics, shaping critical thinking and relating physics with technology (Hewitt, 1972).

4) Hewitt is the frontier of conceptual physics in the area of high school physics instruction. In addition, his works reflects conceptual physics as well. Similar to his lessons, his works gets educators' appreciation. Therefore, in a study deals with conceptual physics in high school, it is the best choice to use Hewitt's books (Swartz, 1999).

5) Textbooks covers large portion of teaching sequence and it has an important role in teaching quality. Therefore, some research must be done about textbooks (Barrow, 1992; Başlantı, 2000; Leite, 1999; Yager & Penick, 1987).

6) Reading techniques are important to have more reading comprehension and development in reading skills (Anadolu Ajans, 2003). Among them K-W-L is one of the easiest and practical reading strategies, and it is flexible for different usages (Willhelm, 2003).

7) Students have difficulties and many misconceptions about heat and temperature concepts, and textbooks are one of the major sources of misconceptions (Çepni, et al., 2000).

This summary results show the need for a study 1) on the effectiveness of textbook on students' attitude and achievement which uses conceptual physics as a language, 2) that includes the effect of K-W-L reading strategy on enhancing textbook comprehension and developing reading skills, 3) that uses factorial design to test individual and overall effects, 4) that includes misconceptions concerning with heat and temperature.

# CHAPTER 3

# METHODS

## 3.1. Population and Sample

The target population of the study is all ninth grade students in Ereğli district of Zonguldak. Selection of the school was decided by convenience sampling, and the accessible population and the sample are determined as all the classes of Zonguldak Ereğli Super High School. The sample consists of four classes with about 30 students each. Each class is randomly assigned to one of the four methodologies: K-W-L reading strategy (K-W-L) with conceptual physics text (CPT), K-W-L reading strategy with traditional physics text (TPT), reading without K-W-L (Non-K-W-L) with conceptual physics text, and reading without K-W-L with traditional physics text.

Gender distribution among these four groups is almost the same. Major portion in the sample was female students, and each group contains only about ten male students. Therefore about 63% of the students were female.

Table 3.1 Numbers of Students in Each Class

| Gender | Group A K-W-L+CPT | Group B K-W-L+TPT | Group C Non-K-W-L | Group D Non-K-W-L +TPT |
|---|---|---|---|---|
| Male | 12 | 10 | 11 | 12 |
| Female | 19 | 20 | 20 | 19 |
| Total | 31 | 30 | 31 | 31 |

The ages of the students changes between 15 and 16. The largest portion of the groups is composed of the students at 16. Table 3.2 shows the age distribution.

Table 3.2 Age Distribution

| Age | Group A K-W-L+CPT | Group B K-W-L+TPT | Group C Non-K-W-L +CPT | Group D Non-K-W-L +TPT | Total |
|---|---|---|---|---|---|
| 15 | 10 | 13 | 5 | 11 | 39 |
| 16 | 21 | 17 | 26 | 20 | 84 |
| Total | 31 | 30 | 31 | 31 | 123 |

## 3.2. Variables

There are eight variables in the study. Two of them are dependent variables. These dependent variables are the post-test scores from achievement test (PostAch) and the post-test scores from the attitude test (PostAtt). Four of the remaining variables will be used as control variables. The control variables are students' pre-achievement test scores (PreAch), students' pre-attitude test scores (PreAtt), Gender and Age. Last two variables are Textbook Style (TS) and Reading Strategy (RS), whose effect on achievement and attitude searched throughout the study. The variables and their characteristics are given in Table 3.3.

Table 3.3 Variables and their Characteristics

| Variable Name | Abbreviation | Type | Nature | Data |
|---|---|---|---|---|
| Post-achievement test scores | PostAch | Dependent | Cont. | Int. |
| Post-attitude test scores | PostAtt | Dependent | Cont. | Int. |
| Pre-achievement test scores | PreAch | Independent – control | Cont. | Int. |
| Pre-attitude testscores | PreAtt | Independent – control | Cont. | Int. |
| Gender | Gender | Independent – control | Disc. | Nom. |
| Age | Age | Independent – control | Cont. | Int. |
| Textbook Style | TS | Independent | Disc. | Nom. |
| Reading Strategy | RS | Independent | Disc. | Nom. |

3.2.1. Dependent Variables

PostAch and PostAtt are two dependent variables included in the study. To determine the change in students' physics achievement and their attitude, two different instruments were administered. The first test is the achievement test named "Heat and Temperature Achievement test". It was developed by the researcher. The other test is the "Heat and Temperature Attitude Scale"; an adapted version of a measuring instrument used in the study of Taşlıdere (2002). At the end of the study, these two instruments were administered as posttests. Post-test scores are the scores of these instruments.

3.2.2. Independent Variables

PreAch, PreAtt, Gender, Age, TS, and RS are independent variables of the study. PreAch and PreAtt were determined by the scores of the measuring instruments when instruments were first administered before the study. Gender and Age were measured by related items placed at the top of the instruments. PreAch, PreAtt, Gender, and Age are all control variables and they are in interval scale. TS and RS are independent variables in nominal scale. TS has two values; CPT (1) and TPS (0). This variable shows whether textbook used in the study is conceptual or traditional. Conceptual textbook was coded as (1) and traditional textbook was coded as (0). Conceptual textbooks were provided by the researcher, and traditional textbooks are the textbooks that students were using. RS is the reading strategy with values K-W-L (coded as 1) and Non-K-W-L (coded as 0). This variable shows whether K-W-L or reading without K-W-L is used as a reading treatment. K-W-L is the adapted version of reading strategy firstly suggested by Ogle (1986). In the adapted version, L column of the K-W-L chart was completed at home as homework. Then students' findings were discussed. Another difference was that students began to K-W-L session by quickly reviewing the related concepts for two-three minutes. Non-K-W-L is the reading strategy students generally use. It is reading the texts in the guide of homework from textbook's chapter-end problems. It is generally reading only to solve unanswered questions (Hewitt, 1983). The way to administer these methodologies was standardized by the protocols given in Appendix A.

## 3.3. Measuring Tools

For the study, two instruments were developed: Heat and Temperature Achievement Test and Heat end Temperature Attitude Scale.

### 3.3.1. Heat and Temperature Achievement Test (PAT)

This test was generated by the researcher by using previous university examinations questions. At first, all of the items related to heat and temperature was searched. There were 82 items. From these, the items related to other concepts and the items that weren't included in the today's curriculum were deleted. Remaining items were grouped into several subcategories according to the sub concepts and question types. From these subcategories, two or three items that best represents each subcategory were selected. At the end of this procedure, there were 30 items that composes the first version of the test. This first version was administered to 30 eleventh grade students. The aim of this administration was to test usability and to control mistyping. This additional administration showed that 50 minutes (a class hour and a break) was enough for the administration of the test for the study. Conducting a pilot study for the test was difficult because of reaching enough number of participants. Therefore, instead of a pilot study to determine whether the test is appropriate to measure heat and temperature achievement, interviews with several students were used. First students were asked to read questions and think the answers loudly. By means of this process, four questions that might mislead students were deleted and the last form of the test was prepared. This test was put in two different forms by changing the arrangement of the items, font type, and design to compose pre and post versions of the test. The purpose of preparing two different versions of the test is to prevent testing threat. The final form of the test was composed of 26 conceptual and computational questions. This test was given in Appendix B

### 3.3.2. Heat and Temperature Attitude Scale (PAS)

This instrument is a 24 item attitude scale used in the study of Taşlıdere (2002). It was developed to measure students' attitude towards simple electricity. The only adaptation was done by changing the name of the concepts. It has five factors; Enjoyment, Self-Efficacy, Importance of Physics, Achievement Motivation, Interest Related Behavior. The PAS was given in Appendix C.

3.3.3. Validity and Reliability of Measuring Tools

There is no change in the original form of the attitude scale other than the name of the concepts. The statements "basit elektrik devreleri" were changed with "ısı ve sıcaklık". Therefore, the validity evidences for the attitude scale of Taşlıdere (2002) may be used as the validity evidences for the attitude scale in this study. The attitude scale was controlled by one instructor and two research assistants of the Department of Science and Mathematics Education at METU, one research assistant of Department of Science and Mathematics Education at Hacettepe University, and two private school teachers to establish face and content validity. In the study of Taşlıdere (2002), the Cronbach Alpha reliability coefficient was found to be 0.932 after the analysis of 160 ninth grade students' data. In this study, attitude scale was administered to 123 students and Cronbach Alpha reliability coefficient was found to be 0.934, a very close value to that of Taşlıdere (2002), in the PAS.

Content and face validity of the PAT was verified by three teachers from regular high schools and one teacher from a private high school. When verifying the content and face validity, the criteria were appropriateness for testing objectives of high school curriculum, representation of university examination, appropriateness for students' achievement level, understandability, and usability. The order of the questions was determined collectively by the researcher and the physics teacher of the private course. The test, then, was administered to an 11th grade class having the size of 30 students to test the time to complete the test, understandability of the questions, level of the questions and mistyping. After the changes, the test was controlled together with several students of different grades, schools and achievement levels. All questions were read and solved loudly by students. To prevent influencing students, researcher presents no ideas, or express whether the items solved correctly or not. The questions that were misleading and not appropriate were deleted. The last form was controlled by physics teachers at a regular high school. After the administration of the test, the data were put in to analysis in SPSS. After the reliability analysis, Cronbach' Alpha reliability coefficient was found to be 0.855 in the PAT.

## 3.4. Teaching/Learning Materials

### 3.4.1. Conceptual Physics Text (CPT)

As a treatment, conceptual physics texts were given to the students in two of the four groups. The texts were adapted from Hewitt's "Conceptual Physics" textbook (1999). During this adaptation procedure, two teachers - one is physics teacher and the other is English teacher- have translated the chapters related to heat and temperature. Then the translations were compared and the parts that were most suitable were combined to form a complete heat and temperature handbook. The draft was examined by several people to test understanding and fluency. Preparing the draft, the pictures in the book were scanned. Keeping the same format of Hewitt's textbook, first copy of the CPT was prepared. To find the best and the most appropriate way of coping the texts, there were some negotiations with photocopiers and printing operators. After the negotiations, it was decided to print documents by colored printers on 100 $g/m^2$ A4 glossy paper. One copy of the text was printed to test the quality of the text material and to correct possible problems. The quality was appropriate to further copying, but not as attractive as the material in printing offices. However, printing offices were financially appropriate only for large amount of copies. Therefore, copying process continued with colored printers. The last form of the textbook was given in Appendix D.

### 3.4.2. K-W-L Handbook

At first, administration of the study was planned to be conducted by a classroom teacher who has four ninth grade classes. To inform teacher about K-W-L, the works about K-W-L were compiled from the literature and a small guide was prepared by the researcher. However, when there was no teacher having the four ninth grade classes, the study was administered by the researcher. Then, this handbook was given in the appendices for the future use. The guide includes the definition of K-W-L, the goals of this reading strategy, the steps, and an example. The handbook was given in Appendix E.

### 3.4.3. Group Protocols

Every group in the study has a different combination of teaching techniques. To standardize teacher's way of teaching and prevent from any bias, short protocols were prepared. Protocols were used by the researcher. There were four groups in the study. For textbooks; no matter which textbook

is used, the concepts taught are the same for all groups. As a reading strategy, if teacher did not used K-W-L, only the concept was taught and then homework was given from the chapter-end problems. If K-W-L was used, teacher conducted “K” and “W” sessions in the class and made students to complete the “L” column of the table at home as a homework. In the next lesson, their answers found for the “L” column were discussed in the class. Whatever the group is, teacher used same lecture notes in all classes.

Although general structure was the same, the version of K-W-L used in the study has some differences in the application. The basic steps of administration K-W-L is given below. First, teacher draws a K-W-L chart on the board and request students do the same. Then teacher presents only the title of the topic to the students. After that teacher ask students to tell what they know about the concept for two-three minutes. Then request students to skim the text quickly. After all, teacher asks students to brainstorm what they know about the concept again, but in detail. In this case, teacher and students fill their “K” column in the table. The information written in this column can be true, false or suspicious. Then teacher wants students to categorize the information written in the “K” column. These categories are written in the space below the table. Then using the information they know and the things that are curious about, teacher makes students ask their questions that they want to learn. These questions are written to the “W” column of the chart on the board by teacher and to the “W” column of the chart that students fill. Then, teacher gives students these questions as homework. After stating their homework for the following lesson, teacher begins to teach concept by using his lecture notes and finishes the lesson.

K-W-L session continue in the next lesson. Teacher gives students two or three minutes to remember what they did. Then discuss what they learned from the text, what are the answers of suspicious points, and what are the misinformations stated in the “K” part; and then, students write them on the “L” column of the table. Students can add their individual questions also in the “W” column and find the answer from the text. Then adds the information to the “L” column. These additional questions can enrich the information learned from the text. The Figure 3.1 shows a sample K-W-L chart and its steps.

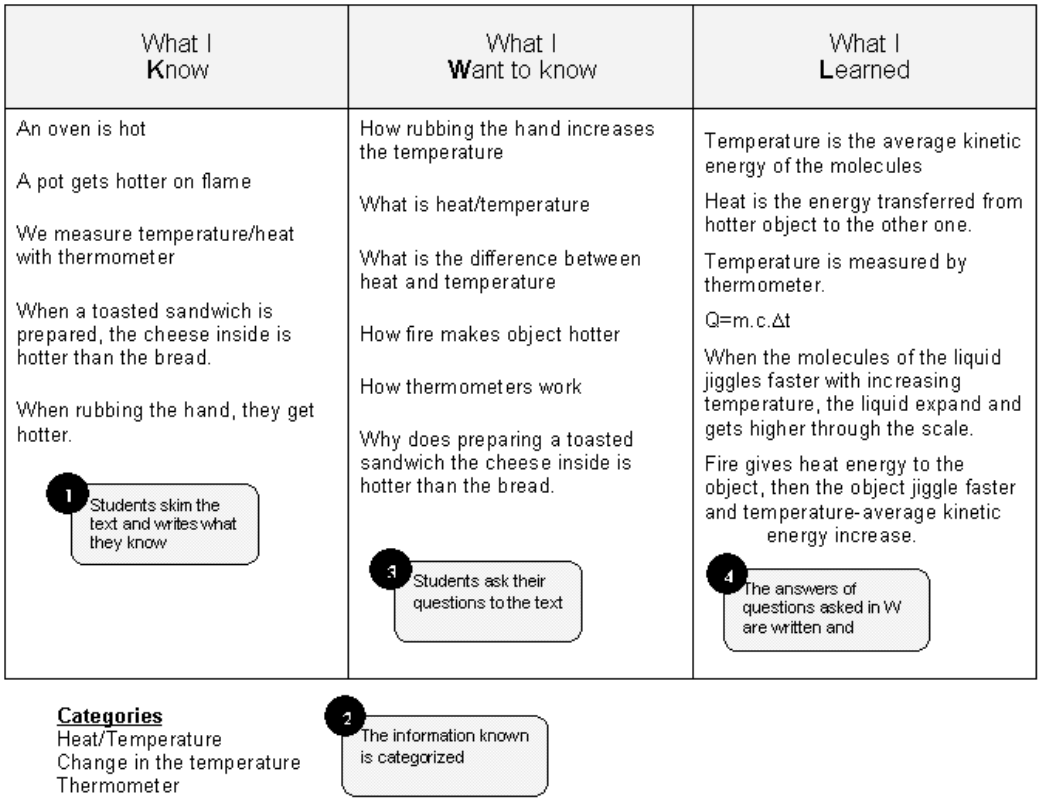


Figure 3.1. A sample K-W-L chart and steps of K-W-L

3.4.4. Worksheets

To enhance learning process and to overcome the negative effect of K-W-L on "time left for exercise", three worksheets were prepared. These worksheets were not different than it is mostly used in high schools. The worksheets were composed of about 12 questions, and most of items were computational. There is no difference between the groups in terms of use, the items inside, or format. All worksheets were given in Appendix F.

## 3.5. Procedure

At the beginning of the study, the problems related with the physics education were searched. A short literature review showed that the most problematic situation in physics education arises because of physics' computational perspective. Therefore another literature review began about the solutions of this problem. There were some solutions, but two approaches that were generalizable to

classroom use. Coordination between physics lessons with math lessons and conceptual physics. It was decided that conceptual physics was the most appropriate approach with respect to students' arithmetic anxiety. All of this literature review was initially done by the use of Internet and the books at METU library. After that the research problem was stated to be "what is the effect of conceptual physics on students' physics achievement and attitude". However, this seems meaningless to be asked for the first time. Because, to put conceptual physics into practice teachers should be aware of conceptual physics, should have broad range of general knowledge about daily use of physics and there should be enough written material to support education. Therefore, another question was composed that whether there was an easier way can be used as the first step of passing to conceptual physics. All of these studies lead conceptual physics to be used in a textbook. In this way, both students and teachers could be introduced with conceptual physics, they could obtain general knowledge about the application of physics in daily life and an example material could be presented. Then a more detailed analysis was made about conceptual physics, situation of current textbooks and the ways of using text material in a course. Among the ways of textbook use, K-W-L is searched more carefully because of its appropriateness to the study. Keywords were prepared and that were searched through Educational Resources Information Center (ERIC), International Dissertation Abstracts, Social Science Citation Index (SSCI), Ebscohost, Science Direct and Internet (Google). At the same time, previous studies at YÖK, Hacettepe Eğitim Dergisi, Eğitim ve Bilim, and Çağdaş Eğitim Dergisi were searched. The books about the related concepts were searched in METU library.

According to literature review the study was designed including CPT and K-W-L. It was planned to test the hypotheses experimentally. The most appropriate experimental design for the study was a factorial design. In this way, effects of more than one variable can be tested in a single study. Moreover, it allows measuring the combined effects of the variables. By putting two elements of reading techniques (K-W-L and Non-K-W-L) and two elements of textbook style (CPT and TPT) four groups were prepared to form factorial design. These four groups were: CPT with K-W-L, TPT with K-W-L, CPT with Non-K-W-L, and TPT with Non-K-W-L. Later, appropriate schools and the classes

were identified, and permission was requested from Ministry of Education. The design of the study was given in the Table 3.4.

Table 3.4 Design of the Study

| | CPT | TPT |
|---|---|---|
| K-W-L | CPT+K-W-L (Group A) | TPT+K-W-L (Group B) |
| Non-K-W-L | CPT+ Non-K-W-L (Group C) | TPT+ Non-K-W-L (Group D) |

A permission was obtained from P.G. Hewitt to use his "Conceptual Physics" textbook (Hewitt, 1999) through e-mail. The reformatted form of Hewitt's permission e-mail is given in Appendix G. Then related chapters from Hewitt's textbook were translated to Turkish by two teachers having branches English and physics. Their translations were compared and best translated parts were put together. The images were scanned through scanner and combined with the translations as the original textbook. After the controls of fluency, understandability, correctness of translation and consistency of the terms in Turkish, a copy is printed. With the copy, the opinions of several photocopiers and printing operators were obtained. The printing, or copying, conditions were discussed. It was decided to print the copies from a color printer.

