THE CONTRIBUTION OF COGNITIVE AND METACOGNITIVE STRATEGY USE TO SEVENTH GRADE STUDENTS' SCIENCE ACHIEVEMENT

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ABSTRACT

THE CONTRIBUTION OF COGNITIVE AND METACOGNITIVE STRATEGY
USE TO SEVENTH GRADE STUDENTS' SCIENCE ACHIEVEMENT

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The purposes of the study were to examine the differences in the level of students' cognitive and metacognitive strategy use and to investigate the contribution of cognitive and metacognitive strategy use (rehearsal, elaboration, organization, critical thinking, and metacognitive self-regulation) to 7th grade students' science achievement. This study also interested in exploring the relationships between students' background characteristics (gender, prior knowledge, socioeconomic status) and the variables including students' cognitive and metacognitive strategy use and science achievement.

The study was carried out during 2007-2008 spring semester at 15 public elementary schools in Keçiören, district of Ankara. A total of 1517 seventh grade students who were volunteers and had permission from their parents involved in the study. Data were collected through Background Characteristics Survey, Motivated Strategies for Learning Questionnaire and Science

Achievement Test and analyzed by using a One-Way Repeated ANOVA, Multiple Linear Regression Analyses and a Canonical Correlation Analysis.

The analyses revealed that there were significant differences in the level of students' cognitive and metacognitive strategy use scores. Besides, elaboration and metacognitive self-regulation strategy use made a statistically significant contribution to the prediction of students' achievement in science ($p<.05$). Metacognitive self-regulation strategy use was found to be the main predictor of science achievement ($\beta=.11$). The first canonical variate indicated that prior knowledge, mother's educational level, father's educational level, number of reading materials at home, frequency of buying a daily newspaper, presence of a separate study room, presence of a computer with internet connection at home are associated with cognitive and metacognitive strategy use and science achievement.

Keywords: Background Characteristics, Cognitive and Metacognitive Strategy Use, Science Achievement

ÖZ

BİLİŞSEL VE BİLİŞ ÖTESİ STRATEJİ KULLANIMININ YEDİNCİ SINIF ÖĞRENCİLERİNİN FEN BAŞARILARINA KATKILARI

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Bu çalışmanın amaçları, öğrencilerin kullandıkları bilişsel ve biliş-ötesi strateji seviyelerinde farklılık olup olmadığını ve bilişsel ve biliş-ötesi strateji kullanımının yedinci sınıf öğrencilerinin fen dersindeki başarılarına olan katkısını incelemektir. Ayrıca, öğrencilerin demografik özellikleriyle bilişsel ve biliş-ötesi strateji kullanımları ve fen başarıları arasındaki ilişkiler de incelenmiştir.

Bu çalışma, 2007-2008 öğretim yılı bahar döneminde Ankara ili Keçiören ilçesinde bulunan 15 devlet ilköğretim okulunda gerçekleşmiştir. Çalışmaya gönüllü ve veli onay formu bulunan 1517 yedinci sınıf öğrencisi katılmıştır. Veriler, Demografik Anket, Öğrenmede Güdüsel Stratejiler Anketi ve Fen Başarı Testi ile toplanmış ve Tekrarlı Ölçümler ANOVA, Çoklu Doğrusal Regresyon ve Kanonik Korelâsyon analizleri kullanılarak değerlendirilmiştir.

İstatistiksel sonuçlar, öğrencilerin bilişsel ve biliş-ötesi strateji kullanma seviyelerinde anlamlı farklılık olduğunu göstermiştir. Ayrıca, kavrama ve biliş-ötesi öz denetim stratejilerinin öğrencilerin başarısını anlamlı olarak yordadığı ortaya çıkmıştır ($p<.05$). Biliş-ötesi öz denetim stratejisinin başarı tahminine en büyük katkıyı yaptığı bulunmuştur ($\beta=.11$). Birinci kanonik olasılıksal değişken çifti; ön bilgilerin, anne ve babanın eğitim durumunun, evde bulunan kitap sayısının, eve gazete alma sıklığının, çalışma odasına, bilgisayara ve internet bağlantısına sahip olmanın; öğrencilerin bilişsel ve biliş-ötesi strateji kullanımları ve fen başarılarıyla ilişkili olduğunu göstermiştir.

Anahtar Kelimeler: Bilişsel ve Biliş-Ötesi Stratejiler, Demografik Özellikler, Fen Başarısı

To My Family

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LIST OF ABBREVIATIONS

MSLQ: The Motivated Strategies for Learning Questionnaire

MSLQ-TV: Turkish version of the Motivated Strategies for Learning Questionnaire

SAT: Science Achievement Test

GPA: Grade Point Average

Ho: Null Hypothesis

SD: Standard Deviation

DV : Dependent Variable

IV : Independent Variable

RMSEA: Root-Mean-Squared Error of Approximation

SRMR: Standardized-Root-Mean-Square Residual

GFI: Goodness-of-Fit Index

CFI: Comparative Fit Index

N : Sample Size

$\chi 2$: Chi-Square

df : Degree of Freedom

p : Significance Level

R: Rehearsal

E : Elaboration

O: Organization

CT : Critical Thinking

MSR : Metacognitive Self-regulation

GEND: Gender

SIBL: Number of sibling

MES: Mother's employment status

FES: Father's employment status

MEL: Mother's educational level

FEL: Father's educational level

READI: Number of reading materials at home

NEWS: Frequency of buying a daily newspaper

ROOM: Presence of a separate study room

COMP: Presence of a computer

INTER: Presence of an internet connection

CHAPTER 1

INTRODUCTION

Orientation from behaviorist theories to cognitive theories of learning results in an increase in learners' responsibility for their own learning (Chen, 2002). Accordingly, learning is not a passive process; on the contrary, it is an effective, continuous and developmental process in which learners engage in the learning process actively (Ministry of National Education of Turkey [MONE], 2006). That is, learners should be independent in their learning process rather than depending on teachers. Hence, the fundamental educational objective is to provide students with being independent, autonomous and efficient learners according to contemporary educators and psychologists (Bin, 2008). In this manner, concept of learning strategies has taken attention by researchers. Earlier, Weinstein and Mayer (1986) described learning strategies as 'behaviors and thoughts that a learner engages in during learning and that are intended to influence the learner's encoding process' (p. 315). Weinstein and Mayer analyzed learning strategies as basic/complex rehearsal strategy, basic/complex elaboration strategy, basic/complex organizational strategy, comprehension monitoring strategy and affective and motivational strategy in order to use for learning basic and complex school tasks. In addition, it was signified that the usage of particular learning strategies has an effect on encoding process so it influences the learning outcome and accomplishment (Weinstein & Mayer, 1986). With the idea that learning strategies can be taught to learners, McKeachie, Pintrich, and Lin (1985, 1987) developed a Learning to Learn course for college students to teach several learning strategies. It was reported that Learning to Learn course provided students with development of learning strategies and accomplishment in other courses

(McKeachie et al., 1985) and the course guaranteed to be effective in teaching learning strategies (McKeachie et al., 1987). In the study of McKeachie et al. (1987) it was highlighted that not only knowledge about learning strategies; but also how, when and why to apply learning strategies should be taught to students.

Due to the fact that cognitive and metacognitive strategy use are thought to be one of the facets of self-regulation (Kuyper, Van der Werf, & Lubbers, 2000), another line of research has focused on the cognitive and metacognitive strategy use within the concept of self-regulation (e.g. Dowson & McInery, 1998; Kuyper et al.; Metallidou & Vlachou, 2007; Ozturk, 2003; Pintrich & De Groot, 1990; Pintrich, Smith, Garcia, & McKeachie, 1993; Yukselturk & Bulut, 2007; Yumusak, Sungur, & Cakıroglu, 2007; Zusho & Pintrich, 2003). These studies indicated that associations between cognitive and metacognitive strategy use and achievement vary with respect to country, subject area and grade level. Besides, some studies on learning strategies have examined individual characteristics such as gender (e.g. Bembenutty, 2007; Bidjerano, 2005; Ozturk, 2003; Metallidou & Vlachou, 2007; Ray, Garavalia, & Gredler, 2003; Wolters & Pintrich, 1998; Yukselturk & Bulut, 2007; Zimmerman & Martinez-Pons, 1986, 1990), prior knowledge (Chen, 2002; Kuyper et al., 2000) and socioeconomic status (Kuyper et al., 2000; Zimmerman & Martinez-Pons, 1986). Of those studies that focused on gender impact indicated generally mixed results. For example, there were fairly gender differences in favor of girls in cognitive strategy use (Ozturk, 2003; Wolters & Pintrich, 1998), in metacognitive strategy use (Ozturk, 2003; Zimmerman & Martinez-Pons, 1990) and in academic attainment (Metallidou & Vlachou, 2007; Niemivirta, 1997; Ray et al., 2003). On the other hand, the study conducted by Bidjerano (2005) reported that there were significant gender differences in the

use of rehearsal, organization, metacognition and elaboration in favor of girls; however, there were not significant gender differences in the use of critical thinking in education courses. According to the study of Wolters and Pintrich (1998), the use of self-regulatory strategy was similar in the subject areas of mathematics, social sciences and English for both females and males. In addition, Niemivirta (1997) concluded that boys outperformed girls in rote learning strategies and detail memorizing. Yukselturk and Bulut (2007) stated that gender did not have a significant impact on student success in an online computer-programming course. What is more, McKeachie et al. (1985) stressed prior knowledge by mentioning that in order to do well in a learning strategy training program, minimal level of basic skill is needed. In a longitudinal study of Kuyper et al. (2000), prior achievement of students was found to be related with their long term educational attainment. Another research indicated that students having a history of academic achievement were more probably to get higher scores in chemistry (Zusho & Pintrich, 2003). However, it was stated that prior computer experience was not helpful for students in accomplishing higher test scores in a lecture learning environment of an information systems course in the study conducted by Chen (2002). The relationship between students' socioeconomic status (measured by questions regarding parents' educational and occupational level) and their long term educational attainment was investigated in a longitudinal study (grade 1 to 5) of Kuyper et al. who reported that parents' educational level (SES variable) was used to predict students' position (track type) in grade 5 which was one of the indicators of attainment. In a study which examined the usefulness of students' reported self-regulated learning strategy use, gender and socioeconomic status (SES) in predicting students' accomplishment in school, Zimmerman and Martinez-Pons (1986) indicated that students' reported self-regulated learning strategy use was best predictor of English and

Mathematics subsections of MAT (Metropolitan Achievement Test) achievement compared to gender and socioeconomic status.

In conclusion, Kiewra (2002) mentioned the old adage 'If you give a man a fish, you feed him for a day, but if you teach him how to fish, you feed him for a life time' to call attention to teaching students how to learn for help them learn now and for a life time. In this manner, McKeachie et al. (1987) underlined learning strategies in order to be life-long learners. Therefore, concept of learning strategies has taken attention by researchers that there have been many studies concerning the effect of learning strategy use on achievement which is an indicator of usefulness of learning strategies (e.g. Metallidou & Vlachou, 2007; Pintrich & De Groot, 1990; Pintrich et al., 1993; Yumusak et al., 2007; Zusho & Pintrich, 2003). However, there are variations in relationships between cognitive and metacognitive strategy use and accomplishment with respect to country, subject area and grade level. In their study, Purdie and Hattie (1996) stressed the significance of cultural differences in the pattern of students' strategy use by finding that there were variations in the pattern of students' strategy use among different cultural groups; Australian students, Japanese students at school in Japan, and Japanese students in Australian schools. Besides, Pintrich (2000) stated that there is no self-regulatory strategy working equally for all individuals and for all tasks. Moreover, according to Duncan and McKeachie (2005), students' strategy use depends on nature of academic task. Therefore, more research is needed in different cultural contexts, with different subject areas and different grade levels before definitive conclusions can be drawn about how cognitive and metacognitive strategy use influence achievement. What is more, there are many different background characteristics such as gender, prior knowledge, and socioeconomic status that students bring them with to the school. In fact,

according to Pintrich (2000), learners' demographic characteristics are one of the factors that have an influence on their accomplishment and learning. There have been few studies concerning gender effect on both strategy use and learning outcomes such as academic achievement and performance (e.g. Bembenutty, 2007; Metallidou & Vlachou, 2007; Ray et al., 2003; Wolters & Pintrich, 1998). These studies, however, demonstrated mixed results. In addition, Ray et al. stated that differences in the use of strategies might be the reasons of some of the gender differences in achievement. Moreover, according to Bidjerano (2005), stereotypical beliefs might be the cause of gender differences in strategy use. Thus, there should be more research to make clear conclusions regarding gender effect in different cultures, with different subject areas and grade levels. Moreover, research about prior knowledge effect within the concept of strategy use (e.g. Chen, 2002; Kuyper et al., 2000) was not enough to make generalizations. Furthermore, there have been also few studies investigating socioeconomic status effect in predicting students' achievement within the concept of strategy use (Kuyper et al., 2000; Zimmerman & Martinez-Pons, 1986). Clearly, there is a lack of study examining the effect of socioeconomic status on both strategy use and achievement. It should be added that socioeconomic status was measured by information about parents' educational level in the study of Zimmerman and Martinez-Pons and both parents' educational and occupational level in the study of Kuyper et al. That is, information about socioeconomic status was obtained by using limited number of variables. As a result, it is evident that more research is needed before definitive conclusions can be drawn about how learners' background characteristics such as gender, prior knowledge, socioeconomic status affect strategy use and achievement. The present study seeks to address these gaps in the literature by aiming to explore how 7th grade students' cognitive and metacognitive strategy use predict their science

achievement and how 7th grade students' background characteristics (i.e. gender, prior knowledge and socioeconomic status (number of sibling, employment status and educational level of parents, number of reading materials at home, frequency of buying a daily newspaper, having a study room, a computer and an internet connection) predict their cognitive and metacognitive strategy use and science achievement. The present study is also interested in examining the differences in students' cognitive and metacognitive strategy use. Due to the fact that both learning strategy use and background characteristics of students have an influence on their accomplishment and learning, the findings of the current study can be helpful for teachers and curriculum developers in order to improve the quality of education. More specifically, information about strategy use differences can be helpful to improve strategies which students use less frequently. Moreover, this study will open a new gate for researchers to conduct further studies with different subject areas, with different achievement tests, at different cultural contexts and at different grade levels.

1.1 Definition of Important Terms

1. Learning Strategies

'Behaviors and thoughts that a learner engages in during learning and that are intended to influence the learner's encoding process' (Weinstein & Mayer, 1986, p. 315). In the current study, in terms of learning strategies, cognitive strategy (rehearsal, elaboration, organization and critical thinking) and metacognitive strategy (metacognitive self-regulation) were measured considered.

1.1 Cognitive strategies

Cognitive strategies are the ways by which new knowledge is chosen, gotten and combined with existing knowledge by learner (Dowson & McInerney, 1998). Cognitive strategy consists of basic and complex strategies for information processing which are rehearsal, elaboration, organization and critical thinking (Pintrich, Smith, Garcia & McKeachie, 1993). In the current study, in terms of cognitive strategies rehearsal, elaboration, organization and critical thinking were measured.

1.1.1 Rehearsal strategy

Rehearsal strategy is a learning strategy that includes memorizing, listing, reciting, repeating and copying of information, underlining and highlighting the significant part of the information for mainly selection and acquisition of the information (Weinstein & Mayer, 1986).

1.1.2 Elaboration strategy

Elaboration strategy is a learning strategy that involves paraphrasing, summarizing, creating analogies, generative note taking, relating new information with old information and forming a sentence and a mental image in order to integrate information (Weinstein & Mayer, 1986).

1.1.3 Organization strategy

Organization strategy is a learning strategy that consists of selecting, ordering, grouping, sequencing, outlining, creating a hierarchy for construction of information (Weinstein & Mayer, 1986).

1.1.4 Critical Thinking Strategy

Critical Thinking Strategy is a deeper processing strategy which previous knowledge is applied to new conditions or thoughts are evaluated critically by students (Pintrich, Smith, Garcia & McKeachie, 1993)

2.2 Metacognitive Strategy

Metacognitive strategy is a deeper processing strategy including planning, monitoring and regulating that assist students in control and regulation of the cognition (Pintrich, Smith, Garcia & McKeachie, 1993). In the current study, in terms of metacognitive strategies planning, monitoring and regulating were measured.

2.2.1 Planning

Planning is a preparation to finish task such as setting rational goals, making schedules, arranging working environments (Dowson & McInerney, 1998), scanning a material before reading, preparing questions before reading a material, making an analysis of a problem (Garcia & Pintrich, 1994).

