PREDICTING ACADEMIC ACHIEVEMENT WITH COGNITIVE AND MOTIVATIONAL VARIABLES

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ABSTRACT

PREDICTING ACADEMIC ACHIEVEMENT WITH COGNITIVE AND MOTIVATIONAL VARIABLES

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This study aimed at investigating the contribution of motivational beliefs (intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy and test anxiety), cognitive and metacognitive strategy use (rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, help seeking) to Turkish high school students' achievement in biology.

In this study Turkish version of the Motivated Strategies for Learning Questionnaire developed by Pintrich, Smith, Garcia, and McKeachie (1991) and a Biology Achievement Test developed by the researcher were used as measuring instruments. The study was conducted in 15 selected schools throughout the five districts in Yozgat (Sorgun, Yerköy, Boğazlıyan and Saraykent districts and city

center) with a total of 519 tenth grade General and Anatolian high school students attending Mathematics and Science group in spring 2004–2005 semester.

The data obtained from the administration of the measuring instruments were analyzed by using Multiple Linear Regression Analyses and a Canonical Correlation Analysis.

Results of the statistical analyses indicated that extrinsic goal orientation and task value each made a statistically significant contribution to the prediction of students' achievement ($p < 0.05$), while intrinsic goal orientation, control of learning beliefs, self-efficacy for learning and performance, and test anxiety failed to achieve significance ($p > 0.05$). Rehearsal strategy use, organization strategy use, management of time and study environment, and peer learning each made a statistically significant contribution to the prediction of students' achievement in biology. The first pair of canonical variates indicated that higher levels of intrinsic goal orientation, task value, and self-efficacy for learning and performance were associated with higher levels of cognitive and metacognitive strategy use except rehearsal strategy use and help seeking.

Keywords: Biology Achievement, Motivational Beliefs, Cognitive and Metacognitive Strategy Use, Self-regulatory Skills.

ÖZ

BİLİŞSEL VE GÜDÜSEL DEĞİŞKENLERİN BAŞARIYA OLAN KATKISININ İNCELENMESİ

YUMUŞAK, Necmettin
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Bu çalışmanın amacı; güdüsel inançların, bilişsel ve biliş-ötesi strateji kullanımının Türk lise öğrencilerinin biyoloji dersindeki başarılarına olan katkısını incelemektir.

Bu çalışmada, ölçüm araçları olarak 1991'de Pintrich, Smith, Garcia, ve McKeachie tarafından geliştirilmiş olan Öğrenmede Güdüsel Stratejiler Anketi'nin Türkçe versiyonu ve araştırmacı tarafından geliştirilen Biyoloji Başarı Testi kullanılmıştır. Bu çalışma, 2004–2005 ilkbahar döneminde, Yozgat'ın beş ilçesindeki (Sorgun, Yerköy, Boğazlıyan, Saraykent ve şehir merkezi) 15 Genel Lise ve Anadolu Lisesinden seçilen 519 onuncu sınıf Matematik ve Fen grubu öğrencisi ile gerçekleştirilmiştir.

Elde edilen veriler, Çoklu Doğrusal Regresyon ve Kanonik Korelâsyon analizi kullanılarak değerlendirilmiştir.

İstatistiksel sonuçlar, dışsal hedef ve öğrencilerin biyoloji dersini önemli ve faydalı görmelerinin başarı tahminine anlamlı bir katkı yaptığını göstermiştir ($p < 0.05$). Bu arada içsel hedef, öğrenme inancı kontrolü, öğrenme ve başarım için öz-yeterlilik ve sınav kaygısı gibi güdüsel inançların anlamlı bir katkı yapmadığını göstermiştir ($p > 0.05$). Anlatım, örgütleme, zaman yönetimi ve çalışma ortamı ve akran eğitimi stratejilerinin her birinin kullanımı da öğrencilerin başarı tahminine anlamlı bir katkı yapmıştır. Birinci kanonik olasılıksal değişken çifti; yüksek seviyelerdeki içsel hedef, öğrencilerin biyoloji dersini önemli ve faydalı görmeleri ve öğrenme ve başarım için öz-yeterlilik inançlarının; tekrar ve yardım araştırması dışındaki yüksek seviyelerdeki bilişsel ve biliş-ötesi strateji kullanımlarıyla ilişkili olduğunu göstermiştir.