The previous studies were searched to find appropriate measuring instruments. Taşlıdere's (2002) attitude test was found appropriate for measuring the attitude towards heat and temperature. This attitude test about simple electricity was adapted to heat and temperature by, only, changing the name of the concepts. However, finding appropriate achievement test was more difficult. This achievement test should include both conceptual and computational items, and be appropriate for the classroom use. The specified criteria enforced researcher to develop his own achievement test. Some difficulties in the development of the achievement test like having difficulties in administering a pilot version, and small time period to develop the test leads researcher to use the questions asked in university examinations. To develop the test all related items in the examinations were examined.

These items were grouped according to the learning outcomes and question types. From each groups of questions the questions best represent the nature of the group were selected. Then they were transferred to the computer environment. This version of the instrument is administered to an 11th grade class of size 30 students before the study. This administration was used to determine the time need to complete the test, understandability, level of the items and whether there is a mistyping. After that, the instrument is administered to 12-15 students of different grades and achievement levels in the form of interview. Students read aloud the items and solved the questions loudly. By means of the interviews, four questions were deleted to support understandability.

Using the literature review, a small manual to inform teachers of the K-W-L procedure was prepared. K-W-L was an effective and flexible technique to improve reading comprehension. However, model of K-W-L was appropriate for small or medium sized texts. If it were used for long texts, some modifications should be made on the reading strategy. Therefore the method was adapted to the study. In this adaptation, first 15 minutes would be used for K-W-L activities, and then the remaining time was used for traditional teaching strategies. Unlike the common form of K-W-L, the modified form of K-W-L (K-W-L-L) would include two brainstorming sessions. At the beginning teachers presents the day's topic and tasks students what they know about the topic. Then students look over the text for two-three minutes. After that the main brainstorming session in K-W-L begins. Moreover, in the modified form of K-W-L, L column in the K-W-L chart filled by the students at home. Categorization of the information, then, made by whole class at the following lesson. To make this difference clear and to standardize teacher's way of teaching a simple protocol was prepared.

To enhance learning environment and to prevent adverse effects of using K-W-L in terms of time left to do practice, three worksheets were prepared. Worksheets were mainly consisting of computational items and were the same for all groups.

Developing the material used in the study, researcher get in touch with the directors and the physics teachers of the selected schools. After the discussions, two decisions were made: the study was only appropriate for Zonguldak Ereğli High School and the researcher would administer the study himself. There were two important reasons behind these decisions. There should be at least four classes

having the same status, and the instructor should be the same for each class to eliminate the effect of teacher.

Study was administered to four super high school classes found at Zonguldak Ereğli High School. Each class randomly assigned to the groups. Pretest versions of attitude and achievement tests were administered by the researcher. To administer, 10 minutes was given to students for the attitude scales and 50 minutes for the achievement tests. Through the research study, a factorial design was used. Two of the groups were given conceptual physics text and they were asked to study the course from this material, instead of their textbooks. The other two groups were used their own textbooks. Each of the classes was treated by the researcher as in the protocols. Study was continued five weeks. Then, post tests were administered. There were eight students absent in the day post-tests administered. To avoid missing data, they were administered with post-tests before the semester ends.

## 3.6. Analysis of Data

The variables in the study are age, gender, previous attitudes, previous achievement, post attitude, post achievement, textbook style and reading strategy. All of data were written in Excel. Analyses were done by using both Excel and SPSS. The research data can be found in Appendix H.

### 3.6.1. Descriptive Statistics

Mean maximum score, minimum score, standard deviation, skewness, kurtosis, standard error for skewness, standard error for kurtosis and histograms were presented for each group.

### 3.6.2. Inferential Statistics and Power Analysis

There are two dependent variables, four independent variables that two of them are covariates and the other two are group membership. Therefore, analysis named MANCOVA was used to statistically equate the groups and to detect the effects of methodologies. Significance level was set to .05, because it is the most preferred value in educational research. The 4:1 ratio of $\beta$ to $\alpha$ is suggested for educational research (Hinkle et al., 1988). Then corresponding $\beta$ was 4. (0.5)= .20 and the power became 1-(.20) =.80. There was no study that combines CPT with K-W-L in the literature. Therefore, no specific effect size level was preferred. Then the mostly used the effect size was considered, which

is .50. Having four treatments with power .80 and with .50 of effect size, appropriate sample size was calculated as 100.

## 3.7. Assumptions

The assumptions and the limitations of the study are given below.

1. The participants of the study honestly answered the items.
2. Throughout the study, implementer correctly applied the protocols and not biased.
3. Administration of the tests was under standard conditions.
4. There are no interactions and sharing between the groups.

# CHAPTER 4

# RESULTS

This chapter begins with missing data analysis, and then shows descriptive and inferential statistics about the study. At the end of the chapter, there is a short summary of the findings.

## 4.1. Missing Data Analysis

Because of the small sample size, each of the missing data was important. At the first administration of the test, there were no students absent. However, missing data could occur by not completely filling the attitude scale. Therefore, before the administering the test and during the administration the need for filling attitude scale was emphasized several times. In addition, each student's attitude scale was revised against the items left blank just after the administration. In the post-test the same procedure was followed. The absent students in the post-test were asked to complete the tests before the semester ends. Therefore, there were no missing data in the study.

## 4.2. Descriptive and Inferential Statistics

### 4.2.1. Descriptive Statistics

To illustrate the relations between the groups, mean scores obtained from the tests, their standard deviations, maximum and minimum scores of each group were calculated. At the same time, to check the normality, skewness, kurtosis, standard error for skewness, and standard error for kurtosis were also calculated. Table 4.1 shows the descriptive statistics of the study.

Table 4.1 Descriptive Statistics

| | Whole | | Group A | | Group B | | Group C | | Group D | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| Scores on PAT | | | | | | | | | | |
| N | 123 | 123 | 31 | 31 | 30 | 30 | 31 | 31 | 31 | 31 |
| Mean | 4.27 | 15.67 | 4.58 | 17.19 | 5.53 | 15.73 | 4.58 | 14.97 | 2.42 | 14.77 |
| Standard deviation | 2.41 | 5.68 | 2.14 | 5.58 | 2.27 | 5.73 | 1.86 | 5.53 | 2.29 | 5.84 |
| Maximum | 12 | 25 | 9 | 25 | 12 | 25 | 8 | 24 | 7 | 25 |
| Minimum | 0 | 6 | 0 | 8 | 2 | 7 | 1 | 6 | 0 | 7 |
| Skewness | 0.165 | 0.90 | 0.110 | -0.041 | 0.683 | 0.026 | -0.136 | 0.150 | 0.795 | 0.261 |
| Std Error for Skewness | 0.218 | 0.218 | 0.421 | 0.421 | 0.427 | 0.427 | 0.421 | 0.421 | 0.421 | .0421 |
| Kurtosis | -0.065 | -1,326 | 0.208 | -1.429 | 1.324 | -1.374 | -0.680 | -1.221 | -.524 | -1.367 |
| Std Error for Kurtosis | 0.433 | 0.433 | 0.821 | 0.821 | 0.833 | 0.833 | 0.821 | 0.821 | 0.821 | 0.821 |
| Scores on PAS | | | | | | | | | | |
| N | 123 | 123 | 31 | 31 | 30 | 30 | 31 | 31 | 31 | 31 |
| Mean | 75.33 | 77.91 | 76.16 | 78.81 | 72.67 | 73.80 | 81.45 | 88.87 | 70.97 | 70.03 |
| Standard deviation | 17.10 | 17.26 | 16.37 | 16.31 | 17.67 | 13.70 | 13.54 | 14.85 | 19.24 | 18.39 |
| Maximum | 118 | 120 | 108 | 116 | 104 | 104 | 113 | 120 | 118 | 108 |
| Minimum | 24 | 24 | 41 | 50 | 45 | 54 | 54 | 60 | 24 | 24 |
| Skewness | -0.134 | -0.086 | -0.020 | 0.421 | 0.262 | 0.633 | 0.212 | -0.121 | -0.194 | -0.534 |
| Std Error for Skewness | 0.218 | 0.218 | 0.421 | 0.421 | 0.427 | 0.427 | 0.421 | 0.421 | 0.421 | .0421 |
| Kurtosis | 0.058 | 0.282 | -0.226 | 0.341 | -1.115 | -0.262 | -0.053 | -0.290 | 0.913 | 0.405 |
| Std Error for Kurtosis | 0.433 | 0.433 | 0.821 | 0.821 | 0.833 | 0.833 | 0.821 | 0.821 | 0.821 | 0.821 |

The PAT scores were given out of 26, and the PAS results were given out of 100. The groups have similar scores from the achievement test at the beginning. There is only a slight difference between the groups. When considering the standard deviations there seems no difference between the groups at the beginning. On the other hand, means of the pre-test attitude test scores (PREATT) changes for each group. However, considering the standard deviations, this difference is not so meaningful.

Pre-achievement test scores (PREACH) changes between zero and 12. There is a big gap among the students inside. But, the standard deviations for the PREACH are between 1.86 and 2.41, and the average mean is 4.27. Then, groups are almost homogenous inside. In the post-achievement test scores (POSTACH), whole groups reached to 25 except Group D (Non-K-W-L with TPT). The

worst score was six, obtained in Group C (CPT with Non-K-W-L). Average mean was reached to 15.67 and standard deviation for PREACH results around 5.68. According to the standard deviations, spread of the scores was achieved in the PAT.

Normality of the pre-test scores was tested according the standard errors of skewness and kurtosis. One way of determining whether the skewness or the kurtosis do not violates normality assumption is that if the value of skewness, or kurtosis, is between the ranges from minus twice standard error to plus twice the standard error of the value, the normality is not significantly violated (Price, 2000). Fortunately, all pre-test data were within that range. Therefore, normality can be considered to be satisfied.

Figure 4.1 presents the histograms that show the distribution of POSTACH. From the histogram, it is clear to be seen that Group A, Group B and Group C positively skewed in terms of POSTACH. Group D is also positively skewed, but not as the other groups.

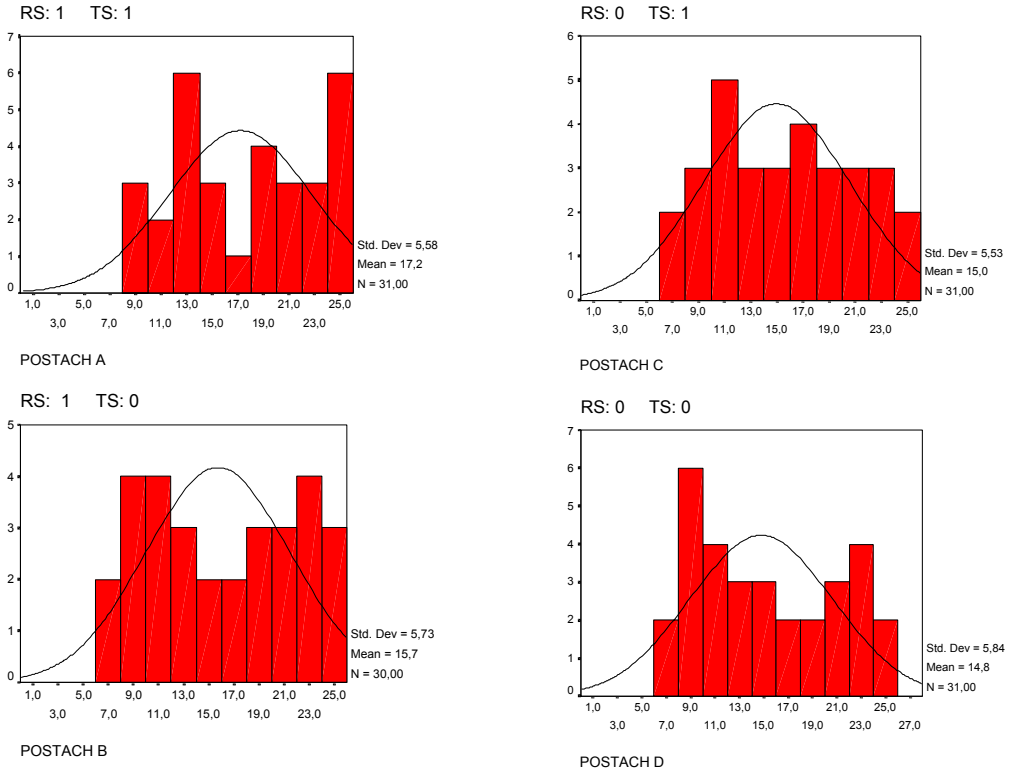

Figure 4.1. Histograms with normal curves related to the POSTACH scores of students for each group.

Figure 4.2 presents the histograms that show the distribution of the post-attitude scores (POSTATT). In terms of POSTATT; Group A, Group B and Group C are positively skewed. However, Group C shows skewness more than other groups. Group D was a bit skewed to the left.

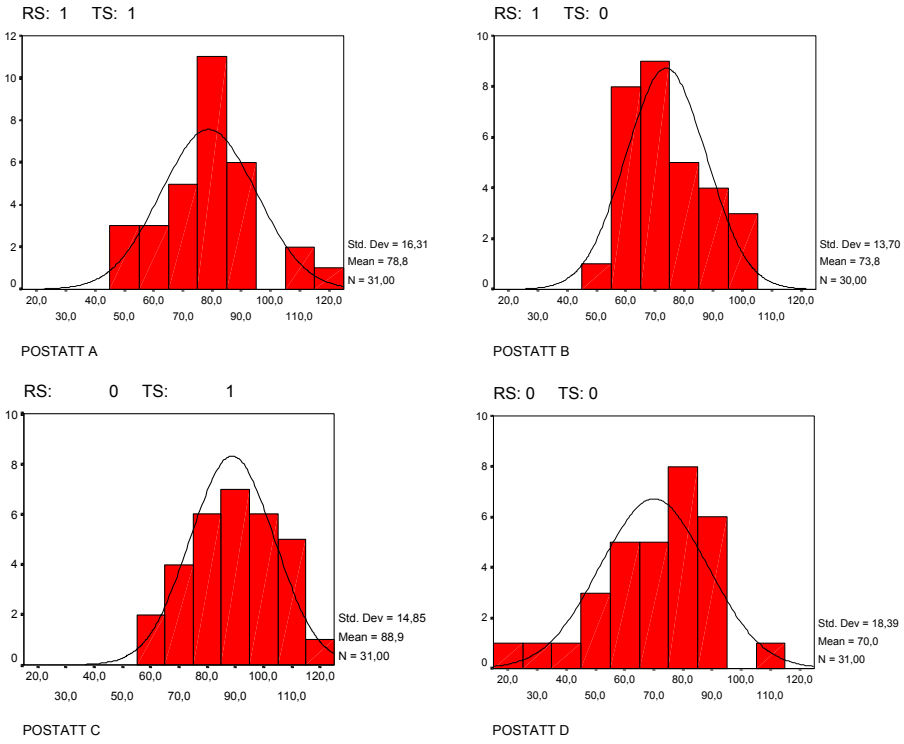


Figure 4.2. Histograms with normal curves related to the POSTATT scores of students for each group

The effect size of main and interaction effects of K-W-L and CPT was calculated by taking the difference of the mean scores for Group A from that of Group D, and then, dividing the result by the standard deviation of Group D. The effect size of K-W-L was calculated by taking the difference of the average mean scores of Group A and Group B from that of Group C and Group D, and then, dividing the result by the average standard deviation of Group C and Group D. The effect size of CPT was calculated by taking the difference of the average mean scores of Group A and Group C from that of Group B and Group D, and then, dividing the result by the average

standard deviation of Group B and Group D. The effect size was determined as .50 before. When the effect of K-W-L without CPT considered, effect size is smaller than pre-determined.

When both methods were used together, effect size has reached to medium levels and near to pre-determined value.The individual effect of the CPT has a larger effect size. Table 4.2 shows the effect sizes according to the groups.

Table 4.2 Effect Sizes between Groups

| Group | Effect size in achievement | Effect size in attitude |
|---|---|---|
| K-W-L+CPT | .41 | .48 |
| K-W-L | .28 | .19 |
| CPT | .14 | .69 |

4.2.2. Inferential Statistics

This part is composed of three subtitles: determination of covariates, assumptions of MANCOVA and MANCOVA analysis.

Determination of Covariates: The variables age, gender, previous physics achievement scores (PREACH), previous physics attitude scores (PREATT) were predetermined as confounding factors. To statistically equate the groups, these variables will be used as covariates. Before using these variables as covariates, their relations with the dependent variables were investigated. Table 4.3 shows the results of significance test of correlation between dependent variables and covariates.

Table 4.3 Significance Test of Correlation between Dependent Variables and Covariates

| | POSTACH | POSTATT |
|---|---|---|
| Age | -0.145 | 0.128 |
| Gender | -0.098 | -0.075 |
| PREACH | 0.840* | 0.037 |
| PREATT | -0.150 | 0.726* |

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

According to Table 4.3, there is a significant correlation between the PREACH and POSTACH, and a significant correlation between PREATT and POSTATT. However, Age and Gender do not significantly correlates with the dependent variables. Including Age and Gender as covariates seems not logical. Therefore, only the PREATT and PREACH were determined as the covariates. When their correlation with each other was calculated the coefficient was found to be -0.042. Then, this is not at .05 level. Therefore, multicollinearity among the covariates was assumed. Then, both variables can be used as covariates.

Assumptions of MANCOVA. Before implementing MANCOVA analysis, five assumptions must be satisfied. These assumptions are: normality, homogeneity of regression, equality of variances, multicollinearity and independency of observations.

As indicated before, normality was checked by the standard errors of skewness and kurtosis. If the skewness of the scores obtained from the POSTACH and POSTATT is between the range from minus twice standard error to plus twice the standard error of the value, the normality is not significantly violated. The statistics shows that none of the value is outside the range from minus to plus twice standard errors. Therefore, the scores can be accepted to be approximately normally distributed.

Homogeneity of regression line shows that the effect of methodologies does not change throughout the covariates. Statistically, the slope of the regression of a dependent variable on covariates must be constant across groups. To satisfy this assumption, three models were generated by using covariates, group memberships and their multiplications. Then their regression was done. Contribution of the third model must not be significant to satisfy the assumption. There are several combinations for modeling. A sample combination is given in Table 4.4. In the sample Model 1 is PREATT, Model 2 is PREATT, RS, TS, and Model 3 includes Model 2 plus their multiplications.