1.2.2 Monitoring

Monitoring is an attempt to make evaluations of assimilation and organization of the learned material (Dowson & McInerney, 1998). Monitoring activities includes self-testing and self-checking by using questions and test-taking strategies during learning of the material (Garcia & Pintrich, 1994).

1.2.3 Regulating

Regulating is an attempt to learn, search for rationalization of material and correct mistakes that face with during monitoring (Dowson & McInerney, 1998). Rereading of the material that are not understood, arranging reading pace according to difficulty level of reading material, examining the material that is not comprehended and during an examination passing over and going back a question later are examples of regulation strategies (Garcia & Pintrich, 1994).

2. Science Achievement

For the present study, science achievement defined as students' performance on 'The Body Systems', 'Force and Motion' and 'Electricity' in Science Achievement Test (SAT).

CHAPTER 2

REVIEW OF RELATED LITERATURE

This chapter includes theoretical base of cognitive and metacognitive strategy use; self-regulated learning and research studies on learning strategies; teaching of learning strategies, the relationships between learning strategies and learning outcomes (e.g. academic achievement and performance) and the background variables effects (gender, prior knowledge and socioeconomic status).

2.1. Self-Regulated Learning

Puustinen and Pulkkinen (2001) stated that the question regarding how an individual regulates his/her own cognitive processes received the attention of researchers in the field of psychology so that several self-regulation models have been proposed in the last two decades (Boekaerts, 1997; Pintrich, 2000; Winne & Perry, 2000; Zimmerman, 2000). Although self-regulated learning models differ in terms of their constructs and conceptualizations, they have common assumptions (Pintrich, 2000). One of the general assumptions is 'active, constructive assumption' which points out that learners are seen as an active and constructive participants during learning. Specifically, learners are thought to build their own significances, purposes and strategies with the help of information from both internal and external environments. Another assumption is 'potential for control assumption' which means that learners' cognition, motivation, behavior and several aspects of environments can be possibly monitored, controlled and regulated by learners. The other assumption

is ‘goal, criterion, or standard assumption’ which is that there are goals according to which learning process is evaluated whether it should go on or there should be changes. The last one is that self-regulated learning activity has a role of mediator in the relation between personal and contextual features and accomplishment. A general definition of self regulated learning follows from the common assumptions is that ‘it is an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate and control their cognition, motivation and behavior, guided and constrained by their goals and the contextual features in the environment’ (Pintrich, 2000, p. 453).

In the following section, Zimmerman’s (2000) social cognitive model of self-regulation and Pintrich’s (2000) general framework of self-regulated learning are presented.

2.1.1 Zimmerman’s social cognitive model of self-regulation

Zimmerman’s (2000) self-regulation model is based on Bandura’s (1986 as cited in Zimmerman, 2000) social cognitive theory in which self regulation is seen as the interaction of personal, behavioral, and environmental triadic processes. Students’ knowledge, metacognitive processes, goals and affect constitute personal processes. Behavioral processes involve self-observation, self-judgment, and self-reaction. Environmental processes include enactive outcomes, modeling, and verbal persuasion (Zimmerman, 1989). According to Zimmerman (2000), feedback from prior performance is utilized to make arrangements during current performance so that self-regulation is signified as cyclical. Self-regulatory processes and along with beliefs fall into three

cyclical phases: forethought, performance or volitional control and self-reflection. Forethought refers to effective processes preparing for action and consists of two distinctive however, closely linked categories; task analysis (goal setting and strategic planning) and self-motivational beliefs (self-efficacy, outcome expectations, intrinsic interest/value, goal orientation). Performance or volitional control includes processes that happen during motoric efforts and influence concentration and action. Performance or volitional control phase has two parts; self-control (imagery, self-instruction attention focusing, and task strategies) and self-observation (self-recording, self-experimentation). Self-reflection phase consists of processes that happen after performance and affects a person's reaction to the performance. Then, self-reflections affect following motoric efforts so that a self-regulatory cycle is completed. Self-reflection phase contains self-judgment (self-evaluation, casual attribution) and self-reaction (self-satisfaction/affect, adaptive/defensive) categories.

2.1.2 Pintrich's general framework for self-regulated learning (SRL)

Pintrich's (2000) general framework for SRL, is also based on Bandura's (1986) social cognitive theory, consists of four phases; forethought, monitoring, controlling and reflection phases. For each phase, self-regulatory activities take place in four distinct areas, namely cognition, motivation/affect, behavior and context. During forethought phase, the self-regulatory activities involve target goal setting, prior content knowledge and metacognitive content knowledge activation (cognition area), goal orientation adaptation, efficacy and ease of learning (EOLs), task value and interest activation (motivation and effect area), time and effort planning (behavior area) and perceptions of task and context (context area). Activities during monitoring refer to metacognitive awareness and monitoring of cognition (cognition area), motivation and effect

(motivation and effect area), effort, time use and need for help (behavior area) changing task and contexts conditions (context area). In the same way, control activities selection and adaptation of cognitive strategies for learning (cognition area), selection and adaptation of strategies for motivation and affect management (motivation and effect area), increasing or decreasing effort, persisting, giving up and help seeking behavior (behavior area) and changing or leaving task and context (context area). Lastly, reaction and reflection phase activities are cognitive judgments and attributions (cognition area), affective reactions and attributions (motivation and effect area), choice of behavior (behavior area) and evaluation of task and context (context area).

What is more, in order to evaluate college students' motivational orientations and learning strategy use in a college course, Pintrich, Smith, Garcia and McKeachie (1991) developed the Motivated Strategies for Learning Questionnaire (MSLQ) which is a self-report, Likert-scaled instrument. The MSLQ involves a motivation section based on a general social cognitive model of motivation (Pintrich, 1989) and a learning strategies section based on cognitive view of learning and information processing (Weinstein & Mayer, 1986). The motivational section (containing 31 items) consists of three general constructs, namely, expectancy, value and affect. Expectancy refers to students' beliefs concerning accomplishment of a task. Students' perceptions of self-efficacy and control beliefs for learning are used as expectancy subscales. Value construct is related with the reasons of students' engagement in an academic task. Value construct consists of subscales of intrinsic goal orientation, extrinsic goal orientation and task value beliefs. Affect construct involving a subscale of test anxiety is regarding students' worry and concern over taking examinations (Pintrich, 1989, in Pintrich et al., 1993). The learning strategy section (including 50 items) is composed of three general scales, namely, cognitive, metacognitive and resource management. Cognitive

strategies involve students' basic and complex strategy use for information processing. That is, rehearsal (e.g., repeating the words over and over) is the most basic cognitive strategy. On the other hand, elaboration strategies (e.g., paraphrasing and summarizing) and organization strategies (e.g., outlining) are more complex strategies. Critical thinking subscale includes strategies to apply previous knowledge to new conditions and to evaluate ideas critically. Metacognitive control strategies are related with strategies assisting students in controlling and regulating their own cognition. The resource management of the learning strategy section consists of four subscales, namely, time and study environment (e.g., using time appropriately and having a suitable place to study), effort regulation (e.g., persisting in front of difficult and uninteresting tasks), peer learning (e.g., taking advantages of friend and a study group while learning) and help seeking (e.g., seeking helps from peers or instructors when necessary) to control other resources aside from cognition.

According to Puustinen and Pulkkinen (2001), Zimmerman's and Pintrich's models are in similar in their background theories, SRL definitions, components taking place in the models and empirical research conducted by Zimmerman and Pintrich. Specifically, both models are based on Bandura's (1986) social cognitive theory. Zimmerman and Pintrich describe SRL as a goal orientated process and both are in agreement in that monitoring, regulating and controlling one's own learning involve cognitive, motivational, emotional and social aspects. In both models, SRL process moves from forethought through self-monitoring and self-control towards self-reflection. Both authors have examined students' motivation orientation with respect to their self-regulated learning strategy use and academic attainment, however, Pintrich has studied more the function of goal orientations in self-regulated learning (Puustinen & Pulkkinen, 2001).

2.2. Research on Learning Strategies

There is a considerable amount of research regarding learning strategies. In the earlier studies, the effectiveness and importance of learning strategies and the teaching of these strategies were investigated (e.g. McKeachie et al., 1985, 1987; Weinstein & Mayer, 1986). Several studies, on the other hand, examined the relationships between cognitive and metacognitive strategy use and students' achievement in different subject areas. Among them are mathematics and English (Dowson & McInery, 1998), Greek language and mathematics (Metallidou & Vlachou, 2007), mathematics (Ozturk, 2003), chemistry, computer science, ecology, economics, education, English, geography/geology, history, microbiology, philosophy, physical education, psychology, sociology and Spanish (Pintrich et al., 1993), an online computer-programming course (Yukselturk & Bulut, 2007), biology (Yumusak et al., 2007), and chemistry (Zusho & Pintrich, 2003). However, there were few studies examining effects of prior knowledge (e.g. Chen, 2002; Kuyper et al., 2000), gender (e.g. Bembenutty, 2007; Bidjerano, 2005; Metallidou & Vlachou, 2007; Niemivirta, 1997; Ozturk, 2003; Ray et al., 2003; Wolters & Pintrich, 1998; Zimmerman & Martinez-Pons, 1990) and socioeconomic status (e.g. Kuyper et al., 2000; Zimmerman & Martinez-Pons, 1986) within the concept of learning strategies.

2.2.1 Research on Teaching of Learning Strategies

In this part, research concerning usefulness and teaching of learning strategies in academic contexts is mentioned.

For example, in one of the earlier studies, McKeachie et al. (1985) pointed out issues (such as transfer and generalizability problems of learning strategies, training of general cognitive strategies versus specific knowledge-based strategies and learning with awareness) concerning teaching of learning strategies in a Learning to Learn course which was an introductory psychology course for freshmen at The University of Michigan. In the course, there were 113 students in the fall semester and 80 in the winter semester indicating three groups of students which were anxious, minority and athlete students. The course provided with not only use of learning strategies but also cognitive theory and empirical results regarding learning strategies. The course topics included attention, memory, problem solving, self-management, time management, comprehension monitoring, test taking strategies, motivational strategies and peer learning. An average SAT score (combined score on Verbal and Quantitative scales) of students was 997 below typical student's score at The University of Michigan. In addition, there were two comparison groups; one of them consisted of students registered other introductory courses (85 students in the fall semester and 141 students in the inter semester and average of SAT score was 1056) and the other included students had aptitude score similar to students who had entered the university a year before the course. The measurements of the study were Learning and Study Strategies Inventory (LASSI) (Weinstein, 1982), a measure of cognition (Cacioppo & Petty, 1982), a measure of attributions and expectancies for success and failure, average grades in courses after the learning to learn course and an interview with several students after the course. As a result, Learning to Learn course provided students with development of learning strategies and accomplishment in other courses. Moreover, the course assisted high anxious students by decreasing the anxiety level. It was added that there should be several research investigating the effects of using several learning strategies in

college courses having different contents, formats and assessments. Furthermore, learning strategy researches should include both cognitive and affective components of motivation.

In another study, Weinstein and Mayer (1986) examined learning strategies; basic/complex rehearsal strategy, basic/complex elaboration strategy, basic/complex organizational strategy, comprehension monitoring strategy and affective and motivational strategy for improving learning in both basic and complex school tasks. In addition, teaching of learning strategies to learners were explored due to the fact that use of learning strategies can influence encoding process which in turn influences the learning outcome and accomplishment. However, it was also noticed that only teaching of learning strategies was not adequate for effective learning; learners should also provide with domain-specific content. As a result, this study strengthened the idea that learning strategies can be defined and taught to learners who are mature enough.

Later, McKeachie et al. (1987) developed an introductory-level course in the Department of Psychology at the University of Michigan for students to teach several learning strategies. The course included theory and research in cognitive psychology and the practice of learning strategies. The course topics were learning from lectures, texts and discussions; memory models and strategies; motivation; writing skills; test taking strategies; problem solving; and self-management. In order to assess students' development, short quizzes, exams and group research project were utilized. In addition, students were asked to prepare logs regarding their reading and their use of learning strategies during studying. In the course, aptitude-treatment and learning strategies-motivational variables interactions and teaching of learning

strategies to other colleges were investigated. Furthermore, to improve the course, several activities were done according to findings of research, feedbacks from students and graduate assistants of the course. In conclusion, the course guaranteed to be effective in teaching learning strategies.

2.2.2 Research on the Relationships between Learning Strategies and Learning Outcomes

The studies that examined the associations between learning strategies which students in various grade levels used during learning and the learning outcomes such as performance and accomplishment in various subject areas are described in this part of the study.

For instance, the study by Pintrich and De Groot (1990) examined motivational (intrinsic value, self-efficacy and test anxiety) and self-regulated learning (cognitive strategy use including rehearsal, elaboration and organizational strategies and self-regulation including metacognitive and effort management strategies) components of classroom academic performance. The participants of the study were 173 seventh grade students (100 girls and 73 boys) with a mean age of 12.6 years from science and English classrooms in USA. MSLQ was used to determine motivational and self-regulated learning components and classroom tasks and assignments were used to determine classroom academic performance. It was concluded that there were positive relationships between self-efficacy and students' cognitive engagement and performance and between intrinsic value and students' cognitive engagement and performance. Regression analyses demonstrated that self-regulation, self-efficacy and test anxiety were best predictors of students' performances. Cognitive strategy revealed a positive relation with most of the performance

measures, however, when both cognitive strategy and self-regulation were used as predictors of academic performance, cognitive strategy relates negatively with performance and self-regulation was better in the prediction of performance. Moreover, there was a high correlation between cognitive strategy and self-regulation (r=.83). In conclusion, self-efficacy and task value were related with students' participation in self-regulated learning. In addition, motivational factors were not adequate for academic achievement; on the other hand, self-regulated learning factors were seen as more directly related with performance. Both motivational and self-regulated learning components should be combined for academic learning models.

Later, Dowson and McInery (1998) investigated how motivational (academic and social goals) and cognitive (cognitive and metacognitive strategies) variables shape middle school students' performance in mathematics and English. There were 602 Australian middle school students (328 females and 274 males) with a mean age of 13.3. Goal Orientation and Learning Strategies Survey (GOALS-S) was used to identify academic and social goals and cognitive and metacognitive strategies. Moreover, students' mathematics and English end-of–year examination results standardized between curriculum areas and schools were used to have information regarding students' performance. Three path analyses were conducted to examine the relation between students' goal orientations and strategy use, between students' strategy use and academic achievement and between students' motivational goals, strategy use and academic achievement. Path analyses brought about that students' mastery goal orientations were related the most strongly with students' cognitive and metacognitive strategy use. In addition, there were significant relations between students' social approval and cognitive strategy use, between students' social approval and planning strategy use, between

students' social confirmatory orientations and planning strategy use and between students' social confirmatory orientations and regulating strategy use. However, there were negative significant relations between students' work avoidance and planning strategy use and between students' work avoidance and monitoring strategy use. Moreover, students' cognitive, monitoring and regulating strategy use related significantly with students' achievement in mathematics. On the other hand, students' monitoring and regulating strategy use related significantly with students' achievement in English. Students' planning strategy use was not related significantly with mathematics and English achievement. Furthermore, students' mathematics and English achievements may be associated with cognitive and metacognitive strategy use which, in turn, was associated with students' social and academic goal orientations. In conclusion, academic accomplishment was related with both cognitive and motivational variables. In addition, it was stressed that every strategy was not equally useful in every subject area. Differential use of diverse strategies in different subject areas was encouraged in this study although the associations between strategy use and attainment. It was recommended that both cognitive and motivational variables should be used to evaluate students' accomplishment.

In a separate study, Zusho and Pintrich (2003) aimed to explore how students' motivation and cognitive and self-regulatory strategy use changed over time and to explore the role of motivational (self-efficacy, task value, goal orientation and affect) and cognitive components (rehearsal, elaboration, organization and self-regulatory strategy use) in the prediction of performance in chemistry. Four hundred fifty eight college students (243 females, 215 males) in USA responded to three surveys three times in a semester: The surveys were adapted from Elliot and Church's intrinsic motivation scale,

Patterns of Adaptive Learning Survey (PALS) and MSLQ. Students' final chemistry performance was used as students' course performance. ANOVA indicated that there was a decline in students' motivational levels, rehearsal and elaboration strategy use but there was an increase in students' organizational and metacognitive strategy use over time. Students having a history of academic achievement were more likely to get higher grades in chemistry. On the other hand, students having high self-efficacy and task value finally performed well in the course. Students who used rehearsal strategy had a good course performance in the course which was an unexpected result. The reason of this situation can be related to nature of subject areas; according the study of Wolters and Pintrich (1998), students used more cognitive strategy in social sciences than in mathematics or English. It was suggested that how motivational processes such as self-efficacy and task value affect learning should be taken into consideration. Besides, facilitation of adaptive motivational beliefs and strategy use were found significant.