Anahtar Kelimeler: Biyoloji Başarısı, Güdüsel İnançlar, Bilişsel ve Biliş-ötesi Strateji Kullanımı, Öz-düzenleme Becerileri.

To My Parents

Gülbahar and Arif YUMUŞAK

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TABLE OF CONTENTS

LIST OF TABLES

TABLE

LIST OF FIGURES

FIGURE

LIST OF SYMBOLS

SYMBOLS

MSLQ :	The Motivated Strategies for Learning Questionnaire
MSLQ-TV :	Turkish version of the Motivated Strategies for Learning Questionnaire
BAT :	Biology Achievement Test
GPA :	Grade Point Average
Ho :	Null Hypothesis
SD :	Standard Deviation
DV :	Dependent Variable
IV :	Independent Variable
RMSEA :	Root Mean Square Error of Approximation
GFI :	Goodness of Fit Index
χ^2:	Chi-Square
df :	Degree of Freedom
MCQ :	Multiple Choice Question
p :	Significance Level
IGO :	Intrinsic Goal Orientation
EGO :	Extrinsic Goal Orientation
TV :	Task Value
CLB :	Control of Learning Beliefs
SELP:	Self- Efficacy for Learning and Performance
TA :	Test Anxiety

R:	Rehearsal
E :	Elaboration
O:	Organization
CT :	Critical Thinking
MSR :	Metacognitive Self-regulation
TSE :	Time And Study Environment
ER :	Effort Regulation
PL :	Peer Learning
HS:	Help Seeking
ACHİE :	Achievement
N :	Sample Size
SAL :	Student Approach to Learning

CHAPTER 1

INTRODUCTION

The topic of learning and achievement has been of interest since the early 1900s. The work of many prominent researchers has lead to a better understanding of how factors such as human behavior, personality, and motivation influence individual learning. Over the past 30 years, the framework for understanding the psychological basis of learning has gradually shifted from a teacher-centered approach to a student-centered approach. Academic researchers experienced a paradigm shift, changing their view of the learner as a passive member of the process to a very active. The idea that students were key persons responsible for their own learning, despite how material was presented, was a major shift in thinking. Accordingly, the students who become aware of and reason about conceptual relations and construct their own conceptualizations and solutions to problem. Hence, they should be independent learners from teachers during their lives. For these students, learning is a process under their control, in which they make task assessments, choose specific strategies to best suit those tasks, monitor their progress, and if need be, reassess or adjust their strategies. This type of learning obviously offers a great deal more autonomy and responsibility to the students and they provide multiple opportunities for contextual control and regulation.

Educational research reveals that independent learners demonstrate motivation by striving to do their very best work, maintaining confidence that they would succeed, and by attributing their performance to factors within their control.

In short, they also demonstrate a high level of self-regulation, which involves complex interactions among students' cognitive processing, motivational beliefs, and metacognitive thinking (Pintrich & Linnenbrink, 2000; Schunk & Zimmerman, 1997). Therefore, researchers turned their attention to the researches about motivational components, cognitive components and self-regulated learning and their relations with each other.

Recent research on self-regulated learning has focused on the importance of integrating motivational and cognitive components of classroom learning. Although there are various models proposed for self-regulated learning which propose different constructs and conceptualizations (Boekaerts, 1997; Pintrich, 2000; Winne & Perry, 2000; Zimmerman, 2000), most models assume that an important aspect of self-regulated learning is the students' use of various cognitive and metacognitive strategies to control and regulate their learning and their motivation to use these strategies and regulate their cognition and effort (Pintrich & DeGroot, 1990; Pintrich, 1999; VanderStoep, Pintrich, & Fagerlin, 1996). For example, according to Zimmerman's (1989, 2000, 2002) model based on social cognitive theory, self-regulation can be viewed as the interaction of personal, behavioral, and environmental triadic and at the same time cyclic processes (Bandura, 1986 as cited in Zimmerman, 2000). Personal processes include students' knowledge, metacognitive processes, goals and affect while behavioral processes include self-observation, self-judgment, and self-reaction. Enactive outcomes, modeling, and verbal persuasion constitute environmental processes. Based on social cognitive theory, these self-regulatory processes and accompanying beliefs fall into three cyclical phases: forethought, performance or volitional control and self-reflection. Forethought involves task analysis and self-motivational beliefs. Performance or volitional control refers to processes occurring during motoric efforts and action such as self-control and self-observation. Self-reflection involves self-judgment and self-reaction. Therefore, self-reflection includes processes that occur after performance efforts and affect an

individual's response to that experience while forethought includes processes that precede efforts to act.