Table 4.4 Results of the analysis of homogeneity of regression line for the POSTATT.

| Model | Change Statistics | | | | |
|---|---|---|---|---|---|
| | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .527 | 135.057 | 1 | 121 | .000 |
| 2 | .044 | 6.152 | 2 | 119 | .003 |
| 3 | .016 | 2.203 | 2 | 117 | .115 |

As seen in Table 4.4, there was no significant contribution of Model 3. Therefore, homogeneity of regression line assumption was assumed to be satisfied. The same analysis was done for the POSTACH also. Again, there was no significant change. Then this assumption was also valid for the POSTACH.

To determine whether equality of variance assumption is satisfied, Levene's test of Equality of variances was used. Table 4.5 indicates that, the error variances of the dependent variables were equal across the groups.

Table 4.5 Levene's Test of Equality of Error Variances

| | F | df1 | df2 | Sig. |
|---|---|---|---|---|
| POSTATT | 1.800 | 3 | 119 | 0.151 |
| POSTACH | 1.822 | 3 | 119 | 0.147 |

There was no significant correlation between the covariates as stated before. Therefore, no multicollinearity among the covariates is satisfied. At last, the independency of the observations is controlled by the researcher. Although administration of the tests was to a class rather than individuals, the researcher controlled the participants to do tests by themselves.

MANCOVA Analysis. There are two dependent variables, four independent variables that two of them are covariates and the other two are group membership. Therefore, multivariate analysis of variance (MANCOVA) is appropriate for testing the hypotheses. The PREACH and PREATT will be used for covariates, Reading Strategy (RS) and Textbook Style (TS) are group memberships, and the POSTACH and POSTATT are dependent variables of the study.

Null Hypothesis 1. The first null hypothesis was; ' There will be no significant main effects of CPT, K-W-L, and interaction effects on the population mean of the collective dependent variables of; ninth grade students' physics achievement and physics attitude toward heat and temperature concepts when the effects of prior achievement, prior attitude, gender, and age are controlled'.

To determine the interaction effect of the RS and TS, MANCOVA is used. According to the results presented in Table 4.6, the first null hypothesis was rejected (for the RS, $\lambda$=0.795, p=.999; for the TS; $\lambda$=0.894, p=.917; for the interaction; $\lambda$=0.48, p=.000).

Table 4.6 Multivariate Test Results

| Effect | Wilks' Lambda | F | Hypothesis df | Error df | Sig. | Eta Squared | Observed Power |
|---|---|---|---|---|---|---|---|
| Intercept | .640 | 32.592 | 2.000 | 116.000 | .000 | .360 | 1.000 |
| PREACH | .140 | 355.892 | 2.000 | 116.000 | .000 | .860 | 1.000 |
| PREATT | .478 | 63.363 | 2.000 | 116.000 | .000 | .522 | 1.000 |
| RS | .795 | 14.940 | 2.000 | 116.000 | .000 | .205 | .999 |
| TS | .894 | 6.887 | 2.000 | 116.000 | .001 | .106 | .917 |
| RS * TS | .493 | 59.730 | 2.000 | 116.000 | .000 | .507 | 1.000 |

To test the effects of the independent variables on each dependent variable, analysis of covariance (ANCOVA) was used as a follow-up test. Table 4.7 indicates the results of follow-up ANCOVAs.

Table 4.7 Test of Between-Subjects Effects

| Source | Dependent | Type III | df | Mean | F | Sig. | Eta | Observed |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | POSTACH | 3411.2 | 5 | 682.2 | 151.7 | .000 | .87 | 1.00 |
| | POSTATT | 21428.0 | 5 | 4285.6 | 33.6 | .000 | .60 | 1.00 |
| Intercept | POSTACH | 212.1 | 1 | 213.0 | 47.4 | .000 | .29 | 1.00 |
| | POSTATT | 3111.9 | 1 | 3111.9 | 24.4 | .000 | .17 | .99 |
| PREACH | POSTACH | 3203.3 | 1 | 3203.3 | 712.3 | .000 | .86 | 1.00 |
| | POSTATT | 8.3 | 1 | 8.3 | .06 | .799 | .001 | .06 |
| PREATT | POSTACH | 16.6 | 1 | 16.6 | 3.7 | .057 | .03 | .48 |
| | POSTATT | 15158.7 | 1 | 15158.7 | 118.8 | .000 | .50 | 1.00 |
| RS | POSTACH | 134.6 | 1 | 134.6 | 29.9 | .000* | .20 | 1.00 |
| | POSTATT | 122.9 | 1 | 122.9 | 1.0 | .328 | .01 | .16 |
| TS | POSTACH | 6.8 | 1 | 6.8 | 1.5 | .223 | .01 | .23 |
| | POSTATT | 1460.8 | 1 | 1460.8 | 11.4 | .001* | .09 | .92 |
| RS * TS | POSTACH | 500.3 | 1 | 500.3 | 111.3 | .000* | .48 | 1.00 |
| | POSTATT | 507.1 | 1 | 507.1 | 4.0 | .049* | .03 | .51 |
| Error | POSTACH | 526.1 | 117 | 4.5 | | | | |
| | POSTATT | 14928.0 | 117 | 127.6 | | | | |
| Total | POSTACH | 34127.0 | 123 | | | | | |
| | POSTATT | 782973.0 | 123 | | | | | |
| Corrected Total | POSTACH | 3937.3 | 122 | | | | | |
| | POSTATT | 36356.0 | 122 | | | | | |

* Significant at the 0.05 level (2-tailed).

Table 4.8 below shows the adjusted means for the dependent variables.

Table 4.8 Adjusted Means for the Dependent Variables

| Dependent Variable | RS | TS | Adjusted Mean | Std. Error |
|---|---|---|---|---|
| POSTACH | 0 | 0 | 19.169 | .422 |
| | 0 | 1 | 14.345 | .389 |
| | 1 | 0 | 12.600 | .404 |
| | 1 | 1 | 16.453 | .382 |
| POSTATT | 0 | 0 | 73.204 | 2.245 |
| | 0 | 1 | 84.708 | 2.072 |
| | 1 | 0 | 75.441 | 2.153 |
| | 1 | 1 | 78.210 | 2.035 |

For the Table 4.8, RS (1) represents K-W-L, RS (0) represents Non-K-W-L, TS (1) represents CPT and TS (0) represents TPT. When comparing with the Table 4.1, adjusted means of POSTACH for all groups is smaller than that of given in Table 4.1, except group Non-K-W-L with TPR. For the comparison of the means of POSTATT, only Group A (CPT with K-W-L) and Group C (CPT with Non-K-W-L) have smaller adjusted means than calculated means given in Table 4.1.

Null Hypothesis 2. The sixth null hypothesis was; 'There is no mean difference exists among students classified by the product of the CPT and K-W-L on ninth grade students' achievement in heat and temperature concepts when prior achievement, prior attitude, gender, and age have been accounted for'.

As seen from Table 4.7 the sixth null hypothesis was rejected ($F(1,117)=111.3$, $p=.000$). Therefore, there is enough evidence that students treated with the CPT and K-W-L at the same time has a greater achievement than those treated with the TPT and Non-K-W-L at the same time.

Null Hypothesis 3. The second null hypothesis was; 'There is no population mean difference exists between the achievement scores in heat and temperature concepts of the ninth grade students' treated with CPT and those of the ninth grade students' treated with TPT when prior achievement, prior attitude, gender, and age have been accounted for'.

As seen from Table 4.7 the second null hypothesis was failed to be rejected ($F(1,117)=1.5$, $p=.223$). That means; there is no evidence that students treated with the CPT have higher physics achievement than those treated with the TPT.

Null Hypothesis 4. The third null hypothesis was; 'There is no mean difference exists between the achievement scores in heat and temperature concepts of the ninth grade students' treated with the K-W-L and those of the ninth grade students' treated with the Non-K-W-L when prior achievement, prior attitude, gender, and age have been accounted for'.

As seen from Table 4.7 the third null hypothesis was rejected ($F(1,117)=29.9$, $p=.000$). Therefore, students treated with the K-W-L have a greater achievement than those treated with the Non-K-W-L.

Null Hypothesis 5. The seventh null hypothesis was; 'There is no mean difference exists among students classified by the product of the CPT and K-W-L on ninth grade students' attitude towards heat and temperature concepts when prior achievement, prior attitude, gender, and age have been accounted for'.

As seen from Table 4.7 the seventh null hypothesis was rejected ($F(1,117)=4.0$, $p=.049$). Therefore, there is enough evidence that students treated with the CPT and K-W-L at the same time has a greater attitude than those treated with the TPT and Non-K-W-L at the same time.

Null Hypothesis 6. The fourth null hypothesis was; 'There is no mean difference exists between the attitude scores in heat and temperature concepts of the ninth grade students' treated with the CPT and those of the ninth grade students' treated with the Non-K-W-L when prior achievement, prior attitude, gender, and age have been accounted for'.

As seen from Table 4.7 the fourth null hypothesis was rejected ($F(1,117)=11.4$, $p=.000$). Therefore, students treated with the CPT have a greater attitude than those treated with the Non-K-W-L.

Null Hypothesis 7. The fifth null hypothesis was; 'There is no mean difference exists between the attitude scores in heat and temperature concepts of the ninth grade students' treated with the K-W-L and those of the ninth grade students' treated with the TPT when prior achievement, prior attitude, gender, and age have been accounted for'.

As seen from Table 4.7 the fifth null hypothesis was failed to rejected ($F(1,117)=1.0$, $p=.328$). That means; there is no evidence that students treated with the K-W-L have higher physics attitude than those treated with the Non-K-W-L.

### 4.3. Change in the Classroom Environments During Treatments

In class observations shows that there was a change during the administration of the treatments. When using CPT, students began to ask more conceptual questions to the instructor. Their questions were to understand the phenomenon rather than only solving the problems. On the other hand, students treated with TPT generally complaint about physics course and saw physics as useless. Students uses K-W-L attend more to classes that students in Non-K-W-L groups. They began to read systematically and began to look for a problem from different perspectives.

When K-W-L is used with TPT, students had a difficulty in finding answers for the questions raised in the "W" step from their textbooks. Then K-W-L session became a bit problematic to follow. However when K-W-L students used CPT, most of their questions were found in the textbook. In addition, the level and type of questions asked in the "W" step of K-W-L procedure was drastically changed

### 4.4. Summary of the Results

The findings of the statistical analyses are summarized below:

1. Students' means of the achievement and attitude scores changed positively in all groups except the mean of the attitude scores in Group D.
2. There were no significant correlation between the independent variables of Age and Gender and dependent variables of the POSTACH and POSTATT.
3. There was a significant correlation between the PREACH and POSTACH. But, there was no significant correlation detected between the PREACH with POSTATT.
4. There was a significant correlation between the PREATT and POSTATT. But, there was no significant correlation detected between the PREATT with POSTACH.

5. Using the CPT instead of the TPT significantly increased the students' achievement in heat and temperature. However, there was no significant change observed on the students' attitude towards the subject.
6. Using the K-W-L instead of the Non-K-W-L significantly increased the students' attitudes towards heat and temperature. However, there was no significant change observed on the students' achievement in the subject.
7. Using both the K-W-L and CPT, instead of the TPT and Non-K-W-L, significantly increased the students' achievements and attitudes towards heat and temperature.

# CHAPTER 5

# CONCLUSIONS, DISCUSSIONS AND IMPLICATIONS

This chapter is divided into six sections. First section includes conclusions. Second presents the discussion of the results. Third section discusses the implications of the study. Fourth section discusses internal validity threats. Fifth section discusses external validity. And, the last section presents some recommendations for further research.

## 5.1. Conclusions

Study introduces population as ninth graders at Ereğli district of Zonguldak. Sample size of 123 participants seems to be a large number for an experimental study. However, this number of participants was divided in four classes. Therefore, there are about 30 students in each group - a critical number for an experimental study. On the other hand, the sample size is equal to the population size at the selected super high school. Therefore, the results of the study can easily be generalizable to the whole population of the selected school. For the individual effects of the K-W-L, effect sizes were at smaller levels than (smaller than .40) it was expected; therefore, results should be evaluated accordingly. That is, although the statistical power was large, the findings related with the individual effect of K-W-L were not absolute facts. The items below states some conclusions related to the results.

1- Using conceptually oriented physics textbooks significantly increased students' attitude towards heat and temperature. On the other hand, although there is an increase in the mean of the students' achievement, no significant effect was detected on the mean of the achievement scores. Textbooks that teaches physics traditionally has no significant contribution to the

achievement. Moreover, there is a small decrease in the mean of the attitude scores. Therefore, it can be concluded that unlike TPT, using CPT significantly increases students' attitude.

2- The K-W-L seems to increase students' achievement more than Non-K-W-L on the concept. However, no statistically significant effect on the attitude was detected. This statistic may be seen as important, but the small effect size leads further research to test the practical significance.

3- When the CPT is supported with the K-W-L, their combined effect significantly increases both achievement and attitude. On this statistic, medium effect sizes were obtained. Therefore, this result has some importance for educators.

## 5.2. Discussion of the Results

The results were similar to those appears in class environment and those arrived at the end of similar studies. Hewitt (1990) presents some success stories about some teachers and claims that conceptual physics increases students' achievement. However, the article was not on statistical basis. In Turkey, the first study based on the statistical analysis was the experimental study of Taşlıdere (2002). In his study, students treated with conceptual physics increased both their achievement and attitude. In his study, he used several materials that promoted learning. On the other hand, using only one of these materials with no conceptual physics instruction most probably do not have as significant effect as complete set of learning. The students that use CPT expressed their opinions in the class. In their opinion, the CPT lead them see physics as everyday phenomena and made the things easier to understand. The ideas in the text were logically placed, and it was enjoyable to read rather than being boring. The in-class observations were in harmony with these opinions. There were more conceptual questions asked to the teacher, and these questions were asked to understand the phenomenon rather than to solve a problem .On the other hand, there were some complaints in other groups treated with the Non-K-W-L like "why we have to learn these concepts, we won't use them in our life".

Yager (1983) claims that science textbooks effects classroom environment. The textbooks in relation with daily life generally get attention of the learner (Chiappetta, 1991). And the textbooks which aim to directly convey knowledge rather than combining information with daily life have negative effect on the learners (Başlantı, 2000). In this study, a significant change was

appeared in the attitude, but not in the achievement. There was a similar result, when students treated with the CPT. Students treated with the CPT sometimes say that up to now no one presents physics in such a way and showed better results in the attitude scales. However, no significant change in the attitude was obtained.

Conceptual physics text includes small number of numerical questions (Hewitt, 1990). Then its effect was not appropriate for testing directly with computational questions. Therefore, all groups were given worksheets that were mostly composed of computational examples to decrease this disadvantage of conceptual physics texts. This need is similar to the need of including more test questions at the back of the textbook as Ayvacı et al. (1999) indicates.

There were some studies talking about the positive effects of using the K-W-L in their lesson like Ogle (1986), Cantrell (1997), and Huffman (1998). But, their studies were not on statistical basis. In addition, they investigate generally the things like development in the reading skills, long term remembering of the information and improvement in understanding the information students received. Therefore, the results of these studies do not directly contribute to current study. There was another barrier in the generalization of literature results on this study. It is the change in the form of the K-W-L. In normal, questions generated through the K-W-L session are tested immediately after the discussions. However, in this study testing the questions was postponed to home as homework and the answers reviewed in the next lesson. Such a change may have effects on students differently. In this study, there is a significant change in the achievement, but not in the attitude. Increase in the achievement somewhat an expected result. Because, by means of the K-W-L, students understand the way of reading a text and can look to a problem from different perspectives (Cantrell, 1997). The same effect was expected in the attitude. However, insignificant result was appeared. This may be due to the structure of the textbook used as a traditional text. Such a text, as indicated in the introduction, aims only to present the information and relies on computations. Therefore, the TPT did not include enough general knowledge to answer students' questions raised in the K-W-L session. Students often complaint about not finding the information they want when the TPT was used. Then, this unwanted situation might result in negative effect on students' attitudes.

There was no study that combines the K-W-L with CPT before in the literature. Therefore, guessing their combined effects on achievement and attitude is difficult. However, first two discussions about individual effects of the K-W-L and the CPT give an idea about the result. The K-W-L is a technique for reading comprehension, and a way to learn to look at a problem from different perspectives. The CPT is the text where students can find their answers, and learn about daily life, technology and more. The K-W-L was effective in increasing the achievement and the CPT was effective in increasing the attitude. Therefore, their combined effects should increase both achievement and attitude, like classroom observations indicate. Fortunately, the statistical analyses were similar to the ideas we present and their combined effect significantly increase both achievement and attitude of the students on heat and temperature.

## 5.3. Implications of the Study

The study has shown that using conceptual physics text is an appropriate technique to increase students' attitudes towards physics. In this way, teachers may help students to overcome their physics anxiety. Because, when students learn that physics is not a completely different concept from the daily life, they can look physics as discovering the mysteries of the unknown concepts.

One of the findings of this study is that textbooks are not effectively used when no specific instructional reading strategy is applied. Ineffective use has two meanings: students do not know how to read a text and simply do not care about the textbook. In other words, students do not look at their textbooks, unless it is necessary. If there is homework to do at the textbook, students just do their homework at the end of the chapter and do not look at other information in the book.

The new modification in the K-W-L makes it more appropriate for the teachers who do not want to spend most of the class hours to reading. In this technique, teachers only spend about fifteen minutes of their lessons for K-W-L.

Reading strategies are generally disregarded techniques in education. This study has shown the importance of the instructional reading strategies. These strategies should be given in education departments of the universities as well as other teaching methodologies.

Authors of the textbooks should give more importance to conceptual side of the books. Unless it is not completely a conceptual physics book, author should include enough number of computational questions as well as conceptual questions to increase understanding.

Conceptual physics courses should be given at 9th grade. Because, at this grade, students choose their content area and they must not be threatened with the computations. Through our study, in-class discussions with the students showed that large percent of the students think of selected non-science content areas because of the computational nature of the science lessons.

### 5.4. Internal Validity Threats

There are some factors that threats internal validity of the study. The common threats are subject characteristics, mortality, location, instrumentation, testing, history, maturation, subject attitude, regression, and implementation.

There are about 30 participants for each group. Therefore, each loss of subject is important. The study was in the school environment. Then, students were expected to attend the classes. But, as a precaution, it was planned to reach to students who do not participate class in the testing day before the semester ends. Eight absent students in post-tests were reached in this way. Another loss of data could arise from the empty items in the attitude scale. To prevent this, students were warned several times when tests were administered and the attitude scales were controlled just after the administration. Then, mortality was appeared in the study.