More recently, Yumusak et al. (2007) conducted a research to investigate how motivational beliefs cognitive and metacognitive strategy use affects Turkish high school students' achievement in biology. Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia & McKeachie, 1991) and a Biology Achievement Test were administrated to 519 tenth grade students (214 girls and 305 boys) with a mean age of 16.4 years. Multiple linear regression analyses carried out resulted in that the variables; extrinsic goal orientation, task value, rehearsal strategy use, organization strategy use, management of time and study environment and peer learning related significantly to students' achievement in biology ($p<.05$). However, the variables; extrinsic goal orientation, rehearsal strategy use and peer learning related inversely to students' biology achievement. It was concluded that similar researches were

necessary in other subject areas to make generalizations. The study recommended that in order to identify relationships between several variables and academic achievement, structural equation modeling techniques can be utilized. In addition, there should be instruments to evaluate different facets of self-regulation.

Another recent study by Bin (2008) investigated what learning strategies contribute to college students' English Foreign Language (EFL) reading achievement and to discover the differences between successful and less successful learners in terms of learning strategy use. In addition, this study provided low-scoring students with being successful learners. There were 30 non-English major college students; fifteen students were higher level in English (successful learners) and 15 students were lower level in English (less successful learners). A questionnaire (containing 13 statements for general strategies and 5 statements for local strategies) was used in order to study students' learning strategy use during learning and multiple-choice test was used to investigate students' reading achievement. Pearson statistical analysis was utilized to analyze the data. As a result, there was a relationship between learning strategy use and reading comprehension. There were differences between successful learners and less successful learners in terms of learning strategy use; successful students could employ learning strategies well and purposely. Bin resulted in that due to the significant role of learning strategies, learning strategies should be taught and the author recommended guidelines to teachers for efficient strategy use instruction.

2.2.3 Research on the Effects of Individual Characteristics; Gender, Prior Knowledge and Socioeconomic Status

In this section, research that investigated the effects of students' characteristics such as gender, prior knowledge and socioeconomic status on learning strategy use and/or learning outcomes; academic performance and achievement are pointed out.

For example, in one of the earlier studies, Zimmerman and Martinez-Pons (1986) investigated 10th grade students' (forty students from a high achievement track and 40 from lower achievement tracks) self-regulated learning strategy use to participate in class, to study and to complete their assignments by using a structured interview procedure. In addition, the usefulness of students' reported self-regulated learning strategy use, gender and socioeconomic (SES) in predicting students' accomplishment in school was searched. Students' SES level was obtained from the information regarding their parents' educational level. Metropolitan Achievement Test (MAT) scores were utilized for students' academic achievement. As a result, fourteen categories of self-regulated learning strategies were specified, namely, self-evaluation, organizing and transforming, goal setting and planning, seeking information, keeping records and monitoring, environmental structuring, self-consequences, rehearsing and memorizing, seeking social assistance (peers, teachers and adults), reviewing records (tests, notes and textbooks) and others at six learning contexts (in classroom situations, at home, when completing writing assignments outside class, when completing mathematics assignments outside class, when preparing for and taking tests and when poorly motivated). A discriminant function analysis revealed that high achieving students demonstrated significantly greater use of 13 of 14

categories self-regulated learning strategies than low achieving students. In addition, based on self-regulated learning measures, 93 % of the students could be correctly grouped into low and high achievers. Students' reported self-regulated learning strategy use was best predictor of English and Mathematics subsections of MAT achievement compared to gender and socioeconomic (SES). It was resulted in the study that Self-Regulated Learning Interview Schedule seems to have promise to identify students' strategy use in naturalistic settings. However, it should be validated against students' actual performance on academic tasks in naturalistic settings.

In the study carried out by Zimmerman and Martinez-Pons (1990), effects of grade level, gender and giftedness on students' verbal and mathematical self-efficacy and use of 14 self-regulated learning strategies (self-evaluating; organizing and transforming; goal-setting and planning; seeking information; keeping records and monitoring; environmental structuring; self-consequating; rehearsing and memorizing; seeking peer, teacher or adult assistance; and reviewing tests, notes and texts) were investigated. Forty-five boys and 45 girls from grade 5th, 8th and 11th from gifted and equal number from regular schools in USA were participated in the study. In both gifted and regular schools, students were Whites, Blacks, Hispanics and Asians and from middle-class homes. By using verbal and mathematical self-efficacy scales, students were asked to estimate their verbal and mathematical self-efficacy. Likewise, by the help of self-regulated learning interview schedule, students were asked to express their self-regulated strategy use. MANOVA demonstrated that gifted students significantly higher in verbal and mathematical self-efficacy and showed significantly greater use of self-regulated learning strategies, in particular; organizing and transforming, self-consequating, seeking peer assistance, and reviewing notes. In addition, girls made significantly greater

use of record keeping and monitoring, environmental structuring and goals setting and planning, however, they indicated lower self-efficacy than boys. There was a relation between students' grade level and use of self-regulated learning strategies; 11th grade students exceed 8th grade students who exceed 5th grade students in reviewing notes and seeking of teacher assistance. Moreover, record keeping and monitoring, goal setting and planning, organizing and transforming strategy use raise significantly between 5th and 8th grades but goal setting and planning, strategy use significantly decline between 8th and 11th grades, record keeping and monitoring strategy use was maintained, organizing and transforming strategy use decline nonsignificantly during 11th grade. Students' verbal and mathematical self-efficacy was found to be related with their self-regulated strategy use. What is more, relations between students' strategy use and self-efficacy are well-adjusted with triadic view of self-regulated learning. It was concluded that students' academic self-efficacy rose during junior high school, gifted students indicated high levels of self-efficacy especially verbal self-efficacy that clarified their motivation and achievement and greater use of learning strategies. It was suggested that academic self-efficacy is significant to realize students' learning and motivational differences.

In another study, Niemivirta (1997) analyzed gender differences in motivation, learning strategy use and achievement. Six hundred twenty eight (295 girls and 333 boys) 7th grade junior high school students were asked to answer a self-report questionnaire in order to evaluate their goal orientations, control beliefs, self-esteem and learning strategy use. In addition, students' grade point average (GPA) indicated their achievement. One-way analysis of variance (ANOVA) indicated that boys outperformed girls in performance orientation, avoidance orientation, means-ends beliefs of ability, agency beliefs of ability,

self-esteem, rote learning strategies and detail memorizing. On the other hand, girls' GPA scores were found to be higher than that of boys. It was concluded that this study supplied significant information regarding motivation, learning strategies and gender differences. However, there should be studies concentrating on practices and processes in natural learning conditions. In addition, how cultural and contextual factors influence motivational and cognitive variables of learning should also be taken into account.

Working with 545 seventh and eighth grade students, Wolters and Pintrich (1998) investigated the mean differences in students' level of motivation (task value, self-efficacy and test anxiety), self-regulated learning (cognitive and self-regulatory strategy use) and classroom academic performance in mathematics, social sciences and English according to gender by using a self-reported questionnaire adapted from Pintrich and De Groot (1990) and Pintrich, Smith, Garcia & Mckeachie (1993). Classroom academic performance was determined by teacher reported grade. Repeated measures ANOVA indicated that there were differences in students' level of motivation (task value, self-efficacy and test anxiety) and cognitive strategy use by subject areas mathematics, social sciences and English ($p<.001$) and by gender ($p<.05$); however, there were not differences in students' regulatory strategy use or students' academic performance. In detail, students used more cognitive strategy in social sciences than in mathematics or English, and more in English than in mathematics. Female students used higher levels of cognitive strategy in the subject areas of mathematics, social sciences and English; however, self-regulatory strategy use and academic performance were similar in all subject areas for both females and males. Multivariate regression analysis showed that relations among motivational, cognitive and self-regulatory strategy use and academic achievement variables were similar across mathematics, social

sciences and English. In conclusion, the level and quality of students' motivational and cognitive components might differ; but relations between motivational and cognitive variables appeared stable across contexts. General self-regulated learning models were advised apply to different domains and different classroom contexts.

Kuyper et al. (2000) conducted a longitudinal study which took four years (grade 1 to 5) to examine background variables (gender, socio-economic status, ethnicity, recommendation and intelligence), prior achievement, motivation, meta-cognition (cognitive strategy use and metacognitive strategy use), and self-regulation of Dutch students (N= 1567) in predicting students' long term educational attainment. Information regarding students' gender and recommendation (referred to suggestion provided by primary schools related with level of secondary education) were gathered from secondary schools in the 1st year. Intelligence was measured by two PSB (*Prüfsystem für Schul- und Bildungsberatung*) sub-tests (Horn, 1969) in grades 1 and 3. Parents' socioeconomic status was measured by questions regarding parents' educational and occupational level. Prior achievement referred to measurements in grade 1 and 3. Motivation questionnaire was administered in grades 1, 3 and 5. Self-regulation of students was determined in grade 5 by questions; how students manage their homework, what approaches they apply while doing homework and how much time they spend for homework. Lastly, attainment was assessed by students' position (track type) in grade 5, examination subject (subject selected by students for the school-leaving certificate) and achievement in grade 5. Correlations and multilevel analysis were carried out to analyze the data. Mainly mathematics test in grade 3, progress test in grade 1 and recommendation were effective in predicting students' position (track type) in grade 5. Parents' educational level (SES

variable), achievement motivation in grade 1 and text comprehension test in grade 3 were also used to estimate students' position in grade 5. Gender difference detected in students' examination subject choice; males selected three science subjects (pure mathematics, physics and chemistry) 30 % more often. Prior achievement, achievement motivation and failure fear were related with mean of achievement. On the other hand, metacognitive and self-regulation variables hardly contributed to mean of achievement. It was concluded that results of the study supported statement of Pintrich and Garcia (1994) that 'models are needed that how motivation, meta-cognition and self-regulation interact and are related to that tasks and situations students confront' (p.124, as cited in Kuyper et al., 2000). It was suggested that students' aptitudes and prior achievements should also be considered in models because the main issue should be that what metacognition and self-regulation provide cognition and motivation.

In another study, Chen (2002) investigated useful self-regulated learning strategies (metacognitive self-regulation, time and study environment, effort regulation, peer learning and help seeking) in a lecture and in a hands-on computer laboratory learning environment of an information systems course. How prior computer experience and software affect students' achievement was also examined. Demographic instrument and MSLQ were administered to 197 students (84 females and 113 males) in a business information systems course in USA. Test scores and laboratory assignment scores were used as performance in a lecture learning environment and in a hands-on computer laboratory learning environment, respectively. As a result of multiple regression, effort regulation was found to be related significantly with achievement in a lecture learning environment ($p<.01$). A negative relationship between peer learning and achievement was also demonstrated. Due to the fact

that normality assumption was not met, the result regarding effective learning strategies in a hands-on computer laboratory learning environment was inconclusive. In conclusion, self-regulated learning strategy use differences between a lecture and a hands-on computer laboratory learning environment were not identified. It was suggested that research is necessary to evaluate self-regulated learning in a hands-on computer laboratory learning environment by using MSLQ.

Ray et al. (2003) studied the gender and aptitude differences in task value, learning strategy use and achievement among 286 (129 females and 157 males) developmental college students (low achievers). Students' course grade and semester grade points were used to measure achievement. The instruments employed in the study were reading, writing and numerical skills components for aptitude, Self-efficacy for Self-regulated Learning Scale for self-regulated learning perceptions (general organizing and planning, external regulation, typical study strategies and recall ability), MSLQ for task value. Additionally, students' demographic data containing gender, and race were also asked. MANOVA resulted that there were gender differences in academic task value, typical study strategy use and achievement in favor of females. In addition, some of the difference in achievement was associated with difference in learning strategy use. It was suggested that other motivational factors should be examined for gender differences and how affective variables effect achievement should be investigated. Moreover, features and behaviors that bring about achievement among low achievers should be determined.

Ozturk (2003) conducted a research to examine how motivational beliefs (intrinsic goal orientation, extrinsic goal orientation, task value, control beliefs, self-efficacy, and test-anxiety) and self-regulated learning (cognitive strategy

use and self-regulation) explain mathematics achievement and to investigate the effects of gender on motivation and self-regulated learning in mathematics. Seven hundred fifty two 9th grade Turkish high-ability students (375 boys and 377 girls) from three types of high school; science, Anatolian and Foreign Language responded to MSLQ and Mathematics Achievement Test (MAT). According to the results of the study, extrinsic goal orientation, self-efficacy, and test-anxiety contributed to students' mathematics achievement significantly. While extrinsic goal orientation and test-anxiety contributed significantly to females' achievement, self-efficacy and test-anxiety contributed significantly to males' achievement. Cognitive strategy use and self-regulation were correlated positively with mathematics achievement. It was unexpected that cognitive strategy use and self-regulation did not contribute significantly to mathematics achievement. Furthermore, there did not exist significant mean difference between girls and boys with respect to extrinsic goal orientation, intrinsic goal orientation, task value, and control beliefs. However, there existed statistically significant mean differences between girls and boys in self-efficacy and test anxiety scores in favor of boys and in cognitive strategy use and self-regulation scores in favor of girls. As a result, this study indicated empirical proofs regarding the significance of motivational beliefs to increase mathematics success. The study suggested to carry out two approaches; correlational and experimental approaches to study relationships between self-regulated learning and mathematics achievement. Correlational approach provides with determining variables related with mathematics achievement whereas experimental approach provides with determining causal relations between self-regulated learning and mathematics achievement.

In the study carried out by Bidjerano (2005), self-regulated learning strategy use (metacognition, elaboration, critical thinking, organization, rehearsal, time and effort management, help seeking and peer learning) of 198 undergraduate students (seventy eight males and 120 females) in Education courses in Northeastern US was examined with respect to gender. The participants were administered MSLQ. Multivariate analysis of variance indicated that there were significant gender differences in the use of rehearsal, organization, metacognition, time management skills, elaboration and effort in favor of girls. However, there were not significant gender differences in the use of critical thinking, help seeking and peer learning. In addition, it was added that gender differences might be due to the stereotypical beliefs that females are assumed to be organized, careful and skillful in academic environment. Another reason might be that females are aware of the strategies they utilize during learning. The author suggested that there should be more studies concerning gender effect in self-regulation to make clear the issue.

More recently, Bembenutty (2007) explored the gender and ethnic differences in relation to academic performance, self-regulation, motivation and delay of gratification and examined whether students in different gender and ethnic groups varied with respect to their use of self-regulation, motivation, delay of gratification and academic performance. The participants were 364 (210 females, 146 males; 8 students did not report gender) college students registered in introductory psychology courses in a public university. In the study, 269 students were Caucasian and others (n=95) were called minority students. In order to have information concerning academic delay of gratification, Academic Delay of Gratification Scale (ADOGS; Bembenutty & Karabenick, 1998) was used and to evaluate students' course-specific motivation and learning strategy use, MSLQ was administrated. Students' final

course grades were used as students' academic performances. Correlational analyses and multivariate and univariate analyses of variance were used to analyze the gathered data. The results indicated that there were gender and ethnic variations in motivation, cognitive strategy use, delay of gratification and use of self-regulation. In all groups, students' reported self-efficacy beliefs moderately to highly associated with grades. In addition, independent of students' gender and ethnicity, their evaluations regarding significance and usefulness of the tasks was related with their accomplishment in class. Differences existed in the associations between delay of gratification and cognitive strategy use, between gender and ethnicity groups. Examination of mean differences for each group results in that there was a significant difference between course grades; Caucasian students got significantly higher grades than minority students. Moreover, minority males' reported self-confidence is significantly lower in their capability to complete the tasks than Caucasian males. In the study, there were suggestions for educators to increase students' willingness to delay gratification and self-efficacy, to teach students how to use cognitive strategies and to help students concerning regulation and management of time and study environment.