Similarly, according to Pintrich's (2000, 2004) framework for self-regulated learning inspired by social cognitive theory, self-regulated learning is composed of four phases, namely forethought, monitoring, control, and reflection phases. Accordingly, the self-regulatory activities taking place in the forethought phase involve goal setting, prior content knowledge activation, metacognitive knowledge activation, efficacy judgments, time and effort planning, and perceptions of task. The monitoring phase concerns metacognitive awareness of different aspects of self and task or context. The control phase consists of selection and adaptation of cognitive strategies for learning, thinking, motivation and affect, and regulation of effort, task, and context. The reflection phase involves cognitive judgments, affective reactions, making choices, and evaluations of the task. Self-regulatory activities for each phase include the regulation of cognition, motivation and affect, behavior, and context. Accordingly, self-regulation can be defined as an active, constructive process whereby students 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 contextual features in the environment (Wolters, Pintrich, & Karabenick, 2003). In fact, the models of Pintrich and Zimmerman drawn on the social cognitive theory define self-regulation as a goal-oriented process, proceeding from a forethought phase through self-monitoring and self-control to self-reflection (Puustinen & Pulkkinen, 2001).

Therefore, it is clear that the two models are similar to each other regarding their background theory and definition of self-regulation. In both models, students are considered as active participants in the learning process with a goal against which they can assess their progress. In addition, the developers of both models have conducted similar empirical research to study self-regulation; both have investigated students' motivation in relation to their use of learning strategies and

academic achievement (Puustinen & Pulkkinen, 2001). For instance, Zimmerman and Martinez-Pons (1986) studied the predictive power of students' gender, socio economic status, and self-regulated learning strategy in academic achievement. They found that when compared to other measures, self-regulated learning strategies, such as reviewing notes, organizing, and goal settings were the best predictors of standardized achievement scores. Moreover, the study conducted by Zimmerman and Martinez-Pons (1990) showed that students' use of self-regulated learning strategies and their perceived verbal and mathematical self-efficacy were correlated with each other. Similarly, Pintrich, Smith, Garcia, and McKeachie (1993) reported that students' motivation, their use of various cognitive and metacognitive strategies, and their achievement were all related with each other.

Despite the similarities, there are, however, some differences between the two models. For instance, Pintrich's (2000) framework for self-regulated learning mainly focuses on the role of goal orientations in self-regulation. In addition, while Zimmerman's model concentrates on cyclical nature of the phases -forethought, monitoring, control, and reflection, Pintrich's model emphasizes the regulation of cognition, motivation and affect, behavior, and context in all phases. For example, according to Pintrich's framework for self-regulated learning, in the forethought phase, activation of prior knowledge or metacognitive knowledge involves the regulation of cognition. Motivational processes subject to regulation in this phase include goal orientations, self-efficacy, and task value. Behavioral regulation includes time and effort planning and planning for self-observation. Finally, contextual regulation involves students' perceptions of task and context (Schunk, 2005).

In sum, even though the models of self-regulation based on social cognitive theory are not identical, both emphasize the role of motivation in regulating behavior directed at accomplishing a task or activity. According to these models, when students engage in a task, they have to monitor their behavior, judge its

outcomes, and react to those outcomes to regulate what they do (Eccles & Wigfield, 2002).

Based on the social cognitive and information processing perspective of self-regulation, Pintrich, Smith, Garcia, and McKeachie developed and finalized a version of the Motivated Strategies for Learning Questionnaire (MSLQ) in the early 1990's to measure some aspects of the self-regulated learning, more specifically motivational beliefs and the use of various learning strategies. The MSLQ was used by many researchers to measure components of self-regulation and to determine its relation to students' academic achievement (Pintrich & DeGroot, 1990; Pintrich et al., 1993; VanderStoep et al., 1996; Wolters & Pintrich, 1998; Neber & Schommer-Aikins, 2002). In fact, the MSLQ contains five scales as indicators of cognitive regulation by students; namely rehearsal, elaboration, organization, critical thinking, and metacognitive self-regulation (see Table 1.1). Some measures of the monitoring and control activities for cognition, which were proposed by Pintrich's framework for self-regulated learning and some performance or volitional control activities suggested by Zimmerman's model are provided by these scales. As regards the regulation of motivation and affect, the MSLQ does not contain any scales assessing the use of related strategies but there are scales in the MSLQ measuring students' motivational beliefs such as intrinsic goal orientation, task value, self-efficacy for learning and performance, and test anxiety, which are mainly stressed in the forethought phase in Zimmerman's model. In Pintrich's framework, regulation of motivation and affect was emphasized in each phase. Concerning the regulation of behavior, there are three scales on the MSLQ measuring how well students regulate their effort in the face of uninteresting and difficult tasks, manage their time and study environment, and identify someone to provide assistance. In fact, both Zimmerman' model and Pintrich's framework for self-regulated learning based on social cognitive theory gave emphasis to such self-regulatory strategies as environmental structuring, help seeking, time management, and controlling performance. Finally, the MSLQ has