Hawthorne effect was the second most important internal validity threat in this study. There were two different treatments: conceptual physics texts and K-W-L reading strategy. To prevent methods from altering students' feeling as a result of having special treatment, there were two ways. First, similar studies could begin earlier to make students' used to these methodologies. Second way is to use equivalent activities in the control group. However, it was difficult to follow these two ways. Because, when it was wanted to begin the study earlier, there were no conceptual physics sources in Turkish to use in the class. At the same time, the permission from the Ministry of Education has been waited to begin the study. Using equivalent activities was difficult. Because, traditional physics texts as an equivalent of conceptual physic texts could be given to students in control group, but this would be very expensive. Considering these problems as a whole, that makes difficult to control students' feelings. Therefore, another way was considered to control

subject attitude; obtaining similar feelings in all of the groups. To achieve this, students were informed about the study. But, it was not in detail. Then each of the groups were said to be treated with different methodologies. That is, all groups thought that they were administered a treatment on them and showed similar feeling in the study. Another precaution was having five weeks between pre-tests and post-tests. After five weeks, their perceptions become normal to any methodologies.

Although convenience sampling was used to form the classes, the classes were randomly assigned into the groups to control subject characteristics. The study was conducted in the same school and in the similar environments; therefore, locations were similar for all of the groups. To prevent instrumentation threat, data collector was the researcher in all of the groups. Because the instruments were in multiple choice type, there were no bias of the favoring one class over others. The time allowed to complete the test was determined before the study, and strictly applied in the study. The instruments were held constant throughout the study. Only change between pre-tests and post-tests was their appearance. Therefore there was no instrument decay. However, pre-testing students might affect students' attitude towards the study. Because, it might be the sign of a post-test. Then, students could spend much effort to learn the concept. One precaution to prevent testing threat was that post tests were administered five weeks after the pretests. Another precaution was the change in the appearance in the post-tests. Maturation was not among the major threats, because the study was not continued so long time. To control implementer bias, protocols were prepared for the implementer. These protocols were given in Appendix A.

### 5.5. External Validity

Because the study conducted only in one school, the results can only be generalized to the schools having the similar conditions. Participants were 9th grade super high school students in Ereğli district of Zonguldak. There are two super high schools in Ereğli having very similar environments. Therefore, the study conducted in Zonguldak Ereğli Super High School assumed to be valid to the other super high school there. All treatments and testing procedure taken place in ordinary classrooms. Therefore, there will be no remarkable differences expected, if the study is administered to the other high schools in Ereğli.

## 5.6. Recommendations for Further Research

1. Further research could perform different replication studies for different physics concept with different samples.
2. It was statistically significant; but, the effect sizes were small for the individual effect of K-W-L. Effectiveness of K-W-L could be reinvestigated to validate the conclusions about K-W-L.
3. Further research could investigate the effect of combining conceptual and computational texts in a single textbook.
4. A study can be conducted to investigate how much physics teachers are ready for conceptual physics.
5. Another study could be conducted to examine the stability of achievement and attitude improvements.

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# APPENDIX A

## TEACHING PROTOCOLS

**The Effect of Textbook Style and Textbook Usage on 9th Grade Students' Achievement and Attitude towards Heat and Temperature**

**Ders Kitabının Tarzı ve Ders Kitabının Kullanılış Şeklinin 9uncu Sınıf Öğrencilerin Isı-sıcaklık Konularındaki Başarı ve Tutumlarına Etkisi**

**AMAÇ:**

Bu çalışmanın amacı kavramsal fizik metinlerinin ve K-W-L okuma yönteminin birleşik etkilerinin dokuzuncu sınıf öğrencilerin ısı-sıcaklık konusuna etkisini incelemektir.

**KAVRAMSAL FİZİK METNİ (CONCEPTUAL PHYSICS TEXTS):**

Öğrencilerin matematikte sıkıntı yaşadığı ve bu sıkıntının fizik dersini de ciddi boyutlarda etkilediği bilinmektedir (Hewitt, 1972; Reinstain, 1990). Paul Hewitt bu konuya çözüm olarak Kavramsal Fiziği önermiştir. Kavramsal fizik, fiziğin matematik diliyle değil öğrencilerin kendi dilleriyle anlatılmasıdır (Hewitt, 1990). Öğrencilerin ilk kez karşılaştıkları fiziği matematik ile dolu gördüğü zaman daha ilk aşamada fiziğe tereddütle karşılaştığını belirten Hewitt bunu bir makalesinde şöyle ifade eder "İlk kez fiziğe başlayanlarla ders işlemek güzeldir, çünkü onlar en kötüyü beklerler." Kavramsal Fizikte kavramlar mantıksal olarak verilir, günlük hayattan ve yakın teknolojiden haberler verilir ve içerisindeki fizik gösterilir. Fizik bir laboratuar dersi değildir, fizik günlük hayatın kendisidir. Formüller ve eşitlikler ilk aşamada sadece değişkenlerin birbiri arasındaki ilişkileri göstermeli, öğrencileri karmaşık işlemler içerisinde boğmamalı. Fizikte iddialı olan bir kimsenin öncelikle kavramsal eksikliği olmamalıdır. Hewitt'in bu yaklaşımı kısa sürede kendisini dünya çapında tanınır biri haline getirdi. Şu anda kitapları 10 ayrı dile çevrilmiş durumda. Ders anlatımları, video ve DVD olarak satışa sunulmuştur. Hewitt'in bu yöndeki başarısını bir araştırmacı "devrim" olarak nitelendirmiştir. Kavramsal fizikten yararlanan kitaplar da bilindik ders kitaplarından farkını hemen göstermiştir. Örneğin, 1998 yılından itibaren Türkiye'de kullanılmaya başlayan ve Sürat Yayınlarınca yayınlanan Fizik ders kitabı kısa sürede çok ilgi uyandırmıştır. Yapılacak olan çalışmada Paul

Hewitt'in bu kitabından ısı-sıcaklık ünitesi Türkçe'ye adapte edilmiştir ve Kavramsal Fizik Metni olarak çalışmanın birinci faktörünü oluşturacaktır.

**K-W-L OKUMA STRATEJİSİ**

Çalışmanın ikinci faktörü K-W-L (Ne biliyorum, Ne öğrenmek istiyorum, Ne öğrendim) okuma yöntemidir. 1986'da Dona Ogle tarafından önerilen bu yöntem kısa zamanda bir çok versiyonu ile birlikte okullarda uygulanmaya başlanmıştır. K-W-L nin diğer okuma yöntemlerinden farkı basit olmakla birlikte esnek bir yapıya sahip olasından dolayıdır. Yapılan çalışmalar bu yöntemin öğrencilerin ilgisini arttırdığını, öğrenme stillerini geliştirdiklerini ve anlama kapasitelerini arttırdığını göstermektedir. Üç ayrı aşamadan oluşur. Ne biliyorum, Ne öğrenmek istiyorum, Ne öğrendim. Daha detaylı bilgiyi "K-W-L Aktif ve Etkili Okuma" ekinde bulabilirsiniz.

**ÇALIŞMANIN DİZAYNI**

Çalışmada iki ayrı faktör bulunmasından dolayı "faktörel dizayn" çalışma için seçilmiştir. Aşağıdaki tablo bu dizaynı göstermektedir.

| | Kavramsal Fizik Metni (KFM) | Geleneksel Fizik Metni (GFM) |
|---|---|---|
| K-W-L Okuma Stratejisi (K-W-L) | KFM+K-W-L | GFM+K-W-L |
| Geleneksel Okuma stratejisi (GOS) | KFM+GOS | GFM+GOS |

**METOTLARIN UYGULANMASI**

Metotların hiçbirinde öğretmenin normal ders anlatışını değiştirmek söz konusu değildir. Yalnız ödevlerin kullanılan ders kitabından verilmesi istenir. Eğer K-W-L uygulanacaksa dersin sadece ilk 15 dakikası bu yöntem uygulanır ve tekrar günlük ders anlatışına geçilir. Öğretmen dersi aşağıda verilen protokollere göre işler.

**PROTOKOLLER**

***A. Geleneksel Okuma stratejisi + Geleneksel Fizik Metni***

- Dersin işlenişinde herhangi bir değişiklik yoktur.
- Öğretmen yalnızca günlük planına uygun ders işler
- Ödevlerini Milli Eğitimin ders kitabından verir.

***B. Geleneksel Okuma stratejisi + Kavramsal Fizik Metni***

- Çalışma öncesinde sınıftaki öğrencilere kavramsal fizik metinleri dağıtılır.
- Öğretmen konu anlatımında herhangi bir değişiklik yapmaz.
- Konu anlatımını günlük plana uygun işler
- Ödevleri Kavramsal Fizik Metninden verir.

***C. K-W-L Okuma Stratejisi + Geleneksel Fizik Metni***

- Öğretmen tahtaya K-W-L tablosu çizer (EK1) ve öğrencilerden de o sırada tabloyu defterlerine geçirmesi istenir.
- Öğrencilere kısaca hangi konuyu işleyeceklerinden bahseder
- Öğrencilerin bu konuda ne bildiklerini sorar.
- 2-3 dakika beyin fırtınası yardımıyla öğrencilerin fikirlerini elde etmeye çalışır.
- Öğrencilere 2-3 dakika da metni gözden geçirmeleri için zaman verilir.
- Yeniden öğrencilere ne bildikleri söylenir. Bu sırada:
    - Öğrencilerin her verdiği bilgi tahtada "Ne biliyorum" sütununa yazılır.
    - Öğrencilerin mümkün olduğunca hafızalarını zorlamaları istenir.
    - Eğer öğrenci bildiğinden kesin emin değilse yanına bir soru işareti konulur.
    - Öğretmen çeşitli şekillerde bu katılımı arttırmaya çalışır.
- Tartışmadan sonra öğretmen ve öğrenciler işbirliği yaparak bildiklerini kategoriler halinde birleştirmeye çalışır.
- Bu kategoriler tablonun ilgili yerine geçirilir.
- Ardından öğrencilerin tablolarında yazdıklarından ve merak ettiği diğer konulardan yararlanarak sorularını oluşturmaları istenir. Bir-iki dakika içinde öğrenciler sorularını "Ne öğrenmek istiyorum" sütununa yazar.
- Sonrasında öğretmen öğrencilerin sorularını alır ve "Ne öğrenmek istiyorum" sütununa yazar.
- Diğer okumalardan ve "Ne biliyorum" sütunundaki bilgilerden faydalanarak öğrencilerin katılımını arttırmaya çalışır.
- Ardından ödev olarak ders kitaplarının ilgili yerlerini okuyup tablolarının "Ne öğrendim" sütununu bir sonraki derse tamamlayıp öğretmene teslim etmeleri istenir.
- Bu aşamadan sonra günlük plana uygun olarak ders işlenir.
- Diğer ödevler Milli Eğitimin Kitabından verilir.

Diğer dersin başında öğretmen ödevleri almadan önce:

- Metni bir-iki dakika gözden geçirmelerini ister.
- Birkaç dakika öğrencilerle birlikte neler öğrendiklerini tartışır ve bilgileri beraberce temel bilgi kategorilerine ayırmaya çalışır.
- Cevaplarını bulamadıkları sorularını tartışır ve onlara bulabilecekleri kaynakları tavsiye eder.
- Öğrencilerin K-W-L çalışma kağıtlarını toplar.

***D. K-W-L Okuma Stratejisi + Kavramsal Fizik Metni***

Konu işlemesine başlamadan önce Kavramsal Fizik Metinleri dağıtılır.

- Öğretmen tahtaya K-W-L tablosu çizer (EK1) ve öğrencilerden de o sırada tabloyu defterlerine geçirmesi istenir.
- Öğrencilere kısaca hangi konuyu işleyeceklerinden bahseder
- Öğrencilerin bu konuda ne bildiklerini sorar.
- 2-3 dakika beyin fırtınası yardımıyla öğrencilerin fikirlerini elde etmeye çalışır.
- Öğrencilere 2-3 dakika da metni gözden geçirmeleri için zaman verilir.
- Yeniden öğrencilere ne bildikleri söylenir. Bu sırada:
    - Öğrencilerin her verdiği bilgi tahtada "Ne biliyorum" sütununa yazılır.
    - Öğrencilerin mümkün olduğunca hafızalarını zorlamaları istenir.
    - Eğer öğrenci bildiğinden kesin emin değilse yanına bir soru işareti konulur.
    - Öğretmen çeşitli şekillerde bu katılımı arttırmaya çalışır.
- Tartışmadan sonra öğretmen ve öğrenciler işbirliği yaparak bildiklerini kategoriler halinde birleştirmeye çalışır.
- Bu kategoriler tablonun ilgili yerine geçirilir.
- Ardından öğrencilerin tablolarında yazdıklarından ve merak ettiği diğer konulardan yararlanarak sorularını oluşturmaları istenir. Bir-iki dakika içinde öğrenciler sorularını "Ne öğrenmek istiyorum" sütununa yazar.
- Sonrasında öğretmen öğrencilerin sorularını alır ve "Ne öğrenmek istiyorum" sütununa yazar.
- Diğer okumalardan ve "Ne biliyorum" sütunundaki bilgilerden faydalanarak öğrencilerin katılımını arttırmaya çalışır.
- Ardından ödev olarak Kavramsal Fizik kitaplarının ilgili yerlerini okuyup tablolarının "Ne öğrendim" sütununu bir sonraki derse tamamlayıp öğretmene teslim etmeleri istenir.
- Bu aşamadan sonra günlük plana uygun olarak ders işlenir.
- Ödevler Kavramsal Fizik Metinlerinden verilir.

Diğer dersin başında öğretmen ödevleri almadan önce:

- Metni bir-iki dakika gözden geçirmelerini ister.
- Birkaç dakika öğrencilerle birlikte neler öğrendiklerini tartışır ve bilgileri beraberce temel bilgi kategorilerine ayırmaya çalışır.
- Cevaplarını bulamadıkları sorularını tartışır ve onlara bulabilecekleri kaynakları tavsiye eder.
- Öğrencilerin K-W-L çalışma kağıtlarını toplar.

**EK1. K-W-L Çalışma Tablosu**

| Ne biliyorum | Ne öğrenmek istiyorum | Ne öğrendim |
|---|---|---|
| | | |

Bilgi kategorileri

A.....

B.....

C.....

D.....

E.....

APPENDIX B

PHYSICS ACHIEVEMENT TEST

# Isı-Sıcaklık Başarı Testi

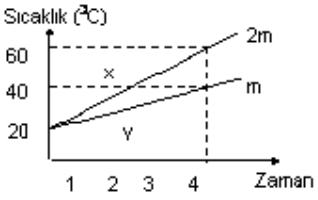
Bu test ısı-sıcaklık konusunda öğrencilerin başarısını ölçmek için hazırlanmıştır.
Testin hazırlanmasında üniversite sınavlarında çıkmış sorular baz alınıp, bu sınavı temsil edecek nitelikte sorular seçilmeye çalışılmıştır.

- Test için öngörülen zaman bir ders saatidir.
- Her soru için biri doğru diğer dördü yanlış beş ayrı şık vardır.
- Soruların doğru cevaplarını başındaki harfi yuvarlak içine alarak soru kitapçığının üzerine işaretleyiniz.
- Yanlış sorular aldığınız puana etki etmeyecektir. Bu nedenle bütün sorularla uğraşmaya özen gösteriniz.
- Sınav sırasında bir başkasıyla konuşmak, kalem, silgi vb. alışverişi yapmak yasaktır.
- Sınav boyunca öğretmenlerimiz size sorular hakkında herhangi bir açıklamada bulunmayacaktır.
- Yazım yanlışı yapıldığına inandığınız noktalarda soruyu işaretleyip bunları araştırmacı öğretmenimize bildiriniz.

Başarılar.

Isı-Sıcaklık Başarı Testi

**1.** Özdeş ısıtıcılarda ısıtılan (2m) kütlesindeki x sıvısı ile (m) kütlesindeki y sıvısının, sıcaklık-zaman grafikleri şekildeki gibidir. Sıvıların özısılarının $\frac{C_X}{C_Y}$ oranı kaçtır?




A) ¼ B) 2/3 C) ¾ D) 1 E) 2

**2.** Uzama katsayısı, katı maddelerin ayırt edici özelliklerinden biridir ve birim uzunluğun, birim sıcaklık artışı için uzama miktarıdır.
**Boyları, d, 2d, 3d olan, X, Y, Z gibi üç çubuğun sıcaklık artışlarına bağlı olarak uzama miktarları şekildeki gibidir.**

| Cisim | İlk boy | Sıcaklık artışı | Uzama miktarı |
|---|---|---|---|
| X | d | 2t | a |
| Y | 2d | 2t | 2a |
| Z | 3d | t | 3a |

**X, Y, Z nin yapıldığı maddelerin aynı olup olmadığı konusunda aşağıdaki yargılardan hangisi doğrudur?**

A) X ile Y aynı olabilir, Z farklıdır.
B) X ile Z aynı olabilir, Y farklıdır.
C) Y ile Z aynı olabilir, X farklıdır.
D) Üçü de kesinlikle farklıdır.
E) Üçü de aynı olabilir.

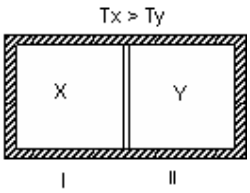
**3.** X, Y, Z maddelerinin donma ve kaynama noktaları şöyledir:

| | Donma nok. ($^0$C) | Kaynama nok. ($^0$C) |
|---|---|---|
| X | -88 | -17 |
| Y | 0 | +100 |
| Z | +33 | +221 |

**Buna göre, aşağıdaki sıcaklık aralıklarının hangisinde bu üç maddeden biri katı, biri sıvı, biri gaz halde bulunur?** (Aralıkların uç noktaları göz önüne alınmayacak.)