Another recent study by Metallidou and Vlachou (2007) explored association among motivational, cognitive and metacognitive variables and performance in subject areas of Greek language and mathematics. In addition, the effects of gender and age were studied. The participants were 263 students (133 girls and 130 boys); 114 fifth grade and 149 sixth grade students from Central Greece. Participants completed Motivated Strategies for Learning Questionnaire (Pintrich & De Groot, 1990). Students' performance referred to teachers' ratings on a 1- to 20-point comparative scale in Greek language and mathematics. Multivariate Analyses of Variance was utilized to examine age

and gender differences in students' motivation, cognitive and regulatory strategy use and performance in Greek language and mathematics. Pearson correlation coefficients were used to investigate associations among self-regulated learning components within and across Greek language and mathematics. Hierarchical regression analyses were done to study the roles of motivation, cognitive and regulatory strategy use variables on students' performance in Greek language and mathematics. As a result, there exists few differences in the pattern of motivation, cognitive and regulatory strategy use variables within and across in Greek language and mathematics. In addition, there were mean differences in students' motivation and cognitive engagement. Self-efficacy verified the most important predictor of performance and cognitive and regulatory strategy use. Moreover, the mediatory role of cognitive and regulatory strategies in motivation-performance relation was proved. In short, cognitive and regulatory strategies contributed to student performance differently in different subject areas. There were not gender differences in motivation and cognitive and regulatory strategy use although girls' performance significantly higher than boys' performance. However, motivation fluctuated mainly with age. In addition, the impact of age on cognitive and regulatory variables was found to be significant; younger students used cognitive and regulatory strategies more than older students in both subject areas. It was concluded in the study that self-regulated learning contains not only general characteristics but also subject-area-specific characteristics. In addition, positive motivation and strategy use provided with improvement of performance. Furthermore, this study indicated empirical evidence regarding mediator role of cognitive and regulatory strategies in motivation-performance relation. It was advised that subject-area-specific features should be paid attention because each motivational factor affects the activation of strategies in diverse subject areas.

Yukselturk and Bulut (2007) aimed to examine how student success in an online computer-programming course can be clarified in terms of selected variables (gender, age, educational level, locus of control and learning style), motivational beliefs (intrinsic goal orientation, extrinsic goal orientation, control beliefs, task value, self-efficacy, and text anxiety) and self-regulated learning components (cognitive strategy use; rehearsal, elaboration, organization and critical thinking and self-regulation) and to inspect thoughts of instructors related to reasons of student achievement in an online course. Eighty volunteer Turkish students between 19 and 29 years of involved in the study. A Demographic Survey was administered to collect students' demographic information; age, gender, education level. Internal-External Locus of Control Scale (IELOC) was administered to gather information regarding students' locus of control. Learning Style Inventory (LSI) was administered to categorize learning styles of students. Semi-structured interviews were also carried out with instructors to gather information regarding reasons of students' success in an online course. Scores of three assignments and a paper-based final examination were used as indications of student success. Correlation analysis showed that while there was a significant positive correlation between intrinsic goal orientation, task value, self-efficacy, cognitive strategy use, self-regulation and students' success, there was a significant negative correlation between educational level, external locus of control and students' success. As a result of regression analysis only self-regulation variable influenced online student success significantly (R=0.41, F= 14.3, p<.05). Likewise, semi-structured interviews pointed out that student success in an online course was highly related with using self-regulated learning strategies and that personal characteristics such as gender, age, educational level, locus of control and learning style did not have a significant impact on student success. It was resulted in the study that self-

regulation was an important issue having an effect on student success in an online course. It was recommended for an online course with a high-quality learning environment that self-regulated learning strategies should be supplied to improve learners' performance and learners should be guided to be self-regulated learners (Zimmerman, 2002; Pintrich & De Groot, 1990). Learners should be motivated with the help of instructional activities. They should be monitored and given feedback during the course. Moreover, topics of the course should be from real life and course materials should be sufficient to meet students' needs and new technologies.

To sum up, it is clear that there were variations in the relationships between students' cognitive and metacognitive strategy use with respect to country, subject area, achievement test and grade levels. Dowson and McInery (1998) stressed that every strategy is not equally useful in every subject area and encouraged differential use of diverse strategies in different subject areas. According to Duncan and McKeachie (2005), students' strategy use depends on nature of academic task. Empirical studies indicated that there were fairly gender differences in favor of girls in cognitive and metacognitive strategy use and achievement although there were studies supporting that gender did not have a significant effect on cognitive and metacognitive strategy use and achievement. In addition, most of the studies strengthened the effectiveness of prior knowledge in academic accomplishment. However, there is a lack research concerning gender, socioeconomic and prior knowledge effect on cognitive and metacognitive strategy use and achievement. Certainly, more research regarding effects of students' characteristics such as gender, prior knowledge, and socioeconomic status is essential to draw consistent conclusions.

CHAPTER 3

PROBLEMS AND HYPHOTHESES

This chapter contains main problems, sub-problems, and the hypotheses of the study.

3.1 Main Problems

1. What cognitive and metacognitive strategies (rehearsal, elaboration, organization, critical thinking, and metacognitive self-regulation) do 7th grade students use?
2. How well does cognitive and metacognitive strategy use predict 7th grade students' achievement in science?
3. How well do 7th grade students' background characteristics (gender, prior knowledge, number of sibling, employment status and educational level of parents, number of reading materials at home, frequency of buying a daily newspaper, presence of a separate study room, presence of a computer and presence of an internet connection) predict their cognitive and metacognitive strategy use and achievement in science?

3.2 Sub-problems

1. Is there a difference in the level of students' cognitive and metacognitive strategy use?
2. Is there a significant contribution of rehearsal strategy use to 7th grade students' achievement in science?

3. Is there a significant contribution of elaboration strategy use to 7th grade students' achievement in science?
4. Is there a significant contribution of organization strategy use to 7th grade students' achievement in science?
5. Is there a significant contribution of critical thinking strategy use to 7th grade students' achievement in science?
6. Is there a significant contribution of metacognitive self-regulation strategy use to 7th grade students' achievement in science?
7. Is there any relationship between students' background characteristics and variables containing students' cognitive and metacognitive strategy use and achievement in science?

3.3 Hypotheses

1. There are no differences in the level of students' cognitive and metacognitive strategy use.
2. There is no significant contribution of cognitive strategy (rehearsal, elaboration, organization and critical thinking) and metacognitive strategy use to 7th grade students' achievement in science.
3. There is no relationship between students' background characteristics and variables containing students' cognitive and metacognitive strategy use and achievement in science.

CHAPTER 4

METHOD

4.1 Population and Sampling

The target population of the study was all 7th grade students in Keçiören district of Ankara. The accessible population was identified as all 7th grade students in the public schools of Keçiören district of Ankara. According to the Provincial Directorate of National Education in Ankara, there were 13,222 seventh grade students; 6996 males and 6226 females in the public schools of Keçiören district. Cluster random sampling was used in the selection of the sample. Fifteen public elementary schools, out of 80, were selected by cluster random sampling. In the selected 15 public elementary schools, 1517 seventh grade students were volunteers and had permission from their parents to be involved in the study. Table 4.1 presents the number of schools and students in each school.

Table 4.1 Numbers of Schools and Corresponding Students.

Number of Schools	*Number of Students*	*Percent (%)*
School 1	119	7.8
School 2	66	4.4
School 3	118	7.8
School 4	258	17.0
School 5	298	19.6
School 6	97	6.4
School 7	10	0.7
School 8	53	3.5
School 9	100	6.6
School 10	121	8.0
School 11	48	3.2
School 12	45	3.0
School 13	64	4.2
School 14	60	4.0
School 15	60	4.0
Total	1517	100.0

There were 725 (47.8 %) boys and 792 (52.2 %) girls, the range of ages was from 12 to 15 years with a mean of 13.11 (*SD*=0.35). In addition, the mean of students' science report card grade of the previous semester, used as their prior knowledge, was 3.26 over 5.00 (*SD*=1.18). The range of students' number of sibling was from 1 to 10 with a mean age of 2.82 (*SD*=1.06). Moreover, majority of students' fathers were employed, however, majority of mothers were unemployed. Majority of both mothers and fathers graduated from high

school and lower. There were generally many numbers of reading materials at students' home. Furthermore, a daily newspaper was sometimes bought at many homes (61 %), however, 6.8 % of families never bought. Majority of students had a separate study room (82%) and a computer (70.9 %) but 49.8 % of students had an internet connection. Table 4.2 gives detailed information related to students' gender (GEND), number of sibling (SIBL), mother's employment status (MES), father's employment status (FES), mother's educational level (MEL), father's educational level (FEL), number of reading materials at home (READI), frequency of buying a daily newspaper (NEWS), presence of a separate study room (ROOM), a computer (COMP) and an internet connection (INTER).

Table 4.2 Background Characteristics of Students

	Frequency	***Percent (%)***
GEND		
Girl	792	52.2
Boy	725	47.8
SIBL		
1.00	67	4.4
2.00	614	40.5
3.00	502	33.1
4.00	232	15.3
5.00-10.00	102	6.7
MES		
Employed	235	15.5
Unemployed	1241	81.8
Offensively employed	19	1.3
Retired	22	1.5
FES		
Employed	1331	87.7
Unemployed	31	2.0
Offensively employed	56	3.7
Retired	99	6.5

Table 4.2 (Continued)	***Frequency***	***Percent (%)***
MES		
Illiterate	35	2.3
Primary School	678	44.7
Secondary School	315	20.8
High School	341	22.5
University	119	7.8
Ms	25	1.6
PhD	4	.3
FES		
Illiterate	6	.4
Primary School	365	24.1
Secondary School	350	23.1
High School	495	32.6
University	227	15.0
Ms	54	3.6
PhD	20	1.3
READI		
0-10 books	109	7.2
11-25 books	361	23.8
26-100 books	542	35.7
101-200 books	269	17.7
More than 200 books	236	15.6
ROOM		
Have a separate study room	1244	82.0
Do not have a separate study room	273	18.0
NEWS		
Never	103	6.8
Sometimes	926	61.0
Always	488	32.2
COMP		
Have a computer	1075	70.9
Do not have a computer	442	29.1
INTER		
Have an internet connection	756	49.8
Do not have an internet connection	761	50.2

4.2 Variables

In this study, there are nineteen variables; students' science achievement test score, cognitive strategy (rehearsal, elaboration, organization and critical thinking) and metacognitive strategy use, background characteristics (age, gender, prior knowledge, number of sibling, employment status and educational level of parents, number of reading materials at home, frequency of buying a daily newspaper, presence of a separate study room, a computer and an internet connection). Students' science achievement test scores were measured by their performance on 'The Body Systems', 'Force and Motion' and 'Electricity'. This variable is considered as a continuous variable and measured on interval scale. Students' possible minimum and maximum scores range from 0 to 15 for science achievement score. Students' cognitive (rehearsal, elaboration, organization, critical thinking) and metacognitive strategy use are considered as continuous variables and measured on interval scale. Students' possible minimum and maximum scores range from 1 to 7 for a score of cognitive and metacognitive strategy use. Students' prior knowledge was explained by their science report card grade.

4.3 Data Collection Instruments

In this study, two instruments were used to collect data from students; Turkish version of the Motivated Strategies for Learning Questionnaire (MSLQ-TV; Sungur, 2004) and Science Achievement Test (SAT). Besides, students answered to the questions about their background characteristics

4.3.1 Background Characteristics Survey

There were 13 items that investigated background characteristics of students, namely, age, gender, prior knowledge, number of sibling, employment status and educational level of parents, number of reading materials at home, frequency of buying a daily newspaper, presence of a separate study room, a computer and an internet connection. Students' report card grade in a science course in the previous semester referred to their prior knowledge. Information about number of sibling, employment status and educational level of parents, number of reading materials at home, frequency of buying a daily newspaper, presence of a separate study room, a computer and an internet connection was used as indicators of students' socioeconomic status.

4.3.2 Motivated Strategies for Learning Questionnaire- Turkish Version (MSLQ-TV)

The Motivated Strategies for Learning Questionnaire (MSLQ) is a self-reported questionnaire developed by Pintrich, Smith, Garcia and McKeachie (1991). The MSLQ is composed of two sections which are motivation section (31 items) and learning strategies section (50 items). It provides students with rating themselves about their motivation and their use of learning strategies. The items are scored on a 7-point Likert-type scale from 1 (not at all true for me) to 7 (very true for me). MSLQ was translated and adapted into Turkish by Sungur (2004). In this study, 31 items of learning strategies section of the Turkish version of the Motivated Strategies for Learning Questionnaire (Sungur, 2004) were used by including the subject area 'science'. The items are related students' use of several cognitive and metacognitive strategies

containing five subscales; rehearsal (4 items, α= .65), elaboration (6 items, α= .76), organization (4 items, α= .59), critical thinking (5 items, α= .72) and metacognitive self-regulation (12 items, α= .80). Each student's subscale score was computed by taking the average of the items that make up that subscale.

Before computing students' score, negatively worded items were reversed to have positive wording of all items. The higher score the student has, the greater interest of the student to the subscale. Table 4.3 explains Cronbach alpha coefficients and number of items of subscales.

Table 4.3 Cronbach Alpha Coefficients and Number of Items of Subscales of MSLQ

Subscales	*Reliability*	*Number of Items*	*Item Description*	*Sample Item*
R	0.65	4	Indicates efforts to select and acquire of information	When I study for this class, I practice saying the material to myself over and over
E	0.76	6	Indicates efforts to integrate the information	I try to relate ideas in this subject to those in other courses whenever possible
O	0.59	4	Indicates efforts to construct the information	I make simple charts, diagrams, or tables to help me organize course material
CT	0.72	5	Indicates efforts to apply previous knowledge to new situation and to make critical evaluations	When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence
MSR	0.80	12	Indicates efforts to control and regulate the cognition	When reading for this course, I make up questions to help focus my reading

In order to validate the factor structure, Confirmatory Factor Analyses were conducted. Results support the use of rehearsal, elaboration, organization, critical thinking and metacognitive self-regulation as separate scales. In Table 4.4, Fit indeces for rehearsal, elaboration, organization, critical thinking and metacognitive self-regulation strategy use are provided.

Table 4.4 Fit Indeces

	RMSEA	***SRMR***	***GFI***	***CFI***
Rehearsal	.00	.01	1.00	1.00
Elaboration	.06	.05	.97	.97
Organization	.09	.04	1.00	.98
Critical Thinking	.05	.03	.98	.99
Metacognitive Self-Regulation	.06	.07	.92	.90

The Root-Mean-Squared Error of Approximation (RMSEA) values are recommended to be below 0.10 for a moderate fit, below 0.05 for a good fit and below 0.01 for an outstanding fit to the data (Kelloway, 1998). In this study, each value is below 0.10, thus good fit to the data. The Standardized-Root-Mean-Square Residual (SRMR) values are advised to be less than 0.05 for a good fit to the data (Kelloway, 1998). Though, values less than 0.10 are also accepted (Kline, 1998). In this study, all values are below 0.10. The Goodness-of-Fit Index (GFI) values are advised to be more than 0.90 for a good fit to the data (Kelloway, 1998). The Comparative Fit Index (CFI) values are recommended to be more than 0.90 for a good fit to the data (Kelloway, 1998). In this study, each value for GFI and CFI is more than 0.90. Therefore, good fit to the data.

4.3.3 Science Achievement Test (SAT)

The science achievement test which is a multiple choice test consisting of 15 items with one correct answer and three distracters was developed by the researcher to evaluate students' performance on the units of 'The Body Systems', 'Force and Motion' and 'Electricity' in 7th grade national science curriculum. More specifically, the unit of 'The Body Systems' includes science concepts, namely, digestive system, excretory system, endocrine system and sense organs, the unit of 'Force and Motion' includes science concepts, namely, helical springs, force-work-energy, simple machines and frictional force and the unit of electricity includes electrification, electric circuits and circuit connections. Before selecting items of SAT, instructional objectives of the units were examined. The names of the units, the number of their instructional objectives in the 7th grade national science curriculum and the number of items representing the units in SAT are provided in Table 4.5. The items were selected from previous years' Secondary Education Entrance Examination and Government Complimentary Boarder and Scholar Examination. The items which were prepared with respect to knowledge, comprehension and application level in the cognitive domain of Bloom's Taxonomy required students remember and recall of the learned material, manipulate the knowledge by modifying its form, explain or summarize the knowledge and employ the learned material in a new condition. In computing SAT score of each student, '1' point was given for a correct answer, '0' point was given for an incorrect answer and all points were added. The SAT scores range '0' to '15'. The higher SAT score indicates student's achievement in SAT. In the current study, the reliability coefficient computed by Kuder Richardson 20 was found to be 0.77.