two scales relevant to the regulation of context, namely, peer learning, and time and study environment. These scales provide a measure of how well students use peers as a resource for learning and how well they manage their time and study environment. However, there are no scales reflecting students' perception of the task and context and their understanding and monitoring of the context (Pintrich, 2004).

Table 1.1 Scales of the MSLQ

	Scale	Areas for Regulation	Number of Items
Motivation	Intrinsic Goal Orientation	Motivation/Affect	4
	Extrinsic Goal Orientation	Motivation/Affect	4
	Task Value	Motivation/Affect	6
	Control of Learning Beliefs	Motivation/Affect	4
	Self-Efficacy for Learning and Performance	Motivation/Affect	8
	Test Anxiety	Motivation/Affect	5
Strategy Use	Rehearsal	Cognition	4
	Elaboration	Cognition	6
	Organization	Cognition	4
	Critical Thinking	Cognition	5
	Metacognitive Self-Regulation	Cognition	12
	Time and Study Environment	Behavior & Context	8
	Effort Regulation	Behavior	4
	Peer Learning	Context	3
	Help Seeking	Behavior	4

As it can be seen, the MSLQ has some limitations in measuring all aspects of self-regulation. However, the content validity of the MSLQ has been supported through extensive research on college student learning and teaching (Gable, 1998) and it has been used successfully with high school students (Barlia & Beeth, 1999; Higgins, 2000). The scales show moderate correlations with academic performance (Schunk, 2005). In fact, results of the study conducted by Pintrich et al. (1993) showed that all motivational scales of the MSLQ were significantly correlated with final grade, except for extrinsic goal orientation. Correlation coefficients ranged from 0.13 to 0.41. Similarly, the learning strategy scales were significantly correlated with final grade except for rehearsal, peer learning, and help seeking. Correlation coefficients ranged from 0.17 to 0.32. All the significant correlation coefficients were positive, except for test anxiety. Moreover, VanderStoep et al. (1996) using the MSLQ to assess students motivational beliefs (i.e. intrinsic orientation, task value, and self-efficacy) and self-regulated learning (i.e. rehearsal, elaboration, organization, and metacogniton) found that these variables along with knowledge variable distinguish high and low achieving students in biology and psychology. In addition, Pintrich and De Groot (1990) who used an earlier version of the MSLQ reported that self-regulation, self-efficacy, and test anxiety significantly predicted students' performance. Except for test anxiety, all the correlations were positive. In sum, the studies using the MSLQ, in general, revealed that except for test anxiety, the correlations between the scales of the MSLQ and achievement, and the correlations among the scales were all positive. The MSLQ scores were found to be good predictors of achievement.

Therefore, the studies conducted to investigate the relationship of self-regulatory processes to student achievement revealed that self-regulated learning is highly related to the quality of learning and that the use of internalized self-regulatory strategies promotes student achievement. In fact, self-regulated learners can initiate learning tasks, determine their own goals, use appropriate strategies to achieve these goals, and then monitor and evaluate their own learning. They are

motivated to use the strategies as well as to regulate their cognition and effort. In fact, cognitive and metacognitive skills are of little value, if students are not motivated to use them (Pintrich & DeGroot, 1990; McCoach & Siegle, 2003). Therefore, self-regulated learners are likely to achieve at higher levels than students who are passive in their learning and depend on teachers for performing these same functions (Risemberg & Zimmerman, 1992).