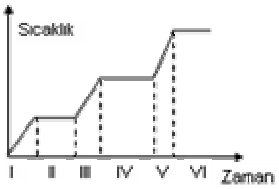
A)(-88) ile(-17) B)(-88) ile(0) C)(-17) ile(0) D)(0) ile(+33) E)(+33) ile(+221)

**4.** Şekildeki I kabında sıcaklığı Tx olan X sıvısı, II kabında da sıcaklığı Ty olan Y sıvısı vardır. Tx> Ty dir ve kaplar çevreden ısıca yalıtılmıştır.
**Kaplar arasında ısı iletimi olduğuna göre, ısı dengesi kuruluncaya kadar geçen sürede aşağıdakilerin hangisinde verilen olayların gerçekleşmesi olanaksızdır?**




A) X soğur, Y ısınır B) X katılaşır, Y soğur
C) X katılaşır, Y kaynar D) X katılaşır, Y ısınır
E) X soğur, Y kaynar

**5.**




Yukarıdaki grafik X,Y,Z gibi üç ayrı sıvıdan oluşmuş bir karışımın kaynama eğrisidir. Bu sıvıların kaynama sıcaklıkları sıra ile $T_X$, $T_Y$, $T_Z$ olup, $T_X < T_Y < T_Z$ dir. **III üncü zaman aralığında, karışımda, bu üç sıvıdan hangileri bulunur?**

A) Sadece X B) Sadece Y
C) Sadece Z D) Y ve Z
E) X ve Y

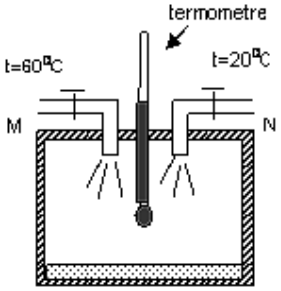
**6.** Öz ısıları sırasıyla c, 2c kütleleri m, 2m olan X,Y cisimlerinin sıcaklıkları $T_1$ dir. Bu cisimler t süre ısıtıldığında sıcaklıkları $T_2$ oluyor.
**Bu sürede X cisminin aldığı ısı miktarı Q olduğuna göre, Y ninki kaç Q olur?**

A) ¼ B) 1/3 C) 1 D) 2 E) 4

**7.** Isıca yalıtılmış bir kapta bulunan $80^0$C deki suyun içine bir parça buz konuyor. Isıl denge sağlandığında sıcaklık $5^0$C oluyor.
**Buna göre,**
I. Başlangıçta kaptaki suyun kütlesi buzunkine eşittir.
II. Olay sırasında buzun tamamı erimiştir.
III. Buzun ilk sıcaklığı $0^0$C den küçüktür.
**yargılarından hangileri kesinlikle doğrudur?**
($c_{su}$= 1 cal/g$^0$C; $c_{buz}$= 0,5 cal/g$^0$C; $L_{buz}$= 80 cal/g)

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

**8.** Şekilde görülen ısıca yalıtılmış kaba bağlı musluklar, birim zamanda eşit miktarda su akıtmaktadır. M musluğundan gelen suyun sıcaklığı $60^0$C, N den geleninki de $20^0$C dir. İki musluk da açılarak kabın yarısı doldurulduktan sonra M musluğu kapatılıyor.
**Kap tümüyle dolup içinde denge sağlanınca termometre kaç $^0$C gösterir?**




A) 50 B) 40 C) 30 D) 25 E) 20

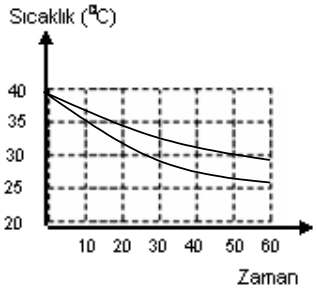
**9.** Bir kaptaki $+10^0$C de 80 gr suya, $-10^0$C deki 80 gr buz parçası atılıyor. Bir süre karışımın sıcaklığının $0^0$C de durduğu saptanıyor. Bu sırada, kapta kaç gram buz ve kaç gram su bulunur? (Isı alışverişinin yalnız su ile buz arasında olduğu varsayılacak. Buzun özısısı 0,5 kal/gr$^0$C ve erime ısısı 80 kal/gr dır)

A) 160 gr su
B) 80 gr su ve 80 gr buz
C) 75 gr su ve 85 gr buz
D) 85 gr su ve 75 gr buz
E) 120 gr su ve 40 gr buz

**10.** Sıcaklık ve Fahrenhayt sıcaklık eşelleri karşılaştırıldığında, $0^0$C nin $32^0$F ye, $100^0$C nin de $212^0$F ye denk olduğu görülür.
**Buna göre, $^0$C cinsinden verilen bir sıcaklığı $^0$F cinsinden ifade etmek için aşağıdaki eşitliklerden hangisi kullanılmalıdır?**

A) $^0F=5/9^0C-32$ B) $^0F=5/9^0C+32$ C) $^0F=9/5^0C+212$
D) $^0F=9/5^0C-32$ E) $^0F=9/5^0C+32$

**11.** Grafikte, kütlesi 100 gr olan suyun soğuma (sıcaklık-zaman) eğrisi (I) ile, kütlesi 75 gr olan suyun soğuma eğrisi ise (II) ile gösterilmiştir. **60 dakikalık süre içinde, kütlesi büyük olan suyun ısı kaybının küçük olanınkine oranı nedir?**




A) 8/9 B) 4/3 C) 3/2 D) 2 E) 10

**12.** Deniz düzeyinde, ısıca yalıtılmış bir kaptaki suya bir miktar buz konulduğunda, buzun kütle-zaman grafiği şekildeki gibi oluyor.


**Buna göre, I,II,III zaman aralıklarının hangilerinde hem suyun hem de buzun sıcaklığı $0^0$C tır?**

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

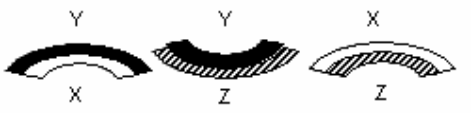
**13.** Sıcaklığı $120^0$C olan 100 gramlık su buharı 60 kilokalorilik ısı kaybederse son fiziksel hali ve sıcaklığı ne olur? (Buharın ısınma ısısı 0.5 kal/gram ve suyun buharlaşma ısısı 540 kal/gram)

A) $50^0$C de su B) $60^0$C de su C) $80^0$C de su D) $100^0$C de su E) $110^0$C de buhar

**14.** $t^0$C deki (M) gr suyun bulunduğu kaba, $100^0$C deki su buharı gönderiliyor. Suyun sıcaklığı $100^0$C oluncaya kadar, (m) gr buhar yoğunlaştığına göre, suyun (L) buharlaşma ısısı, aşağıdaki eşitliklerden hangisiyle bulunabilir? (ısı kaybı yok)

A) mL= M(100-t) B) ML=(M+m)(100-t)
C) ml= (M+m)t D) (M+m)L=mt
E) (M+m)L=M(100-t)

**15.** Birbirine perçinlenmiş X-Y, Y-Z ve X-Z metal şerit çiftleri bir T sıcaklığında şekildeki biçimi almıştır. X,Y, Z metallerinin uzama katsayıları sırasıyla $\alpha$X, $\alpha$Y , $\alpha$Z dir.
**$\alpha$X <$\alpha$Y <$\alpha$Z olduğuna göre, bu çiftlerden hangileri soğutularak doğrusal hale getirilebilir?**

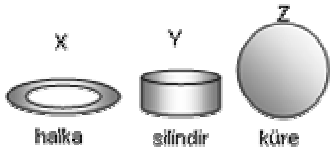



A) Yalnız X-Y B) Yalnız Y-Z C) Y-Z ve X-Z D) X-Y ve X-Z E) X-Y ve Y-Z

**16.** Erime noktası ve kütlesi bilinen bir katı cisim eritiliyor. Erime tamamlanınca hemen, kütlesi ve sıcaklığı bilinen suya atılıyor. Suyun sıcaklığı artarken cisim de katılaşmaya başlıyor. Cismin tamamı katılaştıktan bir süre sonra, ısı dengesi sağlanıyor ve sıcaklık ölçülüyor.
**Bu durumda, katı cismin erime ısısını bulmak için başka hangi bilgiye gerek vardır?**

A) Cismin katılaşma noktası
B) Katı cismin eritilmeye başlamadan önceki sıcaklığı
C) Katı cismin son sıcaklığı
D) Cismin katı ve sıvı haldeki ısınma ısıları
E) Cismin katı haldeki ısınma ısısı

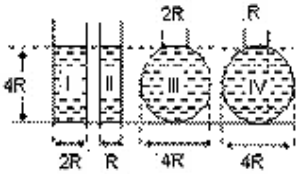
**17.** Aşağıdaki X, Y, Z cisimleri aynı metalden yapılmıştır. Cisimler oda sıcaklığındayken Y silindir ve Z küresi, X halkasının içinden hafif bir sürtünmeyle geçebilmektedir.




**Bu cisimlerin üçü de yüksek bir T sıcaklığına kadar ısıtıldığında Y ve Z nin X halkasından geçip geçemeyecekleri konusunda ne söylenebilir?**

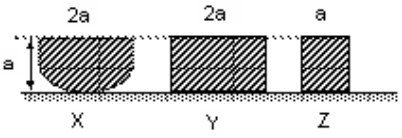
A) Y geçebilir, Z geçemez.
B) Z geçebilir, Y geçemez.
C) İkisi de geçebilir.
D) İkisi de geçemez.
E) Hacimleri bilinmeden bir şey söylenemez.

**18.** Oda sıcaklığında, şekildeki gibi içlerinde aynı düzeyde, aynı sıvıdan bulunan dört cam kap birlikte daha sıcak bir su banyosuna konuyor ve sıcaklık dengesi sağlanıncaya kadar bekletiliyor. **Sıvıların yükselme miktarlarını nasıl sıralayabiliriz?**



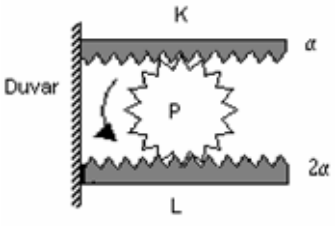

A) IV> III > I = II
B) IV> III > I > II
C) IV> III> II > I
D) IV= III> I > II
E) I = III> IV= II

**19.** Düşey kesitleri ve çapları şekilde verilen X yarımküresi ile Y ve Z dik silindirleri aynı metalden yapılmıştır ve sıcaklıkları eşittir. Bu cisimlere eşit miktarda ısı verildiğinde son sıcaklıkları Tx, Ty, Tz oluyor.
**Tx, Ty, Tz arasındaki ilişki nedir? (cisimlerin çevre ile ısı alış-verişi önemsizdir.)**



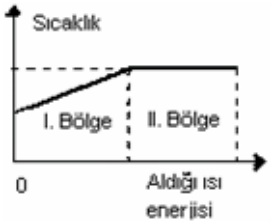

A) Ty=Tz<Tx B) Ty<Tz<Tx C) Ty<Tx<Tz D) Tz< Tx=Ty E) Tx=Ty=Tz

**20.** Şekildeki gibi birer uçlarından duvara tutturu-muş, boyları eşit K ve L dişli çubukları arasındaki, ısıca yalıtkan P çarkı serbestçe dönebilmektedir. K nın uzama katsayısı $\alpha$, L ninki de $2\alpha$ dır. **Buna göre,**
I. Çubukların ikisini de $\Delta T$ kadar ısıtma
II. K yi $\Delta T$ kadar ısıtma, L yi $\Delta T$ kadar soğutma
III. L yi $\Delta T$ kadar ısıtma, K yi $\Delta T$ kadar soğutma
**İşlemlerinden hangileri P çarkının ok yönünde dönmesini sağlar?**




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

**21.** Açık havada, bir kapta ısıtılan arı sıvının sıcaklık-aldığı ısı enerjisi grafiği şekildeki gibidir.
**Grafiğin I. ve II. Bölgelerindeki ısıtma sürecinde, kapta kalan sıvının öz kütlesinin değişip değişmediği konusunda ne söylenebilir?**




| | I.Bölge | II.Bölge |
|---|---|---|
| A) | Azalır | Değişmez |
| B) | Azalır | Artar |
| C) | Artar | Değişmez |
| D) | Artar | Azalır |
| E) | Değişmez | Artar |

**22.** Ayda atmosfer ve su yoktur. Bir cismin aydaki ağırlığı, yerdekinin 1/6 kadardır.
**Eğer ay, şimdiki yerinde ve şimdiki kütlesinde, ancak atmosferi ve suyu olan bir yapıda olsaydı:**
I. Ayda rüzgar olurdu.
II. Ay yüzeyinde gece-gündüz arasındaki sıcaklık farkı şimdikinden az olurdu.
III. Bir cismin aydaki ağırlığı şimdikinden büyük olurdu.
**beklentilerinden hangileri gerçekleşirdi?**

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

**23**. Bir testinin çevresine ıslak tülbent sararsak, suyu daha iyi soğutabiliriz.
**Bu olayla,**
I. Sıcak bir günde limonata bardağına buz koyarsak, bardağın dışı terler.
II. Kestiğimiz karpuzu kısa bir süre güneşte tutarsak soğur.
III. Sıcak günlerde sık sık yerleri sularsak, çevre serinler.
**olaylarından hangileri <u>aynı ilkeyle</u> açıklanabilir?**

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

**24.** Bir kalasın iki noktasındaki uzaklık çelik metre ile farklı sıcaklıklarda ölçülüyor. Çelik metrede okunan değer, ortam sıcaklığının $30^0$C olduğu anda $n_1$, $O^0$C olduğu anda $n_2$ ve $-30^0$C olduğu anda da $n_3$ oluyor.
**Buna göre, $n_1$, $n_2$, $n_3$ arasındaki ilişki nedir?**
(Kalasın sıcaklıkla genleşmediği varsayılmaktadır.)

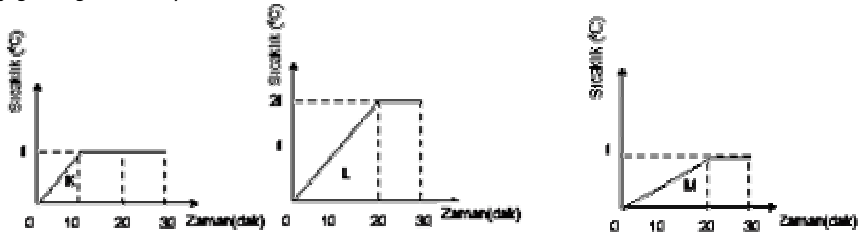
A) $n_1=n_2=n_3$ B) $n_1=n_3<n_2$ C) $n_2<n_1=n_3$ D) $n_1<n_2<n_3$ E) $n_3<n_2<n_1$

**25.** Farklı sıcaklıktaki X ve Y katı cisimleri birbirine değecek şekilde yerleştiriliyor.
**Cisimler arasında ısı dengesinin kurulması sürecinde, X cisminin;**
I. Isı enerjisi değişimi
II. Sıcaklık değişimi
III. Hacim değişimi
**Niceliklerinden hangileri Y ninkilere <u>kesinlikle</u> eşit olur?** (Dış ortamla ısı alışverişi yoktur.)

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

**26.** I.Sıvıların kaynama noktası, ayırt edici özelliklerden biridir.
II.Kaynama süresince sıvının sıcaklığı değişmez.

İçlerinde K,L,M gibi renksiz sıvılar bulunan üç kap, özdeş ısıtıcılarla ısıtılıyor. Sıvılara ait sıcaklık-zaman eğrileri aşağıdaki gibi bulunuyor.




**Bu eğrilere göre, K, L, M nin aynı sıvı olup olmadığı hakkında ne söylenebilir?**

A) K ile L aynı olabilir, M kesinlikle farklıdır.
B) L ile M aynı olabilir, K kesinlikle farklıdır.
C) K ile M aynı olabilir, L kesinlikle farklıdır.
D) Üçü de aynı sıvı olabilir.
E) Üçü de kesinlikle birbirinden farklıdır.

| ANSWERSHEET | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| A | A | C | B | D | E | B | C | D | E |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| D | C | A | A | E | E | C | A | C | E |
| 21 | 22 | 23 | 24 | 25 | 26 | | | | |
| A | B | D | D | A | C | | | | |

APPENDIX C

PHYSICS ATTITUDE SCALE

# MADDE VE ISI ÜNİTESİ TUTUM ÖLÇEĞİ

Sevgili Öğrenciler,

Bu anket sizin ısı sıcaklık konularına karşı tutumlarınızı öğrenmek için geliştirilmiştir. Cevaplarınız önümüzdeki yıllarda fizik derslerinin sizin görüşleriniz ve beklentileriniz doğrultusunda şekillenmesine katkıda bulunabileceğinden önem taşımaktadır. Lütfen bütün soruları yanıtlayınız. Bu araştırmada toplanılan tüm bilgiler kesinlikle gizli tutulacaktır.

Her bir cümleyi dikkatle okuduktan sonra, cümleye ne derecede katıldığınızı veya katılmadığınızı belirtmek için yanındaki seçeneklerden birini işaretleyiniz.

**Adı Soyadı:**_____ **Öğrenci No:**_____ **Sınıfı:**_____

**Cinsiyeti:** ☐**E /** ☐**K** **Yaş:**_____

| **Isı Sıcaklık Konusu;**<br>Isı-Sıcaklık<br>Isı Miktarı ve Ölçülmesi<br>Hal değişimi<br>Genleşme ve Sıkıştırılabilirlik<br>■ Katılarda genleşme<br>■ Sıvılarda genleşme<br>■ Gazlarda genleşme | Kesinlikle Katılıyorum | Katılıyorum | Kararsızım | Katılmıyorum | Kesinlikle Katılmıyorum |
|---|---|---|---|---|---|
| 1. Isı-sıcaklık konularını severim. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2. Isı-sıcaklık konularına karşı olumlu hislerim vardır. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3. Benim için ısı-sıcaklık konuları eğlendiricidir. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4. Okulda ısı-sıcaklık konularını çalışmaktan hoşlanırım. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 5. Diğer konulara göre ısı-sıcaklık konuları daha ilgi çekicidir. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 6. Isı-sıcaklık konularının, ilerideki meslek hayatımda önemli bir yeri olacağını düşünüyorum. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 7. Isı-sıcaklık konularında öğrendiklerimin, gündelik hayatta işime yarayacağını düşünüyorum. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 8. Isı-sıcaklık konularında öğrendiklerimin, hayatımı kolaylaştıracağını düşünüyorum. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 9. Isı-sıcaklık veya teknolojideki uygulamaları ile ilgili kitaplar okumaktan hoşlanırım. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10. Isı-sıcaklık konularının, ilerideki çalışmalarımda bana yararlı olacağını düşünüyorum. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11. Isı-sıcaklık konuları ve teknolojideki uygulamaları ile ilgili kitaplar okumaktan hoşlanırım. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 12. Bana hediye olarak ısı-sıcaklık ile ilgili bir kitap veya ısı-sıcaklıkla ilgili aletler verilmesinden hoşlanırım | ☐ | ☐ | ☐ | ☐ | ☐ |
| 13. Fizik topluluğuna üye olmak isterim. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 14. Arkadaşlarımla ısı-sıcaklık konuları veya teknolojideki uygulamaları ile ilgili meseleleri konuşmaktan hoşlanırım | ☐ | ☐ | ☐ | ☐ | ☐ |
| 15. Günlük hayatta arkadaşlarla ısı-sıcaklık konuları hakkında konuşmak zevklidir. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 16. Isı- sıcaklık konularında başarılı olmak için elimden geleni yaparım. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 17. Isı-sıcaklık konularında elimden gelenin en iyisini yapmaya çalışırım. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 18. Isı-sıcaklık konularında başarısız olduğumda daha çok çabalarım. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19. Isı-sıcaklık konularında yapılacak iş ne kadar zor olursa olsun, elimden geleni yaparım. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20. Isı-sıcaklık konularını öğrenebileceğimden eminim. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21. Daha zor ısı-sıcaklık ile ilgili problemler ile başa çıkabileceğimden eminim. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 22. Isı-sıcaklık konularında başarılı olabileceğimden eminim. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 23. Isı-sıcaklık konularında zor işleri yapabileceğimden eminim. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 24. Yeterince vaktim olursa en zor ısı-sıcaklık ile ilgili problemleri bile çözebileceğimden eminim. | ☐ | ☐ | ☐ | ☐ | ☐ |

# APPENDIX D

## CONCEPTUAL PHYSICS TEXT

To keep the original form of the textbook, it is given in the CD.