Table 4.5 The names of the units, the number of their objectives in the 7th grade national science curriculum and the number of items representing the units in SAT

Units	*Number of objectives*	*Number of items in SAT*
The Body Systems	27	4
Force and Motion	31	5
Electricity	32	6

4.4 Data Collection Procedure

After literature review and preparation of instruments, 15 public elementary schools were selected from Keçiören district randomly. With the necessary permission from Ministry of Education, in March and April, background characteristics survey, MSLQ-TV and SAT were administered to 1517 seventh grade students who both were volunteers and have permission from their parents for the study by the researcher. Completion of the instruments took nearly 40 minutes. Directions were made clear and necessary explanations were done by the researcher. Students were told that SAT would not affect their science grade and there was no right and wrong answer in MSLQ-TV. It was also added that students would not write their names on the instruments, their answers were important for education and the answers would be kept in secrets. It was also emphasized that students had the right to withdraw from the study if they did not want to complete the instruments. Furthermore, they were notified to read all items carefully and complete all of them. Due to the limitation of time, teachers were requested to help the researcher during the administration. Teachers were given information about the study and the

administration process. During the administration of the instruments, no specific problems were encountered.

4.5 Data Analysis Procedure

The statistical analyses were done by means of SPSS 15 for Windows software program. Both descriptive and inferential statistics were used in order to analyze the obtained data. Percentages, mean, median, mode, range, standard deviation, minimum, maximum, skewness and kurtosis were used as descriptive statistics to describe the sample as a result of background characteristics survey, MSLQ-TV and SAT. As an inferential statistics, One-way Repeated ANOVA, Multiple Linear Regression Analysis and Canonical Correlation Analysis were used to test the null hypotheses.

4.6 Assumptions and Limitations

4.6.1 Assumptions

1. The administration of background characteristics survey, MSLQ and SAT was done under standard conditions.
2. The items of background characteristics survey, MSLQ and SAT were responded sincerely by the subjects of the study.

4.6.2 Limitations

1. This study was limited to public schools in Keçiören.
2. This study was limited to 7th grade students.

3. This study was limited to science course.
4. SAT was limited to the first semester of 7th grade science curriculum, namely 'The Body Systems', 'Force and Motion' and 'Electricity' units and 15 questions.
5. The study was limited by its reliance on self-reported data.
6. The characteristics of subjects such as motivation and intelligence might have affected their cognitive and metacognitive strategy use and science achievement.
7. The characteristics of science teacher might have affected cognitive and metacognitive strategy use and science achievement of subjects.

4.7 Threats to Internal Validity of the Study

The characteristics of participants may affect the study. This may result in a subject characteristics threat (Fraenkel & Wallen, 2006). In the current study, the fact that all participants were 7th grade students provided with controlling some characteristics. However, all the characteristics of students such as motivation and intelligence could not be controlled. During the study, the lost of participants may affect the result of the study. This is known as a mortality threat (Fraenkel & Wallen, 2006). Mortality could not be a threat to internal validity of the current study since this was not a longitudinal study. The location that the study is carried out may affect the result of the study. This is called location threat (Fraenkel & Wallen, 2006). The location could not be threat in the current study because data collection instruments; background characteristics survey, MSLQ-TV and SAT were administrated in classrooms under similar conditions. During the study, changes in the instrument cause a threat to internal validity of the study which is an instrument decay threat

(Fraenkel & Wallen, 2006). In the current study, instrument decay could not be threat since this study was not an interview survey. Data collectors' characteristics may influence results of the study that a data collector characteristics threat (Fraenkel & Wallen, 2006). In the current study, teachers were requested to help the researcher during the administration due to the limitation of time. Characteristics of data collectors might influence the result of the study so that there could be a data collector characteristics threat. Data collector bias threat may occur when a data collector distort results of the study unintentionally (Fraenkel & Wallen, 2006). A data collector bias was not a threat for the current study since data collectors were given information about the study. When a subject gets a higher score on a posttest than a pretest, a threat to internal validity occurs that refers to a testing treat (Fraenkel & Wallen, 2006). There could not be a testing threat to internal validity of the current study in the view of the fact that instruments were used only one time. History threat takes place if unexpected event affects results of the study (Fraenkel & Wallen, 2006). Unexpected events did not happen during the administration so that there could not be history threat in the current study. Due to time passing, changes in participants may cause changes in participants' behaviors to study. This refers to maturation threat (Fraenkel & Wallen, 2006). There could not be a maturation threat in the current study because there were no factors regarding the passing of time. The thoughts of participants about the study and participants' performances in the study can be a threat to the validity (Fraenkel & Wallen, 2006). In the current study, this threat was tried to be controlled by the help of explanations about the study in consent forms. Regression threat may result from studying alteration in performance of a group that has extreme preintervention performance (Fraenkel & Wallen, 2006). Regression threat could not occur in the current

study since intervention was not present. In addition, due to the absence of intervention, there could not be an implementation threat.

4.8 Ethical Issues in the Study

Three ethical issues are suggested that every researcher deals with; protecting participants from harm, ensuring confidentiality of research and deception of participants (Fraenkel & Wallen, 2006). In the current study, students were not faced with any physical and psychological harm. Consent forms which provided with information about the purpose of the study were given both students and their parents. In consent forms, it was also added that students would not be faced with any physical and psychological harm and students had the right to withdraw from the study if they did not want to complete the instruments. Communication phone number and e-mail address were also added in consent forms if students and parents had questions about the study. In addition, the administration of instruments was done in students' own school. Confidentiality of research data is also guaranteed in the current study. During the administration, students were wanted to not write their names on the instruments. In consent forms, it was also added that the answers of students were kept secret and the answers were used for only scientific researches. Moreover, during the data analysis procedure, students and schools were given numbers for guaranteeing confidentiality. Students and parents were provided with consent forms which gave information about the purpose of the study and communication phone number and e-mail address along with consent forms for answering the questions of students and parents. These show that deception of students was not an issue in the current study.

CHAPTER 5

RESULTS

This chapter consists of two sections. The first section contains descriptive statistics to describe the sample. The second section includes inferential statistics; One-way Repeated ANOVA, Multiple Linear Regression Analysis and Canonical Correlation Analysis in order to test the null hypotheses.

5.1 Descriptive Statistics

Descriptive statistics related to students' use of rehearsal (R), elaboration (E), organization (O), critical thinking (CT) and metacognitive self-regulation (MSR) strategies and science achievement test score (SATS) were clarified in Table 5.1. Turkish version of the Motivated Strategies for Learning Questionnaire (MSLQ-TV) was used to explore students' cognitive strategy (rehearsal, elaboration, organization and critical thinking) and metacognitive strategy use. The mean score of strategy use illustrated the frequency of that strategy use. In this study, participants generally demonstrated high levels of rehearsal (M= 4.82, SD= 1.41), elaboration (M= 4.95, SD= 1.33), organization (M= 4.56, SD= 1.35), critical thinking (M= 4.71, SD= 1.35), and metacognitive strategy use (M= 5.23, SD= 1.03). The skewness and kurtosis values for cognitive strategy and metacognitive strategy use scores lied between "-2" and "+2" so that it can be said that scores were normally distributed. Science achievement test (SAT) was used to investigate student's performance in various science concepts. The SAT scores ranged from '0' to '15'. The mean

of SAT score was 7.79 (*SD*= 3.49) which indicated moderate achievement of students. Moreover, the skewness and kurtosis values for SAT scores lied between "-2" and "+2" so that it can be said that scores were normally distributed.

Table 5.1 Descriptive Statistics Regarding Variables of the Study

	R	***E***	***O***	***CT***	***MSR***	***SATS***
Mean	4.82	4.95	4.56	4.71	5.23	7.79
Std. Deviation	1.41	1.33	1.35	1.35	1.03	3.49
Minimum	1.00	1.00	1.00	1.00	1.83	.00
Maximum	7.00	7.00	7.00	7.00	7.00	15.00
Range	6.00	6.00	6.00	6.00	5.17	15.00
Skewness	-.35	-.48	-.24	-.34	-.44	.05
Kurtosis	-.56	-.30	-.48	-.45	-.35	-.89

Descriptive statistics concerning students' cognitive and metacognitive strategy uses and science achievement test scores were also made clear according students' gender in Table 5.2. As a result, girls used rehearsal, elaboration, organization, critical thinking and metacognitive self regulation strategy slightly more than boys. The mean of girls' SAT score (*M*= 7.93, *SD*= 3.41) was also slightly higher than the mean of boys' SAT score (*M*= 7.64, *SD*= 3.58).

Table 5.2 Descriptive Statistics Regarding Variables of the Study According to Gender

		R	***E***	***O***	***CT***	***MSR***	***SATS***
Girls	Mean	4.98	5.06	4.69	4.73	5.40	7.93
	Std. Deviation	1.40	1.34	1.34	1.37	1.02	3.41
	Minimum	1.00	1.00	1.00	1.00	1.83	.00
	Maximum	7.00	7.00	7.00	7.00	7.00	15.00
	Range	6.00	6.00	6.00	6.00	5.17	15.00
	Skewness	-.50	-.58	-.32	-.36	-.70	.00
	Kurtosis	-.34	-.25	-.38	-.44	.03	-.80
Boys	Mean	4.66	4.84	4.42	4.68	5.05	7.64
	Std. Deviation	1.41	1.32	1.35	1.33	1.02	3.58
	Minimum	1.00	1.00	1.00	1.00	2.00	.00
	Maximum	7.00	7.00	7.00	7.00	7.00	15.00
	Range	6.00	6.00	6.00	6.00	5.00	15.00
	Skewness	-.20	-.38	-.15	-.33	-.19	.10
	Kurtosis	-.67	-.28	-.53	-.46	-.44	-.96

5.2 Inferential Statistics

5.2.1 Hypothesis 1: There are no differences in the level of students' cognitive and metacognitive strategy use.

One-way Repeated Measures ANOVA was conducted to investigate differences in the level of students' cognitive and metacognitive strategy use. Before the conduction of analysis, assumptions of One-way Repeated Measures ANOVA were checked.

5.2.1.1 Assumptions of One-way Repeated Measures ANOVA

Level of Measurement

The dependent variables; rehearsal, elaboration, organization, critical thinking and metacognitive strategy use are considered as continuous variables and measured on interval scale. Thus, the level of measurement assumption is not violated.

Normality

The skewness and kurtosis values for rehearsal, elaboration, organization, critical thinking and metacognitive strategy use scores lied between "-2" and "+2" as indicated in Table 5.3. Thus, the normality assumption is met.

Table 5.3 Skewness and Kurtosis Values for Rehearsal, Elaboration, Organization, Critical Thinking and Metacognitive Strategy Use

	Skewness	***Kurtosis***
Rehearsal	-.35	-.56
Elaboration	-.48	-.30
Organization	-.24	-.48
Critical thinking	-.34	-.45
Metacognitive Self-regulation	-.44	-.35

A one-way repeated measures ANOVA was conducted to compare students' rehearsal (R), elaboration (E), organization (O), critical thinking (CT) and metacognitive strategy use (MSR) scores. The means and standard deviations are presented in Table 5.4.

Table 5.4 Descriptive Statistics for Students' Rehearsal, Elaboration, Organization, Critical Thinking and Metacognitive Strategy Use Scores.

	Mean	***Std. Deviation***	***N***
Rehearsal	4.82	1.41	1517
Elaboration	4.95	1.33	1517
Organization	4.56	1.35	1517
Critical thinking	4.71	1.35	1517
Metacognitive self-Regulation	5.23	1.03	1517

There was a significant difference in the level of students' cognitive and metacognitive strategy use, Wilks' Lambda=.63, $F(4, 1513)= 218.49$, $p<0.05$, multivariate eta squared=.37 as stated in Table 5.5. Ten pairwise comparisons

among the means for rehearsal (R), elaboration (E), organization (O), critical thinking (CT) and metacognitive strategy use (MSR) scores were conducted. The results of the pairwise comparisons are presented in table 5.6. Each pairwise comparison was significant at the .05 level, using Holm's Sequential Bonferroni procedure. The ρ-value of each pairwise comparison was .00 which was less than α=.05/10=.005, α=.05/9=.0.0056, α=.05/8=.0063, α=.05/7=.0071, α=.05/6=.0083, α=.05/5=.01, α=.05/4=.0125, α=.05/3=.017, α=.05/2=.025, α=.05/1=.05. The eta squared statistics were .01 for pair 1 (rehearsal-elaboration), .01 for pair 3 (rehearsal-critical thinking), .01 for pair 8 (organization-critical thinking) indicating small effect size, .04 for pair 2 (rehearsal-organization), .05 for pair 6 (elaboration-critical thinking) indicating moderate effect size, .13 for pair 4 (rehearsal-metacognitive self-regulation), .11 for pair 5 (elaboration-organization), .09 for pair 7 (elaboration-metacognitive self-regulation), .31 for pair 9 (organization-metacognitive self-regulation) and .21 for pair 10 (critical thinking-metacognitive self-regulation) indicating large effect size. Moreover, the biggest mean difference was between organization strategy use and metacognitive self-regulation strategy use (*M*= .67, *SD*= .03), the smallest mean difference was between rehearsal strategy use and critical thinking strategy use (*M*= .12, *SD*= .03). Metacognitive strategy use (*M*= 5.23, *SD*= 1.03) was appeared to be the most frequently and organization strategy (*M*= 4.56, *SD*= 1.35) use was appeared to be the least frequently used strategy in science learning.

Table 5.5 Multivariate Test

Effect		*Value*	*F*	*Hypothesis df*	*Error df*	*Sig.*	*Partial Eta Squared*
	Wilks' Lambda	.63	218.49(a)	4.00	1513.00	.00	.37

Table 5.6 The Results of the Pairwise Comparisons

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	*Std. Deviation*	*Std. Error Mean*	*Lower*	*Upper*	*t*	*df*	*Sig. (2-tailed)*
Pair 1	R - E	-.13	1.21	.03	-.19	-.07	-4.09	1516	.00
Pair 2	R - O	.26	1.21	.03	.20	.32	8.43	1516	.00
Pair 3	R - CT	.12	1.27	.03	.06	.18	3.66	1516	.00
Pair 4	R - MSR	-.41	1.06	.03	-.46	-.35	-14.90	1516	.00
Pair 5	E - O	.39	1.08	.03	.33	.44	13.98	1516	.00
Pair 6	E - CT	.25	1.06	.03	.19	.30	9.10	1516	.00
Pair 7	E - MSR	-.28	.89	.02	-.32	-.23	-12.14	1516	.00
Pair 8	O – CT	-.14	1.19	.03	-.20	-.08	-4.66	1516	.00
Pair 9	O - MSR	-.67	.99	.03	-.72	-.62	-25.94	1516	.00
Pair 10	CT - MSR	-.52	1.00	.03	-.57	-.47	-20.32	1516	.00

5.2.2 Hypothesis 2: There is no significant contribution of cognitive strategy (rehearsal, elaboration, organization and critical thinking) and metacognitive strategy use to 7th grade students' achievement in science.

This hypothesis was tested by Multiple Linear Regression Analysis. Before testing the hypothesis, firstly assumptions of Multiple Linear Regression Analysis were checked.

5.2.2.1 Assumptions of Multiple Linear Regressions

1. ***Sample Size***

Tabachnick and Fidell (1996) suggested a formula for sample size 'N>50+8m' in which 'm' is the number of independent variable. In this study, there are five independent variables; sample size should be bigger than 90 (N>90). There are 1517 students in the study so sample size assumption is met.

2. ***Multicollinearity and Singularity***

When the independent variables are highly correlated (r=.9 and above) multicollinearity occurs. Moreover, when one independent variable is actually a combination of other independent variables, singularity exists. Multiple regression does not like multicollinearity or singularity. The correlations between independent variables are provided in Table 5.7. Correlation coefficients between independent variables are not higher than .7 and tolerance values are found to be large enough (Table 5.8). Therefore, multicollinearity and singularity assumptions are not violated.

Table 5.7 Correlations

		SATS	*R*	*E*	*O*	*CT*	*MSR*
Pearson Correlation	SATS	1.00					
	R	.19	1.00				
	E	.24	.61	1.00			
	O	.22	.62	.68	1.00		
	CT	.20	.58	.69	.61	1.00	
	MSR	.24	.67	.75	.68	.68	1.00

Table 5.8 Coefficients

	Tolerance
Rehearsal	.49
Elaboration	.35
Organization	.44
Critical Thinking	.44
Metacognitive Self-regulation	.33

3. ***Outliers***

Multiple regression is very sensitive to outliers; very low and high scores. Outliers can be checked by the help of Mahalanobis distance. According to Tabachnick and Fidell (1996), critical χ^2 at alpha=.001 for "5" df is 20.52 to evaluate Mahalanobis distance value. Mahalanobis distance value; 28.35 given Table 5.4 exceeds the critical value; 20.52. There were ten values exceeding the critical value. It is not unusual to be a few outliers.