1.1 Significance of the Study

It should be noted that the importance of self-regulation in academic achievement has been well established almost exclusively for American students. There are a few studies conducted in other countries (Alexander & Dochy, 1995: Purdie & Hattie 1996; Kuyper, Van der Werf, & Lubbers, 2000; Puustinen & Pulkkinen, 2001). Therefore, there is need for research on theoretical models and practical implications of self-regulation in different countries to determine the generalizability of the findings. This study aims to fill these gaps in the literature. Actually, careful examination and validation of theory and research on self-regulation can bring about profitable use of models and applications. On the other hand, uncritical use of models and principles to make students more self-regulated learners may not necessarily result in better academic achievement in all countries since countries may differ in values and beliefs about education and opportunities offered to students (Olaussen & Braten, 1999). In fact, students' use of self-regulatory skills may vary even for different courses depending on the nature of the academic tasks (Duncan & McKeachie, 2005). In line with this idea, present study aimed at determining which self-regulatory learning processes are related to Turkish high school students' achievement in biology course. Actually, current study can be considered as a starting point for a range of research that can be conducted with an ultimate aim of determining the importance of self-regulation in academic achievement among Turkish students in different courses.

CHAPTER 2

REVIEW OF THE LITERATURE

This literature review starts by discussing "What is motivation?", "How can it affect learning?", the effects of motivational variables, and then continues with the effects of cognitive variables, and then self-regulated learning and specifically the effects of self-regulation on learning.

2.1 What is motivation?

Trying to define or explain a complex concept like motivation is extremely difficult. The term motivation is derived from the Latin verb *movere*. The word "motivation" means, "to move". This has been captured in a definition offered by George Miller (1962); "The study of motivation is the study of all those pushes and prods - biological, social, and psychological - those defeat our laziness and move us, either eagerly or reluctantly, to action". For this reason, it can be said that the study of motivation is the study of action. However, it should be noted that there are different definitions of motivation and it has been conceptualized in different ways reflecting variety of views. For example, while early views associated motivation with inner forces such as instincts and traits, current cognitive views focus on thoughts, beliefs, and emotions in relation to motivation (Pintrich & Schunk, 2002). For example, early studies on motivation by Atkinson (1957) and others focused particularly, and sometimes very narrowly, on whether a person would choose to invest in one course of action or another (Maehr, 2005). On the other hand, according to the current cognitive focus, motivation involves

processes whereby goal-directed activity is instigated and sustained (Pintrich & Schunk, 2002). In line with later approach, motivation theorists became interested in the ways in which motivation and cognition work together. For example, Winne and Marx (1989) posited that motivation should be conceived in cognitive processing terms, and that motivational thoughts and beliefs are governed by the basic principles of cognitive psychology, differing from other thoughts and beliefs only in their content. Based on a cognitive perspective, motivation can be characterized as either a product or a process (Winne & Marx, 1989). It can be looked as a product or state, motivation refers to a learner's willingness to engage in and persist at a task. At any particular time, learners are motivated that they experience phenomenological and that influences their choice, effort, and persistence regarding a particular activity. For instance, learners can experience the phenomenological state of being interested, feeling self-efficacious, or wanting to master an activity. Motivation also can be thought as the process or processes that account for learners' level of motivation or goal-directed behavior (Pintrich & Schunk, 2002). From this angle, motivation refers not just to an end state but also to the means through which that state is determined, and more generally to the cognitive processes that govern learners' choice, effort, and persistence (Winne & Marx, 1989). For example, motivation would include the processes that account for a learner being interested, feeling self-efficacious, or wanting to master a task and the impact of these states on learners' behavior.

Similarly, Bandura (1991) studied how motivation and cognition can be combined into cognitive-motivational perspective. Accordingly, he defined motivation as multidimensional phenomenon indexed in terms of selection of pursuits from competing alternatives, intensity of effort, and persistence of exertion'. Moreover, Pintrich and colleagues (2000) suggested that the cognitive and motivational are all related with each other as well as being related with the social context in which the learning is happening.

There are some studies in the literature that investigated relationships among motivational variables and achievement as well as cognitive variables. Pintrich and De Groot (1990) conducted a study to determine these relationships. In their study, they examined relations among self-regulation (use of metacognitive and effort management strategies), cognitive strategy use (rehearsal, elaboration, and organizational strategies), and motivation for learning and performing well in class among seventh graders in science and English. Using the MSLQ, they found that students' achievement values determined initial engagement decisions, and then their self-efficacy facilitated both engagement and performance in conjunction with use of cognitive and self-regulatory strategies. In addition, Pintrich, Marx, and Boyle (1993) presented a more fully articulated discussion of links of motivation and cognition, with specific reference to conceptual change. They described and provided preliminary evidence of how various classroom and motivational factors such as goals, achievement values, efficacy beliefs, and control beliefs can influence whether students change their mental concepts.