APPENDIX E

K-W-L GUIDE

# K-W-L aktif ve etkili okuma stratejisi

İçindekiler:

## GİRİŞ

Türkiye'nin eğitim alanında yaşadığı sorunlar birçok eğitim kuruluşu ve eğitimci tarafından ifade edilmektedir. Maalesef, 2001 yılında yapılan ve 35 ülkenin katıldığı uluslararası bir araştırma olan PIRLS (Uluslararası Okuma Becerilerinde Gelişim), Türk eğitim sisteminin, okuma becerisini geliştirme yönünden de ne kadar büyük bir sıkıntı içerisinde olduğunu gösterdi. Türkiye, 35 ülkenin arasında ancak 28'nci sıraya yerleşebilmiş ve 500 olan PIRLS ortalamasına karşılık Türkiye ancak 449 puanı yakalayabilmişti. Bu büyük sıkıntının sebebine gelince, bu konuda bir çok görüş var. Kimileri öğrencilerin kitap sayısındaki eksiklikten, kimileri okul öncesi eğitime yeterli önemin verilmemesinden, kimileri de sınıf mevcudunun fazlalığından şikayet ediyor. Kimi eğitimcilerin televizyonların zihni körelttiği gibi bir anlayış da söz konusu... Okuma becerilerindeki yaşadığımız bu sıkıntı aynı zamanda EARGED' in yaptığı çalışmalarla da doğrulanıyor.

Şunu biliyoruz ki; okuma becerileri günlük hayatta her an ihtiyaç duyduğumuz bir faaliyet, ve dolayısıyla özel bir önem verilmesi gereken bir konu. Bu nedenle, bu çalışma okuma becerilerini kuvvetlendirmeye adandı. Yapılan araştırmalarız boyunca iki esas üzerinde durduk; uygulamadaki pratiklik ve esneklik. Bu taleplerimiz bizi K-W-L okuma stratejisine yönlendirdi. Bu kitapçık size K-W-L, ve yapılacak çalışmamız için önerdiğimiz, K-W-L okuma stratejisinin değişik bir versiyonunu, K-W-L(l) okuma yöntemlerini tanıttırıp bir sınıf içerisindeki okuma aktivitesinin nasıl yapılabileceğine dair ufkunuzu genişleteceğine inanıyoruz. Başarılar…

## K-W-L, AKTİF VE ETKİLİ OKUMA STRATEJİSİ

K-W-L , etkinliği kanıtlanmış bir okuma stratejisidir. İlk kez Donna Ogle tarafından uygulanan bu teknik yardımıyla öğrencileriniz konu ile ilgili eski bilgilerini harekete geçirecek, ve yazılı bir metinden daha etkili biçimde yararlanmasını öğreneceklerdir. Ama K-W-L okuma yöntemine geçmeden önce bu alanda daha ne gibi adımlar atıldığını inceleyelim.

### *Okuma Stratejileri Hakkında*

Okuma, bu alanda yapılan büyük çaplı bir çalışma tarafından şöyle tanımlanmıştır;

> "*Okumak okuyucunun bir manayı kavrayabilmek için metinle arasındaki etkileşimidir. Bir anlamı kavrayabilmek ise okuyucunun eski bilgilerini harekete geçirebilme becerisi, okuma stratejilerini kullanması ve bunları okuma işlevine uygulayabilmesidir.*"

Buradan anlaşılıyor ki; artık okumak zannedildiği gibi kelimelerin sesli veya sessiz gözden geçirilmesi değil, okuyucu ve okunacak metin arasındaki etkileşim olarak tanımlanmaktadır. Ayrıca bu tanım, etkili okumanın da çeşitli stratejiler içerdiğini göstermektedir.

Hemen hemen bütün okuma stratejileri üç aşama üzerinde durur; okumaya başlamadan önce, okuma esnası ve okuma sonrası değerlendirme. Head & Readence 1986 yılında özellikle kavram yanılgılarının giderilmesinde kullanılabilecek bir okuma yöntemi ileri sürmüştü. Bu yöntemin uygulanışında, öğrencilerin anlamakta en çok zorlandığı kavramlar hakkında birkaç ifade tahtaya yazılır. Bu ifadelerin arkasından öğrencilerin tavırları ve konu hakkındaki düşünceleri tartışılır. Ardından metin okunarak, metin içerisindeki bilgiler yardımıyla öğrenci kendi fikirlerinin doğruluğunu tartar. Ribovich'in 1977 yılında öne sürdüğü

"expectation scheme" biraz daha değişik bir yapıya sahipti. Öğrenci ilk başta hızlıca metni gözden geçirir ve okuduklarından faydalanarak metinle ilgili mümkün olduğunca çok cümleler üretir. Bunların her biri farklı kağıda yazılıp bunlar bir pano üzerinde hiyerarşik bir düzen üzerine oturtulur. Metin baştan sona tekrar okunduktan sonra, ifadelerin öğrencilerin ifadeleri ile ne kadar uyuştuğu ve birbiri arasında kurdukları bağların ne kadar doğru olduğu tartışılır. Barron & Earle ise, 1973 yılında K-W-L metoduna da destek olarak kullanılabilecek "graphic organizer" yöntemini önerdiler. Bu yöntemde, metin içerisindeki kavram ve kelimeler incelenerek, öğrencilerin bunlar arasındaki ilişkileri gösterecek bir diyagram çizmeleri istenir. Daha sonra bu diyagrama öğrencinin önceden de bildiği bilgiler eklenerek bilginin bütünlüğü sağlanabilir. Graphic organizer, okuma sonrasında kullanılabildiği gibi okuma esnasında da kullanılabilir bir yöntemdir. Bunların haricinde daha bir çok yöntemi vardır:. Smith & Brown, Guided Writing Procedure; Manzo & Cassale, Listen-Read-Discuss; Langer, Pre-Reading Plan; Manzo, Reciprocal Questionning; Ogle, K-W-L ve daha diğerleri.

### *K-W-L Ne Demektir?*

K-W-L, what I **K**now, what I **W**ant to know, what I **L**earned ifadelerinin kısaltmasıdır. Yani ne biliyorum, ne öğrenmek istiyorum ve ne öğrendim. Diğer okuma metotları gibi K-W-L de üç ayrı aşamanın üzerinde durur; okumadan öncesi, okuma anı, ve okuduktan sonrası. Etkili bir okuma için bu üç aşama da önemlidir. K-W-L metodu da bu üç aşamayı sağlamakla beraber uygulamasındaki pratiklik, ve uyarlanmasındaki esneklik ile etkili bir metot. Yurtdışında da K-W-L hakkında yapılan çalışmalar ve K-W-L okuma stratejisinin farklı versiyonları herhalde bunun en güzel bir göstergesi.

### K-W-L METODUNUN UYGULANMASI

Tahtaya veya kağıt üzerine çizilen üç sütunlu bir tablo, konu hakkında küçük bir tartışma ve parçayı okumak bütün hepsi bu! K-W-L diğer okuma stratejilerine göre çok daha pratik. Şimdi bu yöntemi biraz daha detaylı inceleyelim. Okuma tekniği üç bölümden meydana gelmektedir. İlk adımdan önce, öğretmen tahtaya üç sütunlu bir tablo çizer. Her bir sütunun başlığı olarak sırasıyla "Ne biliyorum", "Ne öğrenmek istiyorum" ve "Ne öğrendim" yazar (Şekil 1). Bundan sonra yapılacak şey K-W-L çalışmasına başlamak olacaktır.

| Ne biliyorum | Ne öğrenmek istiyorum | Ne öğrendim |
|---|---|---|
| | | |

Bilgi kategorileri

A.....  D. .....

B.....

C. .....

**Şekil 1▲**. Bir K-W-L tablosu örneği

K-W-L metodu üç ayrı adımda işlenir. İlk adım "Ne biliyorum" ve ikinci adım "Ne öğrenmek istiyorum", öğretmen ile öğrencilerin karşılıklı konu üzerinde tartışmalarının çalışma kağıtları üzerine kaydedilmesi ile işlenir. Üçüncü adım olarak öğrenciler makaleyi okuduktan sonra veya okuduğu sırada "Ne öğrendim" bölümünü doldururlar. Uzun makalelerde bölümlerin küçük parçalar halinde okunması ve her bir parçanın arkasında bir sonraki bölüm hakkındaki beklentilerinin sorgulanması tavsiye edilir.

### *K (what I Know) Ne biliyorum?*

Bu adım iki alt bölümden oluşur: *İlk adımda* "beyin fırtınası" yardımıyla öğrencilerin konu hakkındaki bildiklerini ortaya sergilenmesi ve ikinci adımda da bu bildiklerini de çeşitli kategoriler altında birleştirilmesi beklenir. Her iki adım da öğretmen ile öğrencinin karşılıklı diyalogu ile gerçekleşir.

Öğretmen öncelikle konu hakkında anahtar görevi yapabilecek bir kavramı belirler. Seçilecek kavram ve bunun öğrencilere sunumu önemlidir. Bu kavram seçilirken konu ile doğrudan ilişkili olması ve kavramı öğrencilere sunacak ifadenin de mümkün olduğunca öğrencilerin geçmişte kalan bilgilerini canlandıracak nitelikte olması istenir. Örneğin, deniz kaplumbağaları konusu için "su içerisinde yaşayan canlılar hakkında ne biliyorsunuz?" veya "hiç okyanusa gittiniz mi?" gibi geçmiş deneyimlerini hatırlatmaya yönelik ifadeler öğrencinin konu hakkındaki bilgisini ortaya çıkarmaktan çok uzaktır. Beyin fırtınasının amacı okuyucunun metnin verdiği bilgileri elde etmeye yardımcı olabilecek bütün bilgilerin harekete geçirilmesidir. Öğrencilerin konu hakkında bir şeyler bildiğini gördüğünüzde daha fazlası için ona sorular yöneltin. "Peki bu dediğini biraz daha netleştirmek ister misin?", "bunu nereden öğrendiğini hatırlıyor musun?", "bunu bize ispatlayabilir misin?". Emin olunamayan bilgi parçaları okuma öncesi bize eksik, hatalı veya bilmediğimiz şeyleri göstererek okumanın etkisini arttırır.

*İkinci aşamada* ise bilgilerin kategorilere ayrılıp daha genel bir bakış sağlanır. Böylece işe yarar bilgilerle karşılaşma imkanı artacak ve konu okuyucunun zihninde biraz daha şekillenecektir. İlk başta bu alışılmış olmayan görev okuyucu için bu iş zor gelebilir. Bu nedenle bir-iki örnekle öğretmen öğrencileri yönlendirmelidir. Kategorilere ayırma işlemine başlamadan önce "Okumaya başlamadan önce ne tür bilgilerle karşılaşabileceğimizi bir düşünelim. Şu bildiklerimize bir bakalım: bunların arasından kendi

aralarında daha genel kategorilere ayırabilir miyiz?" diye bir geçiş cümlesi kullanarak ardından kendi örneğimizi verebiliriz. Ardından öğrenciler kendi buldukları kategorileri eklerler. Bu sırada öğrencilerin yaşadığı problemler size öğrencilerin okuma becerileri yönündeki sorunlarını gösterecektir. Benzer metinlerin okunması ve benzer metinlerle yapılan karşılaştırmalar öğrencilerin sorunlarının üstesinden gelmelerine yardımcı olacaktır. Bilginin bu şekilde kategorilere ayrılması aynı zamanda bilginin hatırlanmasında da etkili olur.

### *W (what I Want to know) Ne öğrenmek istiyorum?*

Öğrenciler bildiklerini ve ayırdıkları kategorileri kullanarak okuyacağı makaleden neler umduğunu "neden sıcak bir günde kaldırımı çimlerden daha sıcak hissettiğimiz halde soğuk bir günde kaldırımı çimlerden daha soğuk hissederiz?", "sıcaklıkla ısı arasındaki fark nedir?" gibi sorularla ifade eder. Emin olunmayan bilgiler, birbiri ile uyuşmayan fikirler öğrencilerin makaleyi okumak için kendi amaçlarını oluşturur. Okumadan öyle böyle bir beklentinin olması öğrencinin bilgi kapasitesini arttıracaktır. Bu sırada öğretmen öğrencilerin kendi amaçlarına sahip olabilmeleri ve dikkatini arttırabilmeleri için sahip olunan bilgiler arasındaki boşluğun veya uyumsuzluğun altını çizmeli ve öğrencilerin kendi sorularını üretmelerine yardımcı olmalıdır. Genellikle bu aşama grup halinde yapılmasına rağmen öğrenciler kendi amaçlarına sahip olabilsinler diye tartışma boyunca ortaya çıkan ve kendi merak ettikleri sorular ile çalışma kağıtlarını doldururlar. Okuyucu buna zamanla alışacak ve benzer makaleleri okurken zihninde neleri öğrenmek istediği hazır olacaktır. Böylelikle yeni okunan bir materyalin yargılanarak kolayca anlaşılması mümkün olur.

### *L (what I Learned) Ne öğrendim ve L(l) ?*

Ogle bu üçüncü aşamanın diğer ikisinin ardından yapılmasını öneriyor. Fakat bu ders esnasında uzun bir kitabın devamlı olarak okunması için zor bir olay. Bunlar için biz de (l) yani "later" seçeneğini ekledik, yani "daha sonra".

L bileşeninde öğrenciler sorularını çalışma kağıtlarına doldurduktan hemen sonra okumaya ve sorularının cevaplarını metin içerisinde aramaya başlar. Bulduğu cevapları da "L" sütununa yazar. Ardından buldukları cevaplar sınıf içerisinde tartışılır. Öğretmenin bir görevi de okuduktan sonra da cevapsız kalan soruların nasıl cevaplanabileceğine yardımcı olmaktır. Bütün okuyucular sorularının cevaplanması hakkına sahiptir. Aslında bu okumanın gerçek amacıdır.

Çalışmada kullanılan ise L(l) bileşenidir. Aynı şeyler bu bileşen için de geçerlidir. Fakat okuma eve ödev olarak verilir. Öğrenci sorularını evde cevaplayacak ve sınıfta bu cevaplar tartışılacaktır. Ancak bu yöntem araya fazlaca bir zaman aralığı eklemesi, uzun metinleri içermesi ve rahatlıkla suiistimal edilebilmesinden dolayı bazı noktalara dikkat edilmelidir:

- Metin uzun olması ve bir çok kavramın bu uzun metinde geçmesinden dolayı, tartışma boyunca tüm noktalara temas etmek zor olacaktır. Bu nedenle kısaca bir tartışma ile konuya ısındırıldıktan sonra, öğrencilerden bir-iki dakika içerisinde okunacak bölümün gözden geçirilmesi istenir. Ve ardından K-W-L(l) çalışmasına başlanır.
- Öğrencilerin başkasına ait çalışma kağıdını kopya etmesini önlemek için, çalışma kağıdının bir örneğini de sizin için hazırlamalarını da isteyebilirsiniz.
- Eğer gerekli görülürse, eve yönelik başka çalışmalar da K-W-L(l) çalışmasına ek olarak verilebilir.

- Bir sonraki ders öğrencilerle metin üzerinde tartışın. Öncelikle makaleyi yine bir-iki dakika içerisinde gözden geçirip içeriğini hatırlamalarını sağlayıp ardından, sordukları soruları ve edindikleri cevapları tartışın. Bu tartışmanın arkasından hangi bilgilere ulaşamadıklarını ve bu bilgilere nasıl ulaşabileceğinizi de sınıf içerisinde tartışın.

### *Özetle K-W-L metodunun uygulanışı*

Buraya kadar K-W-L okuma stratejisinin bir geniş çaplı bir açıklamasını yaptık. Şimdi bu uygulamanın adımlarını hızlıca tekrarlayalım.

- Öğrencilerin konu hakkındaki eski bilgilerin beyin fırtınası (brain storming) yoluyla ortaya çıkarılır, ve bu sırada ortaya çıkan her bir bilgi tahtaya çizilen K-W-L grafiğinde K (Ne biliyorum) sütununa yazılır. Tartışmalara öğrencilerin mümkün oldukça katılmasına çalışılmalıdır. Bu konuda öğretmenin mahareti önem taşır.
- Daha sonra öğrencilere K-W-L tabloları dağıtılarak öğrencinin tahtadakileri geçirmesi istenir. Çalışma kağıtları tartışmadan önce de yapılabilir, fakat bu durumda tartışma esnasında öğrenciler tartışmalar boyunca söylenenleri kağıtlarına yazmakla vakit geçireceklerinden tartışmaya katılmayabilirler.
- Ardından öğrencilerin bu bilgileri çeşitli kategorilere ayırması istenir ve sonuçlar K-W-L grafiğinde bunun için ayrılan yerlere eklenir.
- Kategorilere ayırma işlemi tamamlandıktan sonra öğrencilerin biraz sonra okuyacağı makaleden ne beklediği veya neler öğrenmek istedikleri sorulur. Bu sırada biraz önce tartışılan bilgilerden de yararlanılır. Oluşan sorular da ikinci sütunumuz olan W, yani ne öğrenmek istiyorum, sütununa yazılır.
- Arkasından öğrenciler makaleyi okuduktan sonra veya okurken, sorduğu soruların cevaplarını son sütunumuz olan L, yani ne öğrendim, sütununa doldurur.
- Ardından sorulan soruların hangilerinin makale içerisinde bulunduğu ve hangileri bulunmadığı sınıf içerisinde tartışılır.

**ÖRNEK BİR K-W-L ÇALIŞMASI**

Aşağıdaki örnek zehirli örümcekler hakkındaki bir yazının okunması sırasında K-W-L metodunun nasıl uygulandığını göstermektedir.

Öğretmen: Bugün havyanlar hakkında başka bir makale okuyacağız. Bu makale örümceğin özel bir türü hakkındadır-Kara Dul. Okumaya başlamadan önce Kara Dul örümceği hakkında ne bildiklerimizi hatırlayalım. Bu tür örümcekler hakkında bilginiz yoksa genel olarak örümcekler hakkında bildiklerinizi gözden geçirin. Daha sonra bu bildiklerinizden hangilerinin Kara Dul için de geçerli olduğunu hep birlikte görelim.

[Hoca tahtaya *Kara Dul örümceği* yazar ve öğrencilerin örümcek hakkındaki bilgilerini gözden geçirmesini bekler. Daha sonra öğrencilerin fikirleri alarak bu fikirleri tahtaya yazar]

Tony: Örümcekler altı ayaklıdır.