Table 5.9 Mahalanobis Distance Value

	Minimum	*Maximum*	*Mean*	*Std. Deviation*	*N*
Mahal. Distance	.24	28.35	5.00	3.84	1517

4. Normality, Linearity, Homoscedasticity and Independence of Residuals

In the Normal Probability Plot, the points lie in a reasonably straight line from bottom left to top right and the residuals have a straight line relationship as indicated in Figure 5.1. Furthermore, in Figure 5.2, the residuals are roughly rectangularly distributed and most of the scores are concentrated in the centre; along the 0 point. Therefore, normality, linearity, homoscedasticity and independence of residuals assumptions are not violated.

Figure 5.1 Normal Probability Plot for SAT

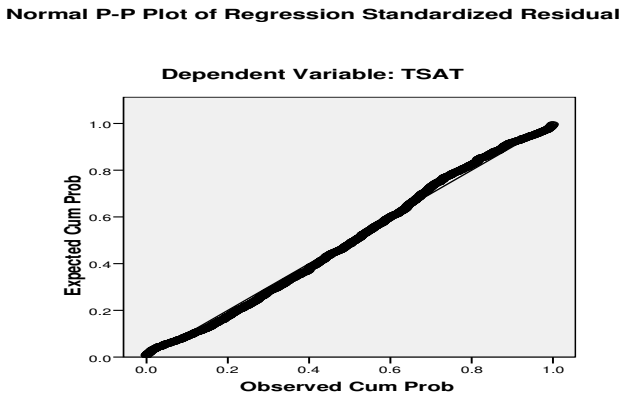
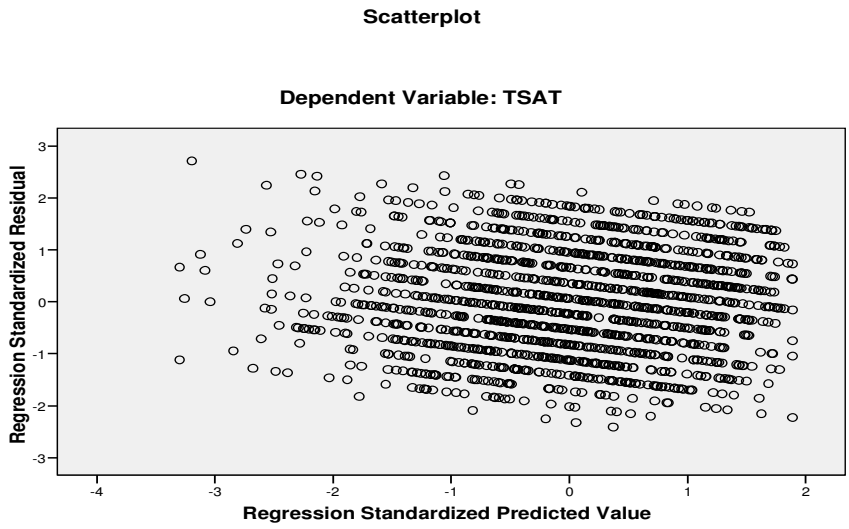


Figure 5.2 Scatterplot of the Standarised Residuals for SAT



The results of the analysis indicated that the model includes rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation strategy use reached statistical significance and explained 6.9 per cent of the variance in students' achievement in science (R=.26, F= 22.37,p<.05). In short, elaboration strategy use and metacognitive self-regulation strategy use made a statistically significant contribution to the prediction of students' achievement in science (p<.05). Moreover, metacognitive self-regulation strategy use made the largest contribution (beta=.11). Both elaboration strategy use and metacognitive self-regulation strategy use had positive relationships with students' achievement in science. What is more, rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation strategy uniquely explained .00, .29, .23, .01 and .41 per cent of the variance in students' science

achievement respectively. In Table 5.10, Beta coefficients, related significance values and part correlation coefficients are illustrated.

Table 5.10 Beta Coefficients, Related Significance Values and Part Correlation Coefficients

Independent Variables	*Beta*	*P*	*Part correlation coefficients*
Rehearsal	.01	.83	.005
Elaboration	.09	.03	.054
Organization	.07	.05	.048
Critical Thinking	.01	.72	.009
Metacognitive Self-regulation	.11	.01	.064

5.2.3 Hypothesis 3: There is no relationship between students' background characteristics and variables containing students' cognitive and metacognitive strategy use and achievement in science.

This hypothesis was tested by Canonical Correlation Analysis. Canonical Correlation was performed between a set of cognitive and metacognitive strategy use and achievement in science variables and a set of background characteristics variables. The cognitive and metacognitive strategy use and achievement in science set measured rehearsal (R), elaboration (E), organization (O), critical thinking (CT), and metacognitive self-regulation (MSR) strategy use and science achievement (SA). The background characteristics set included gender (GEND), prior knowledge (PRIOR), number of sibling (SIBL), mother's employment status (MES), father's employment status (FES), mother's educational level (MEL), father's

educational level (FEL), number of reading materials at home (READI), frequency of buying a daily newspaper (NEWS), presence of a separate study room (ROOM), a computer (COMP) and an internet connection (INTER).

The first canonical correlation was .60 (35.5% overlapping variance); the second was .25 (6.3% overlapping variance). The remaining four canonical correlations were effectively zero. With all six canonical correlations included, $\chi 2$ (72) = 814,34, p <.001 and with the first canonical correlation removed, $\chi 2$ (55) = 153,31, p <.001. Subsequent $\chi 2$ tests were not statistically significant. The first two pairs of canonical variates, therefore, accounted for the significant relationships between the two sets of variables.

Data on the first two pairs of canonical variates were provided in Table 5.10. In detail, correlations between the variables and the canonical variates, standardized canonical variate coefficients, within-set variance accounted for by the canonical (percent of variance), redundancies, and canonical correlations.

With a cutoff correlation of .3, the first canonical variate was positively correlated with prior knowledge (.88), mother's educational level (.49), father's educational level (.57), number of reading materials at home (.53), frequency of buying a daily newspaper (.34), however, negatively correlated with presence of a separate study room (-.35), presence of a computer (-.32) and presence of an internet connection (-.34). Among the cognitive and metacognitive strategy use and science achievement variables set, rehearsal (.50), elaboration (.55), organization (.53), critical thinking (.44), metacognitive self-regulation (.59) and science achievement (.91) correlated with the first canonical variate.

The first pair of canonical variates demonstrated that students who had higher levels of prior knowledge, educated parents, more reading materials at home, higher frequency of buying a daily newspaper, were likely to use more cognitive and metacognitive strategies and to get scores in science achievement. On the other hand, students who had a separate study room and a computer with internet connection were more likely to get lower scores in science achievement test.

On the other hand, the second canonical variate was positively associated with presence of a computer (.42) and presence of an internet connection (.33) but negatively associated with gender (-.71), mother's educational level (-.58), father's educational level (-.40). Among the cognitive and metacognitive strategy use and science achievement variables set, the second canonical variate was positively related with rehearsal (.50), elaboration (.42), organization (.43), metacognitive self-regulation (.69) but negatively related with science achievement (-.36). It should be added that girls appear to use rehearsal, elaboration, organization, critical thinking and metacognitive self regulation strategy more than boys as indicated in Table 5.2.

The second pair of canonical variates demonstrated that students who had a computer with an internet connection, lower educational levels of parents were more likely to use higher levels of rehearsal, elaboration, organization, metacognitive self-regulation strategies and to get lower scores in science achievement test.

Table 5.10 Correlations, Standardized Canonical Coefficients, Canonical Correlations, Percents of Variance, and Redundancies between Background Characteristics (Set 1) and Cognitive and Metacognitive Strategy Use and Science Achievement (Set 2) Variables and Their Corresponding Canonical Variates

	First Canonical Variate		***Second Canonical Variate***	
	Correlation	***Coefficient***	***Correlation***	***Coefficient***
SET 1				
GEND	-.17	-.15	-.71	-.63
SIBL	-.28	-.08	.17	-.03
PRIOR	.88	.70	.12	.19
MES	-.14	-.02	.11	.01
FES	.05	.16	.01	-.04
MEL	.49	.07	-.58	-.49
FEL	.57	.23	-.40	-.21
READI	.53	.11	.04	.27
ROOM	-.35	-.11	.13	.02
NEWS	.34	.09	.11	.16
COMP	-.32	-.03	.42	.26
INTER	-.34	-.07	.33	.08
% of variance	18.40		11.48	Total=29.88
Redundancy	6.54		.73	Total=7.27
SET 2				
R	.50	.10	.49	.20
E	.55	.09	.42	.04
O	.53	.11	.43	.11
C	.44	-.07	.13	-.68
MSR	.60	.23	.69	1.05
SA	.91	.80	-.36	-.55
% of variance	13.09		1.30	Total=14.39
Redundancy	36.84		20.61	Total=57.45
Canonical correlation	.60		.25	

5.3 Summary of the Results

The results of the current study can be summarized as follows:

1. Seventh grade students generally demonstrated high levels of *rehearsal*, *elaboration*, *organization*, *critical thinking*, and *metacognitive strategy use*.
2. More girls than boys reported to use of *rehearsal*, *elaboration*, *organization*, *critical thinking* and *metacognitive self regulation strategies.*
3. The mean of science achievement test scores indicated moderate achievement of students in science.
4. The mean of girls' science achievement test score is slightly higher than that of boys.
5. *Elaboration* and *metacognitive self-regulation strategy use* each made a statistically significant contribution to the variation in students' science achievement
6. *Metacognitive self-regulation use* was the main predictor of students' achievement in science.
7. There was a statistically significant difference in the level of students' *rehearsal, elaboration, organization, critical thinking* and *metacognitive strategy use*.
8. *Metacognitive strategy use* was appeared to be the most frequently and *organization strategy use* was appeared to be the least frequently used strategy in science learning.
9. The first canonical variate indicated that prior knowledge, mother's educational level , father's educational level , number of reading materials at home, frequency of buying a daily newspaper, presence of

a separate study room, presence of a computer with internet connection at home are associated with rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation and science achievement.

10. The second canonical variate demonstrated that gender, mother's educational level father's educational level, presence of a computer with internet connection at home are associated with rehearsal, elaboration, organization, metacognitive self-regulation and science achievement.

CHAPTER 6

CONCLUSIONS, DISCUSSIONS, AND IMPLICATIONS

This chapter included discussion of the results, implications of the study and recommendations for further research.

6.1 Discussion of the Results

The present study was conducted to examine the differences in the level of students' cognitive and metacognitive strategy use and to clarify the contribution of cognitive and metacognitive strategy use (rehearsal, elaboration, organization, critical thinking, and metacognitive self-regulation) to 7th grade students' achievement in science. This study also interested in analyze the relationships between students' background characteristics (gender, prior knowledge, socioeconomic status (number of sibling, employment status and educational level of parents, number of reading materials at home, frequency of buying a daily newspaper, presence of a study room, a computer and an internet connection) and the variables including students' cognitive and metacognitive strategy use (rehearsal, elaboration, organization, critical thinking, and metacognitive self-regulation) and science achievement.

In the current study, one-way repeated measures ANOVA revealed a significant difference in the level of students' rehearsal strategy use, elaboration strategy use, organization strategy use, critical thinking strategy use and metacognitive strategy use. This finding is not surprising since in order

to provide students with learning to learn which is one of the aims of Turkish Science and Technology Curriculum, students need to be taught about learning strategies and when and how to use them. In addition, student-centered strategies suggested in the curriculum try to bring to light and to improve higher order thinking skills such as critical and creative thinking, analyzing and evaluating. For instance, students are given opportunities to self-evaluate and think critically by evaluation methods like self-evaluation and peer-evaluation, to organize and present the knowledge by concept maps, to supply meaningful learning by V-diagrams, to provide with planning, application and analyzing and reasoning by scientific process skills. Consequently, with the help of activities mentioned in the curriculum, students are instructed about learning strategies.

Multiple Linear Regression Analysis was conducted to investigate the contribution of rehearsal, elaboration, organization, critical thinking and metacognitive strategy use to science achievement. Analysis indicated that elaboration strategy use and metacognitive self-regulation strategy use were significant predictors of Turkish elementary school students' achievement in science. Moreover, metacognitive self-regulation strategy use was found to be the main predictor (β=.11). When the relationship between elaboration strategy use and science achievement was taken into consideration, it was appeared that elaboration strategy use had positive relationships with students' achievement in science. This finding is not surprising considering the fact that elaboration strategies assist learners in transferring prior knowledge in the long term memory into working memory to make external connections between new information and prior knowledge (Weinstein & Mayer, 1986). Accordingly, students with a high level of elaboration strategy use such as paraphrasing, summarizing, creating analogies and forming a mental image got higher scores

on science achievement test. Indeed, majority of SAT items required students manipulate the knowledge by modifying its form, explain or summarize the material. This finding was in line with the Duncan and McKeachie's (2005) assertion that there might be variations in students' strategy use depending on the nature of the academic tasks. In a similar way, Wolters et al. (2003) emphasized the significance of nature of the tasks and tests in forming students' strategy use to be successful.

In this study, metacognitive self-regulation strategy use also found to be positively related to students' achievement in science. Theoretically, it is expected result because metacognitive strategies include planning, monitoring and regulating which assist students in controlling and regulation of their cognition (Pintrich et al., 1993). Accordingly, students who do planning activities such as setting rational goals, making schedules, arranging working environments, monitoring activities such as self-testing and self-checking by using questions and test-taking strategies and regulating such as rereading of the material that are not understood, arranging reading pace according to difficulty level of reading material and examining the material that is not comprehended are more likely to succeed. Indeed, in their study with 7th grade students from science and English classrooms, Pintrich and DeGroot (1990) demonstrated that self-regulation constructed from metacognitive and effort management strategies was one of the best predictors of students' performance. In addition, although there was a high correlation between self-regulation and cognitive strategy use, when both cognitive strategy and self-regulation were used as predictors of academic performance, cognitive strategy related negatively with performance and self-regulation was better in the prediction of performance. Therefore, authors suggested that cognitive strategy use without self-regulatory strategies is not helpful for academic accomplishment.

Similarly, Yukselturk and Bulut (2007) revealed that cognitive strategy use (including rehearsal, elaboration, organization and critical thinking) and self-regulation (including metacognitive self-regulation and effort regulation) were significantly positively correlated with students' success in an online computer-programming course in an online certificate program. In addition, regression analyses indicated that self-regulation was only variable accounted for the variance in the online course. In another study, Pintrich et al. also showed that cognitive and metacognitive strategies were positively related to course grade except for rehearsal strategy use. Pintrich et al. suggested that being dependent on more surface processing strategies is not beneficial for academic performance. Since rehearsal strategy which is a surface processing strategy is effectual for mainly selection and acquisition of the information, for deeper level of understanding of the information deeper processing strategies such as elaboration, organization, critical thinking and metacognitive strategies are necessary. Pintrich et al. also stated that students depending on deeper processing strategies like elaboration, organization, critical thinking and metacognitive self-regulation for information processing were more probably to get high scores. Because, students who utilize deeper processing strategies; summarizing, creating analogies, relating new information with old information and forming a mental image to integrate information, selecting, ordering, outlining and creating a hierarchy to construct information, applying previous knowledge to new conditions, evaluating thoughts critically and planning, monitoring and regulating cognitive activities other than memorizing the information show meaningful learning. Thus, Linnenbrink and Pintrich (2003) stressed that employing deeper processing strategies more likely results in better understanding of the material. What is more, Dowson and McInery (1998) pointed out that cognitive and metacognitive strategies connected to better academic accomplishment. According to authors, this finding

strengthened the importance of deciding on appropriate strategies in an academic condition along with using strategies.