Susan: Diğer böcekleri yerler.

Eddie: Bence büyük ve tehlikelilerdir.

Öğretmen: Büyük ve tehlikeli derken söylediklerini daha da netleştirmek ister misin?

Eddie: Onlar, onlar, diğer örümcekleri yerler. Ayrıca insanlar da onlardan korkar.

Steph: Diğer böcekleri yakalamak için ağ yaparlar.

Tom: Kuzenini bir keresinde sokmuştu ve az kalsın ölecekti.

Öğretmen: Yani insanlar için de tehlikeli olabilir mi diyorsun?

Tom: Evet, kuzenim bu yüzden hastaneye gitmek zorunda kaldı.

Öğretmen: Peki Kara Dul hakkında başka bir bilgisi olan var mı? Tammy?

Tammy: Buralarda yaşadıklarını sanmıyorum. Kimsenin bir örümcek tarafından ısırıldığını duymadım.

Öğretmen: Karadullar nerede yaşar? Bir bilen var mı? (Bekler) Peki örümcekler hakkında daha neler biliyorsunuz?

John: Bir kere televizyonda görmüştüm. Arkalarında özel bir işaret vardı. Sanırım mavi bir üçgen, daire veya ona benzer bir şey. Eğer dikkat edecek olursanız Kara Dul olup olmadığını anlayabilirsiniz.

Öğretmen: Peki aramızda neye benzediğini hatırlayan başka biri var mı? (Bekler) Şu ana kadar örümcekler hakkında neler söylediklerimize bakın. Buraya eklememiz gereken başka bir bilgi olabilir mi?

John: Sanırım yavrularını veya erkek örümcekleri öldürüyorlar ama emin değilim.

Öğretmen: Nereden öğrendiğini hatırlıyor musun?

John: Sanırım bir makalede okumuştum.

Öğretmen: Tamam bunu da listemize ekleyelim. Amam hatırlayın, bu listede kesin emin olmadığımız her şeyi makaleyi okurken kontrol edebiliriz.

Öğretmen: Peki örümcekler hakkında başka ne biliyorsunuz? (Bekler). Tamam, okumaya başlamadan önce ne türde veya kategorideki bilgilerin makalede yer alabileceğini düşünelim. Şu ana kadar hangi kategorilerdeki bilgilerden bahsettik?

Peter: Nasıl göründüklerinden.

Öğretmen: Evet, büyük ve altı ayaklı olduğunu söyledik. Ve aramızdan birisi de Kara Dulun üzerinde renkli bir işaret olduğunu söylemişti. Güzel, bu tanımlama hayvanlar veya böcekler hakkında okurken en çok karşılaşacağımız bir bilgi.

Anna: Nerede yaşadıkları; fakat emin değiliz.

Öğretmen: Güzel, nerede yaşadıklarını bilmemiz gerekiyor. Peki başka ne tür bir bilgiyi bu makaleden elde etmeyi bekliyoruz? Diğer hayvanlar hakkında okuduğumuz diğer makalelerden öğrendiklerimizi hatırlayın.

Diane: Ne çeşit bir ev yaptıklarını öğrenmek istiyorduk.

Paul: Ne yerler?

Andy: Kendilerini nasıl korurlar.

Cara: Nasıl yavru sahibi olurlar? Kaç tane yavruları olur?

Öğretmen: Çok güzel. Öğrenmek isteyebileceğimiz başka bir bilgi var mı? (Bekler). Kara Dul örümcekleri hakkında ne bildiğimizi ve ne öğrenmek istediğimizi düşünmüştük. Şimdi cevaplarını öğrenmek istediğimiz sorular neler? Sanırım emin olmadığımız şeyler vardı, nerede yaşadıkları gibi. Okurken cevabını öğrenmek isteyeceğimiz başka ne gibi bir bilgi olabilir?

Cara: Ben örümceklerin kaç tane yavru doğurduğunu öğrenmek isterim.

Rico: Gerçekten Kara Dul insana zarar verir mi? Daha böyle bir şey duymadım fakat babam örümcekler hakkında çok şey biliyor.

Andy: Niye Kara Dul ismi verilmiş? Dul ne demek?

Öğretmen: Güzel bir soru! Aranızda bunu bilen var mı? Niye bu örümcek "Kara Dul" olarak adlandırılıyor?(Birkaç öğrencinin daha sorularını aldıktan sonra, her bir öğrencinin kendi sorularını çalışma kağıtlarına yazmalarını ister.) En çok cevabını öğrenmeyi istediğiniz sorular nelerdir? Haydi sorularınızı çalışma kağıtlarınıza yazın. Okudukça cevaplarını kontrol edip cevaplarınızı da çalışma kağıtlarınıza ekleyin. Aynı zamanda unutmamak istediğiniz bilgileri de kağıtlarınıza yazmayı unutmayın. (Öğrenciler makaleyi okur).

Öğretmen: Makaleyi sevdiniz mi? Neler öğrendiniz?

Raul: Kara Dul kocasını yiyormuş, kimi zamanda kendi yavrusunu. Böğ! Sanırım bu örümceği sevebileceğimi hiç zannetmiyorum.

Steph: Burada da yaşayabilirler. Makalede Amerika'nın her yerinde yaşadıklarını söylüyor.

Andy: Abdomenlerindeki kırmızı veya sarı kum saati şeklindeki işaretlerinden tanınabilirler.

Öğretmen: Abdomen ne demektir, yani bu kelime yerine başka ne kullanabiliriz? Sara sözlükten abdomen kelimesinin manasına bakabilir misin, kum saatinin neresinde olduğunu bulalım. Sara bu kelimenin manasına bakarken bizde sorularınızın arkasından neler öğrendiğinizi görelim. Cevabını bulamadığınız sorular var mı? Veya makalede olmayıp da başka öğrenmek istediği bir şey var mı? (tartışma öğretmenin öğrencilerin daha önceden sahip olduğu bilgilerle önceden okuduğu makaleleri karşılaştırmasıyla devam eder.

Ayrıca öğretmen öğrencilerin kendi sorgulamasını sağlayarak bilgisinin sadece bir makale ile sınırlı kalmamasına yardımcı olur. Bu yolla öğretmen bilginin sadece yazarın makaleye koyduğu şeylerden ibaret olmadığını gösterir. Bunun yanında sorularını tanımlayıp cevaplarını makale içerisinde taramasını da öğrencilerine göstermiş olur.

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# APPENDIX F

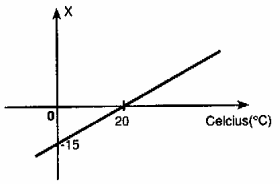
# WORKSHEETS

## Çalışma Kağıdı 1

**1.** Bir X termometresi suyun donma noktasını -20 kaynama noktasını 100 derece ölçüyor.
**Buna göre 40°C lik sıcaklığı X termometresi kaç derece ölçer?**

A) 18 B) 24 C) 28 D) 30 E) 40

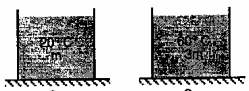
**2.**




Celcius ve X termometreleri arasındaki ilişkiyi veren grafik şekildeki gibidir.
**Buna göre, suyun kaynama noktasını X termometresi kaç derece gösterir?**

A) 20 B) 40 C) 45 D) 60 E) 75

**3.**




Şekilde ısıca yalıtılmış kaplarda belirtilen sıcaklık ve kütlede su vardır.
**I. ve II. kaptaki sular yeterince büyük bir kapta karıştırılırsa son sıcaklık kaç °C derece olur?**

A) 30 B) 40 C) 50 D) 60 E) 80

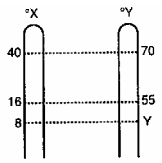
**4.**

| | Özısı | Kütle | İlk Sıcaklık | Son Sıcaklık | Alınan Isı |
|---|---|---|---|---|---|
| X | 2c | m | $T_1$ | $T_2$ | Q |
| Y | 3c | 2m | $T_1$ | $T_2$ | ? |

**Tabloya göre Y nin aldığı ısı kaç Q olur?**

A) $\frac{1}{4}$ B) $\frac{1}{3}$ C) 1 D) 3 E) 4

**5.**




Şekildeki X ve Y termometrelerinden X termometresi sırasıyla 40° ve 16° değerlerini gösterirken, Y de 70° ve 55° yi göstermektedir.
**Buna göre X termometresi 8° yi gösterdiği anda Y termometresi kaç dereceyi gösterir?**

A) 50 B) 45 C) 40 D) 35 E) 30

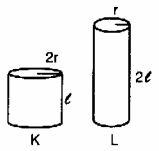
**6.** **Bilgi:** Isı, iletim, taşıma ve ışıma olmak üzere üç farklı yol ile yayılmaktadır.
**Buna göre,**
I. Işık vermekte olan ampulün etrafını ısıtması
II. Çorba içine daldırılan kaşığın ısınması
III. Su dolu bir akvaryumun sıcaklığını artırmak için, içine ısıtıcı daldırılması
**yukarıda verilen olaylarda ısı hangi yolla yayılmaktadır?**

| | I | II | III |
|---|---|---|---|
| A) | taşıma, | taşıma, | iletim |
| B) | ışıma, | iletim, | taşıma |
| C) | taşıma, | iletim, | taşıma |
| D) | ışıma, | taşıma, | iletim |
| E) | iletim, | iletim, | ışıma |

**7.** K, L, M sıvılarından 2m, m, 3m kütlelerinde alınıp bunlara Q, 3Q, 2Q ısısı verilince sıcaklık değişimleri eşit olmaktadır.
**Buna göre, K, L, M sıvılarının $C_K$, $C_L$, $C_M$ özısıları arasında nasıl bir ilişki vardır?**

A) $C_K > C_L > C_M$ B) $C_K > C_M > C_L$ C) $C_L > C_M > C_K$
D) $C_L > C_K > C_M$ E) $C_M > C_L > C_K$

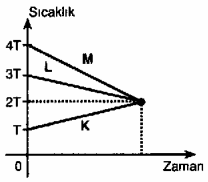
**8.**




Aynı maddeden yapılmış K ve L silindirlerine $Q_K$ ve $Q_L$ ısıları verildiğinde silindirlerin boyca uzama miktarları eşit oluyor.
**Buna göre oranı $\frac{Q_K}{Q_L}$ kaçtır?**

A) $\frac{1}{4}$ B) $\frac{1}{2}$ C) 1 D) 2 E) 4

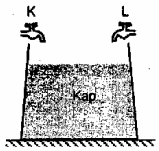
**9.**




Isıca yalıtılmış ortamda bulunan K , L ve M sıvılarının ilk sıcaklıkları T , 3T , 4T 'dir. Sıvılar karıştırıldığında denge sıcaklığı 2T oluyor.
**Buna göre,**
I. K nin ısı sığası, L ninkinden büyüktür.
II. M nin ısı sığası, K ninkinden küçüktür.
III. L nin ısı sığası, M ninkinden büyüktür.
**Ifadelerinden hangileri <u>kesinlikle</u> doğrudur?**

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

**10.** Özdeş ve sabit debili K ve L musluklarından sırasıyla 20° ve 60° de su akmaktadır.
Her iki musluk beraberce açılıp kap yarı yüksekliğine kadar doldurulduktan sonra K musluğu kapatılıyor.

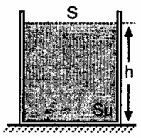



**Kap tamamen dolduğu anda suyun sıcaklığı (T) için hangisi doğru olur?**

A) 40°C B) 40°C < T < 50°C C) 50°C
D) 50°C < T < 60°C E) 60°C

# Çalışma Kağıdı 2

**1.** Şekildeki kaba su doldurulmuştur.
**Suyun buharlaşma hızı,**
h, suyun derinliği
S, suyun havayla temas yüzeyi
T, suyun sıcaklığı
**niceliklerinden hangilerine bağlıdır?**



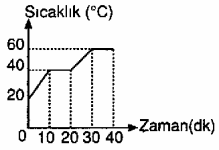

A) Yalnız h B) h ve S C) h ve T
D) S ve T E) Yalnız T

**2.** –10°C de 40 gram buz, +10°C de 36 gram su içine atılıyor ve ısıl denge sağlanana kadar bekleniyor.
**Isıl denge sağlandıktan sonra $\frac{m_{su}}{m_{buz}}$ oranı kaçtır?**

($c_{buz}$ = 0,5 cal/g °C ($C_{su}$= 1 cal/g°C $L_e$ = 80 cal/g)

A) $\frac{1}{2}$ B) 1 C) $\frac{5}{4}$ D) $\frac{3}{2}$ E) $\frac{5}{3}$

**3.** m gramlık katı bir madde sabit hızlı ocakta ısıtılınca sıcaklık-zaman grafiği şekildeki gibi oluyor.
**Aynı katı maddenin 2m gramı ısı verme hızı önceknin iki katı olan bir ocakta ısıtıldığında grafikteki,**




I. Erime sıcaklığı değeri artar.
II. Erime süresi azalır.
III. Kaynama süresi değişmez.
**yargılarından hangileri doğrudur?**

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

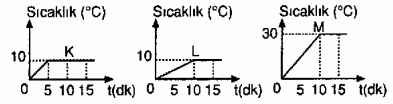
**4.** **140°C deki 10 gram su buharından 6400 kalorilik ısı alınırsa ne olur?** ($c_{buhar}$ = 0,5 cal/g °C, $L_b$ = 540 cal/g)

A) 20°C de su B) 50°C de su
C) 100°C de su buharı D) 0°C de su buharı
E) 0°C de su

**5.** **110°C de 10 gram su buharının 100°C de 10 gram su haline gelebilmesi için kaç kalori ısı enerjisi kaybetmesi gerekir?**
($L_b$ = 540 cal/g °C $c_{buhar}$ = 0,5 cal/g °C)

A) 5400 B) 5450 C) 5500
D) 5550 E) 5600

**6.**

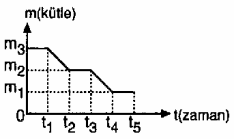



K, L, M sıvılarının bulunduğu üç kap özdeş ısıtıcılarla ısıtılıyor. **Sıvıların sıcaklık-zaman grafikleri şekildeki gibi olduğuna göre,**

I. L ile M aynı sıvı olabilir, K farklıdır.
II. K ile L aynı sıvı olabilir, M farklıdır.
III. K ile L'nin kütleleri eşit, M'ninki farklıdır.
**yargılarından hangileri kesinlikle doğrudur?**

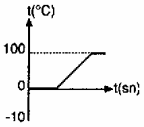
A) Yalnız I B) Yalnız II C) Yalnız III
D) I ve III E) II ve III

**7.** Ağzı açık bir kaptaki, sıvı karışımına ısı veriliyor ve kütle zaman grafiği şekildeki gibi oluyor.
**Buna göre aşağıdakilerden hangisi yanlıştır?**

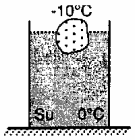



A) Karışımda en az üç ayrı sıvı vardır.
B) $t_1$-$t_2$ ve $t_3$-$t_4$ zaman aralıklarında sistemin sıcaklığı sabittir.
C) 0-$t_1$, $t_2$-$t_3$ ve $t_4$-$t_5$ zaman aralıklarında sistemin sıcaklığı artmıştır.
D) Donma noktası en düşük olan sıvı $m_1$ kütlesine sahiptir.
E) Kaynama noktası en düşük olan sıvı $t_1$-$t_2$ aralığında buharlaşmıştır.

**8.** **Yandaki grafik hangi olaya aittir?**
A) 0°C deki buzun 0°C de su olması
B) 0°C deki suyun 100°C de su olması
C) –10°C deki buzun 0°C de su olması
D) 0°C deki suyun 100°C de buhar olması
E) 0°C deki buzun 100°C de buhar olması



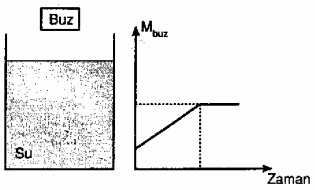

**9.** 0°C deki 2m gram su içine-10°C de m gram buz atılıyor ve ısıl denge sağlanana kadar bekleniyor.
**Buna göre,**




I. Denge sıcaklığı 0°C dir.
II. Kalan suyun özkütlesi değişmemiştir.
III. Buzun kütlesi artmıştır.
**yargılarından hangileri doğrudur?**

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

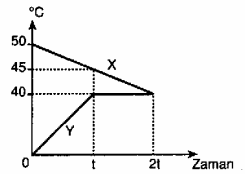
**10.**




İçinde yeterince su bulunan bir kaba bir buz parçası bırakıldığında buzun kütlesinin zamana bağlı grafiği şekildeki gibidir.
**Buna göre;**
I. Buzun ilk sıcaklığı 0°C'nin altındadır.
II. Buzun ilk sıcaklığı 0°C'dir.
III. Suyun son sıcaklığı 0°C'nin üstündedir.
**hangileri kesinlikle doğrudur?**

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

**11.**




X sıvısının içerisine eşit kütlede Y katısı atıldığında, 2t anında tamamen eriyerek, 40°C karışım haline geliyorlar.
**Buna göre X'in öz ısısının Y'nin erime ısısına oranı $\frac{C_X}{L_Y}$ kaçtır?**

A) $\frac{1}{2}$ B) $\frac{1}{3}$ C) $\frac{1}{4}$ D) $\frac{1}{5}$ E) $\frac{1}{6}$

# Çalışma Kağıdı 3

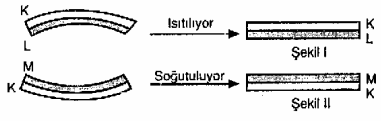
**1.**

| Cisim | İlk boy | Sıcaklık artışı | Uzama miktarı |
|---|---|---|---|
| X | L / 4 | t | a /4 |
| Y | L | 4t | 3a |
| Z | 2L | 2t | 4a |

**İlk boyları, sıcaklık artışları ve uzama miktarları tabloda verilen X, Y, Z çubuklarının aynı maddeden yapılıp yapılmadıkları hakkında ne söylenebilir?**

A) Y ve Z aynı olabilir, X kesinlikle farklıdır.
B) Y ve X aynı olabilir, Z kesinlikle farklıdır.
C) Üçü de kesinlikle farklıdır.
D) X ve Z aynı olabilir, Y kesinlikle farklıdır.
E) Üçü de aynı madde olabilir.