In the present study, Canonical Correlation Analysis was conducted to analyze the relationships between students' background characteristics (including gender, prior knowledge and socioeconomic status) and variables including students' cognitive and metacognitive strategy use and science achievement. Results revealed that the first canonical correlation was .60 (35.5% overlapping variance); the second was .25 (6.3% overlapping variance). Therefore, since the first canonical correlation and its corresponding pair of canonical variates had more explanatory power, they were used as a base for interpreting the relationship between pairs of canonical variates. Concerning students' prior knowledge, it was seen that there were positive significant associations between prior knowledge and each of variables including rehearsal strategy use, elaboration strategy use, organization strategy use, critical thinking strategy use, metacognitive self-regulation strategy use and science achievement. That is, students who had higher level of prior knowledge were likely to use more rehearsal strategy, elaboration strategy, organization strategy, critical thinking strategy and metacognitive self-regulation strategy and have higher achievement in science. The positive relationship between prior knowledge and science achievement is not surprising. Because in the current study students' report card grade of the previous semester in a science course was used as an indicator of their prior knowledge. In addition, science achievement test items used to measure students' science achievement in this study included the units taught students in the previous semester. Thus, it was expected that students' prior knowledge was related positively with their science achievement. Importance of prior knowledge was also mentioned in the studies of Kuyper et al. (2000) and

Zusho and Pintrich (2003). For instance, in their longitudinal study, Kuyper et al. investigated the role of prior achievement in predicting students' educational attainment in grade 5 of secondary education. In the study, prior achievement was measured in grade 1 and grade 3; three progress tests were administrated regarding arithmetic, Dutch language and information processing in grade 1 and two achievement tests were administrated regarding text comprehension and mathematics in grade 3. It was found in the study that prior achievement of Dutch students was related with their long term educational attainment. Similarly, working with 458 college students, Zusho and Pintrich (2003) signified that students having a history of academic achievement were more probably to get higher scores in chemistry. However, in the study of Chen (2002), it was stated that prior computer experience was not helpful for students in accomplishing higher test scores in a lecture learning environment of an information systems course. What is more, prior knowledge has a significant role in rehearsal strategy, elaboration strategy, organization strategy, critical thinking strategy and metacognitive self-regulation strategy. The reason of this result can be that students with a history of success are expected to know cognitive strategies and have skills to decide on appropriate cognitive strategies for achievement. More research, however, is necessary to clarify the role of prior knowledge on cognitive and metacognitive strategy use and achievement. Regarding the role of students' socioeconomic status (consisting of number of sibling, employment status and educational level of parents, number of reading materials at home, frequency of buying a daily newspaper, presence of a separate study room, a computer and an internet connection) on variables containing students' cognitive and metacognitive strategy use and science achievement, it was seen that there were positive significant relations between socioeconomic variables including mother's educational level, father's educational level, number of reading

materials at home, frequency of buying a daily newspaper and each of variables including rehearsal strategy use, elaboration strategy use, organization strategy use, critical thinking strategy use, metacognitive self-regulation strategy use and science achievement. These findings are not unexpected since educational level of parents, number of reading materials at home and frequency of buying a daily newspaper are signs that give clues about parents' attitudes toward education and children are influenced from their parents' attitudes. On the other hand, there were significant but negative relationships between socioeconomic status variables including presence of a separate study room and presence of a computer with an internet connection and each of variables including rehearsal strategy use, elaboration strategy use, organization strategy use, critical thinking strategy use, metacognitive self-regulation strategy use and science achievement. The reasons of the findings can be integrated as students can utilize computer and internet for chatting, playing games or entertainment rather than for educational purposes. That is, students who had educated parents, more reading materials at home and higher frequency of buying daily were more probably to use more rehearsal strategy such as memorizing, listing, repeating and copying of information, elaboration strategy such as paraphrasing, summarizing, creating analogies and forming a sentence and a mental image to integrate information, organization strategy such as selecting, ordering, grouping, sequencing and outlining, critical thinking strategy such as applying previous knowledge to new conditions or evaluating thoughts critically and metacognitive self-regulation strategy such as planning, monitoring and regulating and get high degree of science achievement. In addition, students who had a separate study room and a computer with internet connection at home were probably to use less rehearsal, elaboration, organization, critical thinking and metacognitive self-regulation strategies and get lower scores. In their study, Kuyper et al. investigated the

relationship between Dutch students' socioeconomic status (measured by questions regarding parents' educational and occupational level) and their long term educational attainment was investigated in a longitudinal study (grade 1 to 5). The result indicated that parents' educational level (SES variable) was used to estimate students' position in grade 5 that referred to educational track. Zimmerman and Martinez-Pons (1986) examined the usefulness of students' reported self-regulated learning strategy use, gender and socioeconomic status (SES) in predicting students' accomplishment in school. The SES level of students was decided according to their parents' educational level. The study result showed that students' reported self-regulated learning strategy use was best predictor of English and Mathematics subsections of MAT (Metropolitan Achievement Test) achievement compared to gender and socioeconomic. On the other hand, there is not a study that examining the effect of socioeconomic status on cognitive and metacognitive strategy use. It is obvious that studies concerning the effects of socioeconomic status on strategy use and academic achievement are necessary to draw definitive conclusions.

The current study failed to indicate significant associations between gender and strategy use including rehearsal, elaboration, organization, critical thinking and metacognitive self regulation strategies and between gender and science achievement. These findings can be expected due to the fact that in Turkish Elementary Science and Technology Curriculum which has been implemented since 2006, gender differences in educational tools and settings were tried to be eliminated by suggesting to provide students with educational materials including equal number of figures, expressions and descriptions for both girls and boys and with such a learning environment that both girls and boys could find equal opportunities to take place in activities both in and out of class

(Ministry of National Education of Turkey [MONE], 2006). Further research, however, is necessary to clarify this finding.

Metallidou and Vlachou (2007) also found no gender differences in 263 fifth and sixth grade students' motivation and cognitive and regulatory strategy use in subject areas of Greek language and mathematics. However, the authors found the study finding surprising since girls' performance significantly higher than boys' performance which was decided by teachers' ratings. They thought that the reasons might be the girls' indirect indication of lower confidence in their ability or teachers' subjectivity regarding girls' performance. In addition, Yukselturk and Bulut (2007) failed to find a significant gender impact on 80 Turkish students' success in an online course and the authors added that impacts of personal characteristics such as age, gender, learning style on student accomplishment is uncertain. In their study with 545 seventh and eighth grade students, Wolters and Pintrich (1998) demonstrated that academic success and use of self-regulatory strategy were similar in the subject areas of mathematics, social sciences and English for both females and males. However, female students employed higher levels of cognitive strategy use than male students in all three subject areas. The authors associated these findings with test anxiety that students who were with higher levels of anxiety, were more probably to employ cognitive strategies however, less probably to employ regulatory strategies and were likely to get lower scores. There were also other studies that reported gender differences in favor of girls. For example, Zimmerman and Martinez-Pons (1990) indicated that girls made significantly greater use of record keeping and monitoring, environmental structuring and goals setting and planning, however, they indicated lower self-efficacy than boys. The authors clarified that due to the lack of data about students' performance, it was difficult to interpret their self-efficacy

perceptions which were significant for understanding gender differences in self-regulated learning so further research is necessary. Similarly, working with 286 developmental college students (low achievers), Ray et al. (2003) concluded that there were gender differences in typical study strategy use and achievement in favor of females. In addition, they pointed out that some of the difference in achievement was attributed to difference in learning strategy use. In another study, Ozturk (2003) demonstrated that there existed statistically significant mean differences between girls and boys in cognitive strategy use and self-regulation scores in favor of girls. Moreover, the study conducted by Bidjerano (2005) indicated that there were significant gender differences in the use of rehearsal, organization, metacognition and elaboration in favor of girls; however, there were not significant gender differences in the use of critical thinking skills in education courses. According to Bidjerano, the reasons of the results might be that females might be more aware of the strategies they employ and that stereotypical beliefs girls are assumed to act in a certain way in an academic environment. On the other hand, working with 628 seventh grade junior high school students, Niemivirta (1997) concluded that boys outperformed girls in rote learning strategies and detail memorizing. The author explained that boys had higher scores in means-ends beliefs and employed superficial strategies and added that students' self-regulation come from students' reactions to environmental and situational requires.

To sum up, regarding the contribution of rehearsal, elaboration, organization, critical thinking and metacognitive strategy use to students' science achievement, the findings of the present study indicated generally similar results with the reported studies in the literature. However, more research is necessary with different subject areas, at grade level and with different tasks due to the fact that every strategy is not equally useful in every subject area

(Dowson & McInery, 1998) and students' strategy use depends on nature of academic task (Duncan & McKeachie, 2005). What is more, although self-reported questionnaires such as MSLQ have relatively advantages in designing, administering and scoring (Winne & Perry, 2000), they supply information regarding participants' interpretations of their behaviors and researchers cannot monitor participants' statements of cognitive and metacognitive processes (Turner, 1995, as cited in Winne & Perry, 2000). In addition, items in self-reported questionnaires want participants to generalize their behaviors across conditions rather than indicating specific learning events (Winne & Perry, 2000). Therefore, limitations of MSLQ should be taken into account during the interpretation of results. Still, the present study contributes our understanding of the relationships between cognitive and metacognitive strategy use and achievement, by supporting that cognitive and metacognitive strategies have an effect on achievement. However, selection of appropriate strategies is necessary. What is more, there are many different background characteristics such as gender, prior knowledge, socioeconomic status that students bring them with to the school. Pintrich (2000) signified that learners' demographic characteristics are one of the factors that have an influence on their accomplishment and learning. Certainly, it is obvious that there is not enough research in order to interpret impacts of learners' background characteristics on strategy use and accomplishment.

6.2 Implications of the Study

The results of study provide teachers, curriculum developers and textbook authors with suggestions that contribute to the improvement of the quality of education. More specifically, the present study demonstrated that there was a significant difference in the level of students' cognitive and metacognitive

strategy use; metacognitive strategy use was found to be the most frequently and organization strategy use was found to be the least frequently used strategy in science learning. Teachers may integrate activities into instructions to encourage the use of less frequently used strategies. For instance, preparation of concept maps to organize the learned concept providing students with use of organization strategy. Similarly, curriculum developers and textbook authors may include activities in curriculum and textbooks to promote the less used strategies. In addition, the current study indicated that elaboration strategy use and metacognitive self-regulation strategy use were significant predictors of students' achievement in the science concepts of 'The Body Systems', 'Force and Motion' and 'Electricity'. This result supported the idea that students use cognitive and metacognitive strategies strategy use depending on the nature of the academic tasks. Therefore, teachers may prepare educational settings and tasks that encourage students to engage in the learning process actively and to use deeper processing strategies such as elaboration, organization, critical thinking and metacognitive strategies. In the same manner, curriculum developers and textbook writers may include student centered activities that improve deeper level strategies in correspondingly curriculums and textbooks. Additionally, this study demonstrated that metacognitive self-regulation strategy use was found to be the main predictor of students' achievement. This result implied that knowledge about when and how to use cognitive strategies is significant. Thus, teachers may be trained in teaching students about learning strategies and also about when and how to use them. Additionally, the current study also demonstrated that background variables including prior knowledge, mother's educational level, father's educational level, number of reading materials at home, frequency of buying a daily newspaper had significant positive effects and background variables including presence of a separate study room and a computer with an internet connection had significant but

negative effects on students cognitive and metacognitive strategy use and science achievement. So, in preparing educational contexts and tools, teachers, curriculum developers and textbook authors may take into consideration differences in students' characteristics such as prior knowledge and socioeconomic status and how these differences affect students' academic learning. They may signify the importance of reading books, magazines and newspapers and using technology for educational purposes during instruction, in curriculum and textbooks. Moreover, teachers may be in contact with parents to be aware of whether their children use computer and internet for educational purposes.

6.3 Recommendations for Further Research

In the present study**,** the contribution of cognitive and metacognitive strategy use to 7th grade students' science achievement and the effects of students' demographic characteristics on students' cognitive and metacognitive strategy use were examined. However, there may be some recommendations for further research illuminates the results of the present study. More research is necessary with different subject areas, at grade level and with different tasks due to the fact that every strategy is not equally useful in every subject area (Dowson & McInery, 1998) and students' strategy use depends on nature of academic task (Duncan & McKeachie, 2005). Moreover, both motivational beliefs and learning strategies components of MSLQ should be used in order to examine the relationships among students' motivational beliefs, their use of cognitive and self-regulatory strategies and academic outcomes. This study might provide with a general view about students' self-regulated learning. What is more, the findings of this study contribute to our understanding of demographic differences in strategy use and accomplishment. However, it is

clear that there should be more research to draw conclusions about demographic differences. Besides, the study was limited by its reliance on self-reported data. Subsequent research is needed to verify the consistency and accuracy of the present findings through use of multiple methods and measures.

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APPENDICES

APPENDIX A

PERMISSION OBTAINED FROM MINISTRY OF EDUCATION

1956

Orta Doğu Teknik Üniversitesi
Middle East Technical University

Öğrenci İşleri Dairesi
Başkanlığı
Registrar's Office

06531 Ankara, Türkiye
Phone: +90 (312) 2103417
Fax: +90 (312) 2107960
www.oidb.metu.edu.tr

19.02.2008
İlköğretim Fen ve Matematik Bölümü
SBE/2008-196

B.30.2.ODT.0.70.72.00/400 —1017 -217

14.2.2008

SOSYAL BİLİMLER ENSTİTÜSÜ MÜDÜRLÜĞÜ'NE

İLGİ: 26.12.2007 tarih ve B.30.2.ODT.0.E1.00.00/2007/400-1982-13755 sayılı yazınız.

İlgi yazınız T.C. Ankara Valiliği Milli Eğitim Müdürlüğü'ne iletilmiş olup, alınan yazı ve ekleri ilgisi nedeni ile ilişikte sunulmuştur.

Gereğini bilgilerinize arz ederim.

Saygılarımla.

Nesrin ÜNSAL
Öğrenci İşleri
Dairesi Başkanı

ÖĞRENCİ İŞLERİ
DAİRESİ BAŞKANLIĞI
Ev. Arş. Md. Sıra :

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

Bölüm : Strateji Geliştirme
Sayı : B B.08.4.MEM.4.06.00.04–312/10783
Konu : Araştırma İzni (Gülsüm AKYOL)

04.02.2008

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
Öğrenci İşleri Dairesi Başkanlığına

İlgi : a) 04.01.2008 tarih ve 243 sayılı yazınız.
b) 30.01.2008 tarih ve 312/9167 sayılı Valilik Oluru.

Üniversiteniz İlköğretim Fen ve Matematik alanları Eğitimi Anabilim Dalı Yüksek Lisans Programı öğrencisi Gülsüm AKYOL'un, **"Bilişsel ve Biliş Ötesi Strateji Kullanımının 7. Sınıf Öğrencilerinin Fen Başarılarına Katkıları."** konulu tez çalışması kapsamında; ekli listede belirlenen okullarda uygulama yapma isteği ilgi (b) Valilik Oluru ile uygun görülmüş olup, konu hakkında çalışmanın yapılacağı İlçe Milli Eğitim Müdürlüklerine bilgi verilmiştir.

Mühürlü anket örneği (5 sayfa 46 maddeden oluşan) yazımız ekinde gönderilmiş olup, uygulama yapılacak sayıda çoğaltılması ve çalışmanın bitiminde iki örneğinin (CD/disket) Müdürlüğümüz Strateji Geliştirme Bölümüne gönderilmesi hususunda bilgilerinizi ve gereğini rica ederim.

Murat Bey BALTA
Vali a.
Milli Eğitim Müdürü

EKLER :
1. Anket (5 sayfa)
2. Okul Listesi (1 Sayfa)
3. Valilik Onayı (1 Sayfa)

11.02.08 002621

T.C.
ANKARA VALİLİĞİ
İl Milli Eğitim Müdürlüğü

Bölüm : Strateji Geliştirme
Sayı : B B.08.4.MEM.4.06.00.04-312/ 9167 30/.01/2008
Konu : Araştırma İzni (Gülsüm AKYOL)

VALİLİK MAKAMINA
ANKARA

İlgi : a) MEB'e Bağlı Okul ve Kurumlarda Yapılacak Araştırma ve Araştırma Desteğine Yönelik İzin ve Uygulama Yönergesi.
b) ODTÜ Öğrenci İşleri Dairesi Başkanlığının 04.01.2008 tarih ve 243 sayılı yazısı.

Orta Doğu Teknik Üniversitesi İlköğretim Fen ve Matematik Alanları Eğitimi Anabilim Dalı Yüksek Lisans Programı öğrencisi Gülsüm AKYOL'un **"Bilişsel ve Biliş Ötesi Strateji Kullanımının 7. Sınıf Öğrencilerinin Fen Başarılarına Katkıları."** konulu tez önerisi ilgi (a) yönerge doğrultusunda Müdürlüğümüz Değerlendirme Komisyonu tarafından incelenmiş olup, (5 sayfa 46 maddeden oluşan) çalışmanın, ekli listede belirlenen okullarda, 2007-2008 Eğitim-Öğretim dönemi II. yarıyılında, gönüllülük esasına dayalı olarak uygulanması Müdürlüğümüzce uygun görülmüştür.