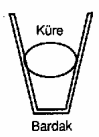
**2.**




Birbirine perçinlenmiş K ve L çubuğu ısıtıldığında Şekil I deki gibi, birbirine perçinlenmiş M ve K çubuğu soğutulduğunda Şekil II deki gibi olmaktadır.
**Buna göre, çubukların $\lambda_K$, $\lambda_L$ ve $\lambda_M$ boyca uzama katsayıları arasındaki ilişki nasıldır?**

A) $\lambda_K > \lambda_L > \lambda_M$ B) $\lambda_K = \lambda_L > \lambda_M$ C) $\lambda_L > \lambda_M > \lambda_K$
D) $\lambda_L > \lambda_K > \lambda_M$ E) $\lambda_K > \lambda_M > \lambda_L$

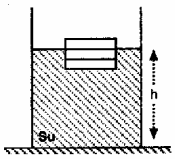
**3.**




Ani sıcaklık değişimlerine dayanıklı cam küre ve bardak şekildeki gibi sıkışmıştır.
**Bardağı kırmadan bunları birbirlerinden ayırmak için aşağıdaki işlemlerden hangileri yapılmalıdır?**

A) Bardağın içine soğuk su konmalıdır.
B) Bardak dıştan soğuk suya daldırılmalıdır.
C) Bardak dıştan sıcak suya daldırılmalıdır.
D) Bardağın içine sıcak su konmalıdır.
E) İkisi birden soğuk suya tam daldırılmalıdır.

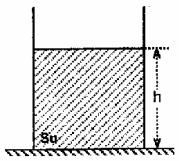
**4.**



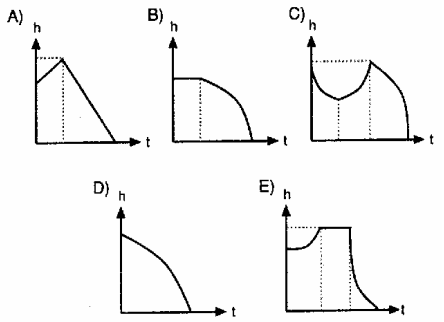

Şekildeki cisim 0°C deki suda dengededir.
**Suyun sıcaklığı bir ısıtıcı yardımıyla artırıldığında cismin hareketi için aşağıdakilerden hangisi doğrudur?**
(Cisim ve kabın genleşmesi önemsiz)

A) Cisim bir miktar aşağı doğru hareket eder.
B) Cisim bir miktar daha yukarı doğru hareket eder.
C) Cisim önce bir miktar daha batar, sonra yukarı doğru hareket eder.
D) Cisim önce bir miktar yukarı hareket eder, sonra aşağı doğru hareket eder.
E) Cisimde herhangi bir hareket gözlenmez.

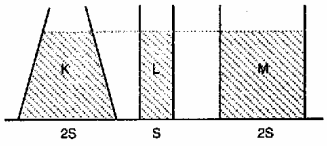
**5.** 0°C de ağzı açık bir kapta h yüksekliğinde su vardır. Bu kaba kaptaki tüm su kaynayarak buharlaşıncaya kadar eşit zaman aralığında eşit miktarda ısı veriliyor.




**h yüksekliğinin zamana bağlı değişim grafiği aşağıdakilerden hangisidir?**
(Kabın genleşmesi ihmal ediliyor.)



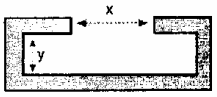

**6.**




Aynı sıcaklıktaki K, L ve M sıvıları son sıcaklıkları aynı olacak şekilde ısıtılıyor ve kaplardaki son sıvı seviyeleri eşit oluyor.
**Buna göre, aşağıdakilerden hangisi doğrudur?**
(Kapların genleşmeleri önemsizdir.)

A) L ile M aynı olabilir, K farklıdır.
B) K ve L aynı olabilir, L farklıdır.
C) K ve M aynı olabilir, L farklıdır.
D) Üçü de farklı sıvı olabilir.
D) Üçü de aynı sıvı olabilir.

**7.** Türdeş bir metal cismin üzerinde şekildeki gibi x ve y uzunlukları verilmiştir.




**Cismin sıcaklığı artırılırsa x ve y'nin değişimi nasıl olur?**

| | x | y |
|---|---|---|
| A) | Artar | Artar |
| B) | Artar | Azalır |
| C) | Azalır | Artar |
| D) | Azalır | Azalır |
| E) | Artar | Değişmez |

**8.** Türdeş bir maddeden yapılmış içleri tamamen dolu r ve 2r yarıcaplı K ve L kürelerine eşit miktarda ısı enerjisi veriliyor.

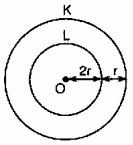
**Buna göre;**

I. K'nin sıcaklığı, L'den 8 kat fazla artar.
II. Sıcakları eşit artar.
III. Hacimlerindeki artış miktarı eşit olur?

**yargılarından hangileri doğrudur?**

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

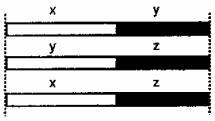
**9.** Uzama katsayıları $\alpha_K$ ve $\alpha_L$ olan tellerden yapılan O merkezli K ve L telleri ısıtıldığında aralarındaki r uzaklığı değişmiyor.




**Buna göre $\frac{\alpha_K}{\alpha_L}$ oranı kaçtır?**

A) 2 B) $\frac{3}{2}$ C) 1 D) $\frac{2}{3}$ E) $\frac{1}{2}$

**10.**



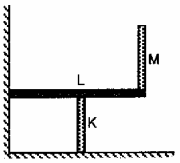

Uzama katsayıları $\alpha_X$ , $\alpha_Y$ ve $\alpha_Z$ olan, eşit uzunluktaki X , Y , Z çubukları 2t sıcaklığında şekildeki gibi birleştiriliyor. Sıcaklıkları t'ye düşürüldüğünde son boyları sırasıyla $\ell_1$ , $\ell_2$ ve $\ell_3$ oluyor.

$\ell_1 > \ell_2 > \ell_3$ oldu€una göre,

**$\alpha_X$ , $\alpha_Y$ ve $\alpha_Z$ arası ilişki nedir?**

A) $\alpha_Z > \alpha_X > \alpha_Y$ B) $\alpha_X > \alpha_Y > \alpha_Z$
C) $\alpha_Z > \alpha_Y > \alpha_X$ D) $\alpha_Y > \alpha_X > \alpha_Z$
E) $\alpha_Y > \alpha_Z > \alpha_X$

**11.** Sürtünmesiz düzlemlerde yerleştirilmiş K , L , M cisimleri dengededir.




**Buna göre;**

I. K ve L birlikte ısıtılırsa denge bozulur.
II. L ve M birlikte ısıtılırsa denge bozulmaz
III. K ve M soğutulursa denge bozulmaz

**yargılarından hangileri doğrudur?**

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

# APPENDIX G

## PERMISSION BY PAUL HEWITT

Dear Volkan,

You certainly DO have my permission to use my book or tapes to help you with your project. I wish you the best of luck!

Good Energy,

Paul Hewitt

# APPENDIX H

## RESEARCH DATA

ID: (Group name+ student id given by the researcher inside a group)

RS: Reading strategy; K-W-L (1) and Non-K-W-L (0)

TS: Textbook Style; CPT (1) and TPT (0)

A: Age

G: Gender; male (1) and female (0)

PREACH: students' achievement score from pre-achievement test

PREATT: students' attitude score from pre-attitude test

POSTACH: students' achievement score from post-achievement test

POSTATT: students' attitude score from post-attitude test

| ID | RS | TS | A | G | PREACH | POSTACH | PREATT | POSTATT |
|---|---|---|---|---|---|---|---|---|
| A01 | 1 | 1 | 16 | 1 | 4 | 12 | 84 | 116 |
| A02 | 1 | 1 | 15 | 2 | 5 | 21 | 53 | 76 |
| A03 | 1 | 1 | 15 | 1 | 4 | 18 | 82 | 78 |
| A04 | 1 | 1 | 16 | 2 | 5 | 21 | 52 | 54 |
| A05 | 1 | 1 | 16 | 1 | 6 | 24 | 96 | 108 |
| A06 | 1 | 1 | 16 | 2 | 5 | 21 | 75 | 50 |
| A07 | 1 | 1 | 16 | 2 | 3 | 12 | 59 | 62 |
| A08 | 1 | 1 | 16 | 2 | 5 | 19 | 94 | 82 |
| A09 | 1 | 1 | 16 | 1 | 6 | 23 | 78 | 83 |
| A10 | 1 | 1 | 15 | 2 | 7 | 24 | 80 | 84 |
| A11 | 1 | 1 | 15 | 1 | 4 | 17 | 72 | 55 |
| A12 | 1 | 1 | 15 | 2 | 3 | 12 | 61 | 79 |
| A13 | 1 | 1 | 16 | 2 | 4 | 15 | 105 | 90 |
| A14 | 1 | 1 | 16 | 1 | 6 | 23 | 81 | 86 |
| A15 | 1 | 1 | 16 | 1 | 4 | 15 | 65 | 74 |
| A16 | 1 | 1 | 16 | 2 | 2 | 9 | 67 | 75 |
| A17 | 1 | 1 | 15 | 2 | 7 | 24 | 66 | 73 |
| A18 | 1 | 1 | 15 | 1 | 5 | 18 | 70 | 74 |
| A19 | 1 | 1 | 15 | 1 | 1 | 10 | 72 | 72 |
| A20 | 1 | 1 | 16 | 2 | 3 | 12 | 90 | 94 |
| A21 | 1 | 1 | 16 | 2 | 4 | 14 | 85 | 94 |
| A22 | 1 | 1 | 16 | 2 | 0 | 9 | 84 | 85 |
| A23 | 1 | 1 | 16 | 1 | 3 | 11 | 108 | 78 |
| A24 | 1 | 1 | 16 | 2 | 1 | 8 | 104 | 114 |
| A25 | 1 | 1 | 16 | 1 | 8 | 25 | 68 | 62 |

| ID | RS | TS | A | G | PREACH | POSTACH | PREATT | POSTATT |
|---|---|---|---|---|---|---|---|---|
| A26 | 1 | 1 | 16 | 2 | 4 | 13 | 71 | 75 |
| A27 | 1 | 1 | 15 | 1 | 6 | 22 | 50 | 53 |
| A28 | 1 | 1 | 16 | 2 | 5 | 18 | 81 | 80 |
| A29 | 1 | 1 | 16 | 2 | 4 | 13 | 78 | 75 |
| A30 | 1 | 1 | 16 | 2 | 9 | 25 | 41 | 68 |
| A31 | 1 | 1 | 15 | 2 | 9 | 25 | 89 | 94 |
| B01 | 1 | 0 | 16 | 2 | 7 | 22 | 48 | 54 |
| B02 | 1 | 0 | 15 | 2 | 10 | 24 | 87 | 87 |
| B03 | 1 | 0 | 15 | 2 | 4 | 11 | 48 | 82 |
| B04 | 1 | 0 | 16 | 1 | 4 | 11 | 76 | 90 |
| B05 | 1 | 0 | 16 | 1 | 8 | 24 | 99 | 104 |
| B06 | 1 | 0 | 15 | 2 | 6 | 21 | 54 | 72 |
| B07 | 1 | 0 | 16 | 1 | 2 | 9 | 77 | 75 |
| B08 | 1 | 0 | 15 | 2 | 6 | 20 | 96 | 87 |
| B09 | 1 | 0 | 16 | 1 | 7 | 22 | 52 | 64 |
| B10 | 1 | 0 | 16 | 1 | 2 | 9 | 58 | 80 |
| B11 | 1 | 0 | 16 | 1 | 5 | 13 | 97 | 96 |
| B12 | 1 | 0 | 15 | 2 | 6 | 20 | 69 | 67 |
| B13 | 1 | 0 | 16 | 2 | 2 | 7 | 67 | 58 |
| B14 | 1 | 0 | 15 | 2 | 4 | 9 | 68 | 62 |
| B15 | 1 | 0 | 16 | 1 | 6 | 19 | 95 | 76 |
| B16 | 1 | 0 | 16 | 2 | 6 | 18 | 73 | 66 |
| B17 | 1 | 0 | 16 | 2 | 8 | 23 | 73 | 70 |
| B18 | 1 | 0 | 16 | 2 | 12 | 25 | 104 | 90 |
| B19 | 1 | 0 | 16 | 1 | 6 | 18 | 59 | 78 |
| B20 | 1 | 0 | 16 | 2 | 5 | 15 | 65 | 55 |
| B21 | 1 | 0 | 15 | 2 | 5 | 15 | 75 | 72 |
| B22 | 1 | 0 | 15 | 1 | 4 | 10 | 68 | 60 |
| B23 | 1 | 0 | 15 | 2 | 5 | 13 | 57 | 70 |
| B24 | 1 | 0 | 15 | 2 | 2 | 7 | 68 | 74 |
| B25 | 1 | 0 | 15 | 2 | 5 | 13 | 99 | 103 |
| B26 | 1 | 0 | 16 | 2 | 5 | 11 | 65 | 63 |
| B27 | 1 | 0 | 15 | 2 | 8 | 22 | 53 | 56 |
| B28 | 1 | 0 | 16 | 2 | 4 | 8 | 93 | 74 |
| B29 | 1 | 0 | 16 | 1 | 6 | 16 | 45 | 67 |
| B30 | 1 | 0 | 15 | 2 | 6 | 17 | 92 | 62 |
| C01 | 0 | 1 | 15 | 2 | 5 | 11 | 93 | 96 |
| C02 | 0 | 1 | 16 | 1 | 5 | 18 | 72 | 78 |
| C03 | 0 | 1 | 16 | 2 | 2 | 7 | 86 | 111 |
| C04 | 0 | 1 | 16 | 1 | 3 | 10 | 113 | 120 |
| C05 | 0 | 1 | 16 | 2 | 3 | 10 | 84 | 108 |
| C06 | 0 | 1 | 16 | 2 | 4 | 14 | 85 | 96 |
| C07 | 0 | 1 | 16 | 2 | 3 | 8 | 69 | 74 |
| C08 | 0 | 1 | 16 | 1 | 1 | 10 | 66 | 81 |
| C09 | 0 | 1 | 16 | 2 | 2 | 6 | 98 | 82 |
| C10 | 0 | 1 | 15 | 2 | 5 | 16 | 75 | 72 |
| C11 | 0 | 1 | 16 | 1 | 4 | 14 | 96 | 96 |
| C12 | 0 | 1 | 16 | 2 | 6 | 19 | 76 | 88 |
| C13 | 0 | 1 | 15 | 1 | 6 | 21 | 106 | 106 |
| C14 | 0 | 1 | 16 | 2 | 3 | 8 | 74 | 68 |
| C15 | 0 | 1 | 16 | 1 | 3 | 8 | 81 | 96 |

| ID | RS | TS | A | G | PREACH | POSTACH | PREATT | POSTATT |
|---|---|---|---|---|---|---|---|---|
| C16 | 0 | 1 | 16 | 2 | 8 | 24 | 89 | 108 |
| C17 | 0 | 1 | 16 | 2 | 1 | 12 | 78 | 90 |
| C18 | 0 | 1 | 16 | 1 | 5 | 16 | 96 | 96 |
| C19 | 0 | 1 | 16 | 2 | 7 | 21 | 98 | 83 |
| C20 | 0 | 1 | 16 | 2 | 7 | 24 | 54 | 107 |
| C21 | 0 | 1 | 16 | 2 | 4 | 14 | 66 | 91 |
| C22 | 0 | 1 | 15 | 1 | 5 | 16 | 59 | 65 |
| C23 | 0 | 1 | 16 | 2 | 4 | 12 | 88 | 93 |
| C24 | 0 | 1 | 16 | 1 | 5 | 16 | 90 | 88 |
| C25 | 0 | 1 | 16 | 2 | 7 | 23 | 64 | 60 |
| C26 | 0 | 1 | 16 | 1 | 7 | 23 | 74 | 96 |
| C27 | 0 | 1 | 16 | 2 | 6 | 19 | 80 | 89 |
| C28 | 0 | 1 | 16 | 2 | 4 | 10 | 78 | 61 |
| C29 | 0 | 1 | 15 | 2 | 6 | 20 | 72 | 84 |
| C30 | 0 | 1 | 16 | 1 | 7 | 22 | 82 | 91 |
| C31 | 0 | 1 | 16 | 2 | 4 | 12 | 83 | 81 |
| D01 | 0 | 0 | 16 | 2 | 0 | 7 | 101 | 88 |
| D02 | 0 | 0 | 15 | 2 | 4 | 20 | 64 | 64 |
| D03 | 0 | 0 | 16 | 2 | 1 | 13 | 71 | 71 |
| D04 | 0 | 0 | 15 | 2 | 3 | 20 | 118 | 108 |
| D05 | 0 | 0 | 16 | 1 | 5 | 22 | 73 | 77 |
| D06 | 0 | 0 | 16 | 1 | 1 | 13 | 52 | 52 |
| D07 | 0 | 0 | 15 | 2 | 1 | 12 | 94 | 94 |
| D08 | 0 | 0 | 16 | 2 | 3 | 19 | 39 | 39 |
| D09 | 0 | 0 | 15 | 1 | 7 | 25 | 66 | 68 |
| D10 | 0 | 0 | 16 | 2 | 2 | 15 | 61 | 61 |
| D11 | 0 | 0 | 15 | 2 | 0 | 9 | 79 | 79 |
| D12 | 0 | 0 | 16 | 2 | 1 | 11 | 84 | 84 |
| D13 | 0 | 0 | 16 | 2 | 1 | 11 | 66 | 66 |
| D14 | 0 | 0 | 15 | 2 | 2 | 14 | 88 | 88 |
| D15 | 0 | 0 | 16 | 1 | 7 | 24 | 65 | 61 |
| D16 | 0 | 0 | 15 | 2 | 5 | 22 | 24 | 24 |
| D17 | 0 | 0 | 16 | 1 | 1 | 10 | 89 | 87 |
| D18 | 0 | 0 | 16 | 1 | 0 | 8 | 82 | 82 |
| D19 | 0 | 0 | 16 | 1 | 0 | 8 | 79 | 75 |
| D20 | 0 | 0 | 16 | 1 | 1 | 10 | 82 | 79 |
| D21 | 0 | 0 | 16 | 1 | 6 | 23 | 54 | 54 |
| D22 | 0 | 0 | 16 | 2 | 1 | 9 | 72 | 56 |
| D23 | 0 | 0 | 16 | 2 | 3 | 18 | 72 | 72 |
| D24 | 0 | 0 | 15 | 2 | 3 | 17 | 73 | 76 |
| D25 | 0 | 0 | 16 | 2 | 0 | 8 | 36 | 34 |
| D26 | 0 | 0 | 15 | 2 | 2 | 14 | 89 | 87 |
| D27 | 0 | 0 | 16 | 2 | 3 | 17 | 64 | 89 |
| D28 | 0 | 0 | 15 | 1 | 5 | 21 | 48 | 59 |
| D29 | 0 | 0 | 15 | 2 | 0 | 7 | 68 | 51 |
| D30 | 0 | 0 | 16 | 1 | 0 | 8 | 69 | 68 |
| D31 | 0 | 0 | 16 | 1 | 7 | 23 | 78 | 78 |