Makamlarınızca da uygun görüldüğü takdirde Olurlarınıza arz ederim.

Murat Bey BALTA
Milli Eğitim Müdürü

OLUR
28/01/2008
Mehmet KURDOĞLU
Vali Yardımcısı

EKLER :
1. Öğrenmede Güdüsel Stratejiler Anketi (3 sayfa, 31 madde)
2. Başarı Testi (2 sayfa, 15 madde)

APPENDIX B

BACKGROUND CHARACTERISTICS SURVEY

Sevgili Öğrenciler;

Bu çalışmada, sizlerin **fen** dersine yönelik öğrenme stratejilerinizi ve çalışma becerilerinizi belirlemek için; 1. bölümde 'Öğrenmede Güdüsel Stratejiler Anketi', 2. bölümde ise 'Fen Başarı Testi' uygulanacaktır.

Lütfen her cümleyi dikkatle okuduktan sonra, size uygun gelen seçeneği mutlaka işaretleyiniz.

Katkılarınızdan dolayı teşekkür ederim.

Gülsüm AKYOL
ORTA DOĞU TEKNİK ÜNİVERSİTESİ
Yüksek Lisans Öğrencisi

KİŞİSEL BİLGİLER

1. Cinsiyetiniz nedir?

(1) Kız (2) Erkek

2. Kardeş sayısı : .....

3. Doğum Tarihiniz (Yıl olarak belirtiniz): .....

4. Geçen dönemki Fen Bilgisi karne notunuz: .....

5. Anneniz çalışıyor mu?

(1) Çalışıyor (2) Çalışmıyor
(3) Düzenli bir işi yok (4) Emekli

6. Babanız çalışıyor mu?

(1) Çalışıyor (2) Çalışmıyor
(3) Düzenli bir işi yok (4) Emekli

Anne ve Babanızın eğitim düzeyi nedir?

7. Anne _____.	**8. Baba _____.**
(1) Hiç okula gitmemiş	(1) Hiç okula gitmemiş
(2) İlkokul	(2) İlkokul
(3) Ortaokul	(3) Ortaokul
(4) Lise	(4) Lise
(5) Üniversite	(5) Üniversite
(6) Yüksek Lisans	(6) Yüksek Lisans
(7) Doktora	(7) Doktora

9. Evinizde kaç tane kitap bulunuyor?
(Magazin dergileri, gazete ve okul kitapları **dışında**)

(1) Hiç yok ya da çok az (0 - 10)
(2) 11 - 25 tane
(3) 26 - 100 tane
(4) 101 - 200 tane
(5) 200 taneden fazla

10. Evinizde bir çalışma odanız var mı?

(1) Evet (2) Hayır

11. Ne kadar sıklıkla eve gazete alıyorsunuz?

(1) Hiçbir zaman (2) Bazen (3) Her zaman

12. Evinizde bilgisayarınız var mı?

(1) Evet (2) Hayır

13. Bilgisayarınızın internet bağlantısı var mı?

(1) Evet (2) Hayır

APPENDIX C

TURKISH VERSION OF THE MOTIVATED STRATEGIES FOR LEARNING QUESTIONNAIRE (MSLQ-TV)

Bu anket fen dersinde kullandığınız öğrenme stratejileri ve çalışma becerilerini belirlemeye yönelik ifadeler yer almaktadır. Cevap verirken aşağıda verilen ölçeği gözönüne alınız. **Eğer ifadenin sizi tam olarak yansıttığını düşünüyorsanız, 7' yi yuvarlak içine alınız. Eğer ifadenin sizi hiç yansıtmadığını düşünüyorsanız, 1' i yuvarlak içine alınız. Bu iki durum dışında ise 1 ve 7 arasında sizi en iyi tanımladığını düşündüğünüz numarayı yuvarlak içine alınız.**
Unutmayın; Doğru ya da Yanlış cevap yoktur yapmanız gereken sizi en iyi tanımlayacak numarayı yuvarlak içine almanızdır. **Tüm seçenekleri okuyup cevaplandırmanız araştırmanın geçerliliği için büyük önem taşımaktadır.**

1 --- 2 --- 3 --- 4 --- 5 --- 6 -- 7

beni hiç yansıtmıyor	**beni tam olarak yansıtıyor**	**Öğrenme Stratejileri**	**Beni hiç yansıtmıyor.**						**Beni tam olarak yansıtıyor.**
1.		Fen dersi ile ilgili birşeyler okurken, düşüncelerimi organize etmek için konuların ana başlıklarını çıkarırım.	1	2	3	4	5	6	7
2.		Fen dersi sırasında başka şeyler düşündüğüm için önemli kısımları sıklıkla kaçırırım.	1	2	3	4	5	6	7
3.		Fen dersi ile ilgili bir şeyler okurken, okuduklarıma odaklanabilmek için sorular oluştururum.	1	2	3	4	5	6	7
4.		Fen dersiyle ilgili duyduklarımı ya da okuduklarımı ne kadar gerçekçi olduklarına karar vermek için sıklıkla sorgularım.	1	2	3	4	5	6	7
5.		Fen dersine çalışırken, önemli bilgileri içimden defalarca tekrar ederim	1	2	3	4	5	6	7
6.		Fen dersi ile ilgili birşeyler okurken bir konuda kafam karışırsa, başa döner ve anlamak için çaba gösteririm.	1	2	3	4	5	6	7
7.		Fen dersine çalışırken, daha önce okuduklarımı ve aldığım notları gözden geçirir ve en önemli noktaları belirlemeye çalışırım.	1	2	3	4	5	6	7
8.		Eğer fen dersi ile ilgili okumam gereken konuları anlamakta zorlanıyorsam, okuma stratejimi değiştiririm.	1	2	3	4	5	6	7
9.		Fen dersine çalışırken, dersle ilgili okumaları ve ders sırasında aldığım notları defalarca okurum	1	2	3	4	5	6	7
10.		Ders sırasında veya ders için okuduğum bir kaynakta bir teori, yorum ya da sonuç ifade edilmiş ise, bunları destekleyen bir bulgunun var olup olmadığını sorgulamaya çalışırım.	1	2	3	4	5	6	7
11.		Dersle ilgili konuları organize etmek için basit grafik, şema ya da tablolar hazırlarım.	1	2	3	4	5	6	7
12.		Fen dersinde işlenen konuları bir başlangıç noktası olarak görür ve ilgili konular üzerinde kendi fikirlerimi oluşturmaya çalışırım.	1	2	3	4	5	6	7
13.		Fen dersine çalışırken, dersten, okuduklarımdan, sınıf içi tartışmalardan ve diğer kaynaklardan edindiğim bilgileri biraraya getiririm.	1	2	3	4	5	6	7
14.		Yeni bir konuyu detaylı bir şekilde çalışmaya başlamadan önce çoğu kez konunun nasıl organize edildiğini anlamak için ilk olarak konuyu hızlıca gözden geçiririm.	1	2	3	4	5	6	7
15.		Fen dersinde işlenen konuları anladığımdan emin olabilmek için kendi kendime sorular sorarım.	1	2	3	4	5	6	7
16.		Çalışma tarzımı, dersin gereklilikleri ve öğretmenin öğretme stiline uygun olacak tarzda değiştirmeye çalışırım.	1	2	3	4	5	6	7

17.	Genelde derse gelmeden önce konuyla ilgili birşeyler okurum fakat okuduklarımı çoğunlukla **anlamam**	①②③④⑤⑥⑦
18.	Fen dersindeki önemli kavramları hatırlamak için anahtar kelimeleri ezberlerim.	①②③④⑤⑥⑦
19.	Fen dersine çalışırken, konuları sadece okuyup geçmek yerine ne öğrenmem gerektiği konusunda düşünmeye çalışırım.	①②③④⑤⑥⑦
20.	Mümkün olduğunca fen dersinde öğrendiklerimle diğer derslerde öğrendiklerim arasında bağlantı kurmaya çalışırım.	①②③④⑤⑥⑦
21.	Fen dersine çalışırken notlarımı gözden geçirir ve önemli kavramların bir listesini çıkarırım.	①②③④⑤⑥⑦
22.	Fen dersi için birşeyler okurken, o anda okuduklarımla daha önceki bilgilerim arasında bağlantı kurmaya çalışırım.	①②③④⑤⑥⑦
23.	Fen dersinde öğrendiklerimle ilgili ortaya çıkan fikirlerimi sürekli olarak gözden geçirmeye çalışırım.	①②③④⑤⑥⑦
24.	Fen dersine çalışırken, dersle ilgili okuduklarımı ve derste aldığım notları inceleyerek önemli noktaların özetini çıkarırım.	①②③④⑤⑥⑦
25.	Fen dersiyle ilgili konuları, ders sırasında öğrendiklerim ve okuduklarım arasında bağlantılar kurarak anlamaya çalışırım.	①②③④⑤⑥⑦
26.	Fen dersindeki konularla ilgili bir iddia ya da varılan bir sonucu her okuduğumda veya duyduğumda olası alternatifler üzerinde düşünürüm	①②③④⑤⑥⑦
27.	Fen dersinde önemli kavramların listesini çıkarır ve bu listeyi ezberlerim.	①②③④⑤⑥⑦
28.	Fen dersine çalışırken iyi anlamadığım kavramları belirlemeye çalışırım.	①②③④⑤⑥⑦
29.	Fen dersine çalışırken, çalışmalarımı yönlendirebilmek için kendime hedefler belirlerim.	①②③④⑤⑥⑦
30.	Ders sırasında not alırken kafam karışırsa, notlarımı dersten sonra düzenlerim.	①②③④⑤⑥⑦
31.	Fen dersinde, okuduklarımdan edindiğim fikirleri sınıf içi tartışma gibi çeşitli faaliyetlerde kullanmaya çalışırım.	①②③④⑤⑥⑦

Katıldığınız için teşekkür ederiz.

APPENDIX D

SCIENCE ACHIEVEMENT TEST

EK 6 - FEN BAŞARI TESTİ

1. Hangi salgı bezinin salgıladığı hormon doğru verilmiştir?

A) Hipofiz bezi – Büyüme hormonu
B) Böbrek üstü bezi – İnsülin hormonu
C) Pankreas – Adrenalin hormonu
D) Tiroit bezi – Glukagon hormonu

2. Nergis çiçeği bulunan bir odada uzun süre kaldığımızda, çiçeğin kokusunu alamaz hale geliriz. Odaya fırından yeni çıkmış ekmek getirilirse kokusunu hemen alırız.

Bu durumu aşağıdaki ifadelerden hangisi açıklar?

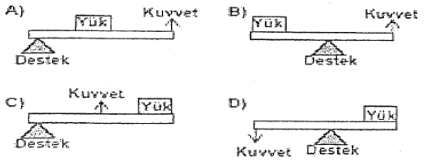
A) Alışkın olduğumuz tat ve kokuları, duyu sinirleri daha net algılar.
B) Bir maddeye karşı duyarsızlaşan duyu sinirleri, başka maddeyi algılayabilir.
C) Bir kokunun net olarak algılanmasında hafızamız etkilidir.
D) Koku ve tat alma duyu sinirleri birbiriyle bağlantılı çalışır.

3. Aşağıdakilerden hangisi vücudumuzdaki zararlı maddelerin dışarı atılmasında görevli **<u>değildir</u>**?

A) Karaciğer B) Böbrek
C) Akciğer D) Deri

4. İnsan vücudunda karbonhidratların sindirimi nerede tamamlanır?
A) Ağızda
B) Midede
C) İnce Bağırsakta
D) Kalın Bağırsak

5. Aşağıdaki şekillerde verilen kaldıraçların hangisinde yatay konumda denge **<u>sağlanamaz</u>**? (Çubukların ağırlıkları önemsizdir.)

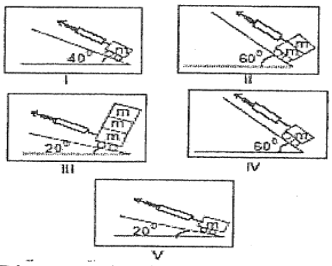


6. Aşağıdaki bilgilerden hangileri doğrudur?

I-Reosta ile akım şiddeti ayarlanabilir.
II-Ampermetre ile akım şiddeti ölçülür.
III-Voltmetre ile gerilim ölçülür.

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

7.

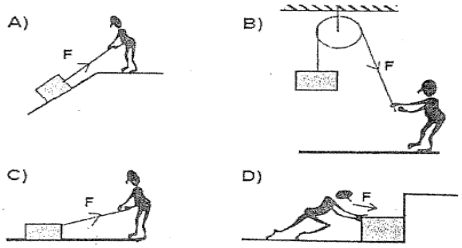


Bir öğrenci eğik bir düzlem üzerindeki kütleyi yukarı doğru sabit hızla çeken kuvvetin, eğik düzlem açısı ile ilişkili olduğunu göstermek istiyor.
Buna göre yukarıdaki düzeneklerden hangilerinin kullanılması **<u>en uygundur</u>**?

A) I, II ve IV B) I, III ve V
C) I, IV ve V D) II, III ve V

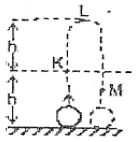
8. Fiziksel anlamda iş yapılabilmesi için;
- Kuvvet uygulanmalı
- Kuvvet etkisindeki cisim yol almalıdır.

Buna göre aşağıdakilerden hangisinde **<u>kesinlikle</u>** iş **<u>yapılmaz</u>**?

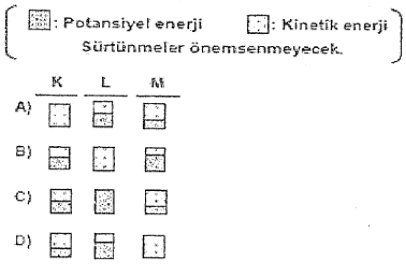


1

9.

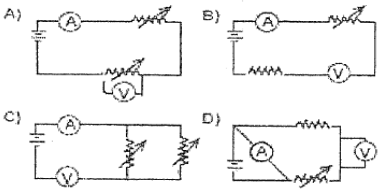


Şekilde düşey doğrultuda yukarı doğru atılan bir topun izlediği yol görülmektedir. Buna göre; topun K, L, M noktalarındaki potansiyel ve kinetik enerji dağılımları hangisindeki gibi olur?

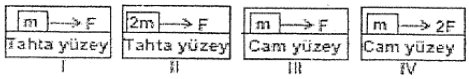


10. Aşağıdakilerden hangisinde devre elemanları doğru bağlanmıştır?

(: Değişken direnç)



11.



Sürtünme kuvvetinin, birbirine sürtünen iki yüzeyin cinsine bağlı olduğunu kanıtlamak isteyen bir öğrenci yukarıda verilen deney düzeneklerinden hangilerini kullanmalıdır?

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

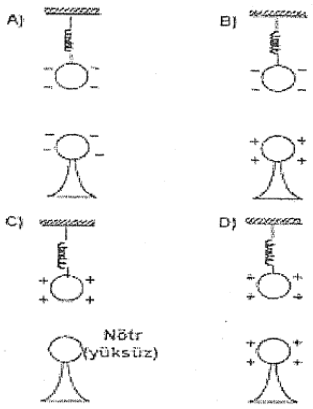
12. Cam bir çubuğun, ipek eşarba sürtülmesi sonucunda pozitif olarak yüklendiği görülüyor. Buna göre aşağıdakilerden hangisi doğrudur?

A) Cam çubuğa eşarptan pozitif yük geçmiştir.
B) Cam çubuktan eşarba negatif yük geçmiştir.
C) Cam çubuktan eşarba pozitif yük geçmiştir.
D) Eşarp, nötr hale gelmiştir.

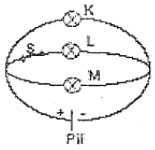
13. Biri (-) yüklü diğeri nötr iki küre birbirine dokundurulduğunda kürelerin son yük durumu aşağıdakilerden hangisindeki gibi olur?

a) Her ikisi de (−) yüklü
b) Her ikisi de nötr
c) Her ikisi de (+) yüklü
d) Zıt yüklü

14. Birbirine aynı uzaklıkta özdeş küre ve yaylardan yapılmış aşağıdaki sistemlerden hangisinde yayın uzaması **en fazla** olması beklenir?



15.



Özdeş ampullerle kurulu şekildeki devrede S anahtarı açıldığında K ve M ampullerinin parlaklıkları için aşağıdakilerden hangisi doğru olur?

	K	M
A)	Değişmez	Artar
B)	Artar	Artar
C)	Azalır	Azalır
D)	Değişmez	Değişmez