In general, results of the studies revealed the relationships among motivational variables, cognitive variables, and academic achievement. In line with these findings, current study aimed at determining the contribution of motivational beliefs, cognitive and metacognitive strategy use to Turkish high school students' achievement in biology. Also, present study aimed at determining relationships among motivational and cognitive variables in high school biology courses. In the following sections, different motivational variables and their relation to achievement and cognitive variables will be discussed.

2.2 Motivational Variables

2.2.1 Goal Orientations

Motivation researchers have become very interested in learners' goal orientations and their relation to academic achievement (see Ames, 1992; Covington, 2000; Dweck, 1999; Pintrich, 2000; Eccles & Wigfield, 2002). Goal orientation theory deals with the purpose and meaning that an individual attaches to achievement behavior (Ames, 1992). Dweck and Leggett (1988) explained this phenomenon of different response pattern in face of failures by conceptualization of goals: "goals individuals are pursuing create the framework within which they interpret and react to events". Goal orientations concern the purposes for engaging in achievement behavior. In addition, it reflects a way that individuals come to define and judge their performance in terms of some standards of excellence (Elliot, 1997).

As Pintrich and Schunk (2002) suggested there may be number of different goal orientations relevant to academic achievement, however, two of them are always emphasized in different goal orientation theories with labels of learning versus performance (Elliot & Dweck, 1988; Miller, Behrens, Grene, & Newman 1993); task versus ego (Fox, Goudes, Biddle, Duda, & Armstrong, 1994); mastery versus performance (Ames &Archer, 1988; Cho, 1992); and task mastery, ego-social, and work-avoidant (Meece, Blumenfeld, & Hoyle, 1988; Meece & Holt, 1993; Nolen & Haladyna, 1990). In the present study, goal orientations will be categorized as intrinsic and extrinsic goal orientations.

Intrinsic goal orientation refers to a concern with learning and mastering the task using self-set standards and self-improvement. In intrinsic goal orientation, achievement is represented as mastery and understanding with an emphasis on self-development. Therefore, students who adopt an intrinsic goal orientation are focused on learning, mastery of the material and this goal orientation leads them to make attributions to effort, and to base their self-efficacy

judgments on the idea that effort will lead to success and mastery (Ames, 1992). Under the intrinsic goal orientation, such positive self-efficacy beliefs can be enhanced while feelings of test anxiety can be lessened. In fact, findings in the literature suggest that intrinsic goal orientation would be positively related to self-efficacy and task value beliefs and negatively related to test anxiety. The research has indicated that students pursuing intrinsic goals reveal higher levels of task value, efficacy (Ames & Archer, 1988), and interest (Harackiewicz, Barron, Tauer & Elliot, 2002). They are also cognitively more engaged by using metacognitive and cognitive strategies (Meece, Blumenfeld, & Hoyle, 1988; Pintrich & De Groot, 1990), seeking challenge (Elliot & Dweck, 1988), demonstrating persistence (Elliot, McGregor, & Gable, 1999), and showing lower levels of anxiety (Ames, 1992). For example, Benmansour's (1999) study explored Moroccan high school students' perceived motivational orientations, self-efficacy, test anxiety, and strategies used in mathematics. The findings indicated that self-efficacy was related to higher intrinsic goal orientations, lower test anxiety, and use of a wider repertoire of strategies including active ones. In terms of frequency of use of active and passive learning strategies, all students far more frequently used passive ones, but intrinsically motivated students were more likely to use active ones as well as passive ones.

On the other hand, extrinsic goal orientation represents a focus on demonstrating competence or ability and how ability will be judged relative to others, for example, trying to surpass normative performance standards, attempting to best others, and seeking public recognition of high performance levels (Ames, 1992; Dweck & Leggett, 1998). In addition, this goal orientation is often connected with grades and other extrinsic rewards rather than an interest in learning (Ames, 1992; Dweck & Leggett, 1998). Accordingly, extrinsic goal orientation includes a focus on getting good grades and pleasing others as the main criterion for judging success. Thus, students who adopt a performance goal orientation are assumed to be focused on their performance relative to others, to be

concerned about demonstrating their ability, and to be centered on their self-worth (Ames, 1992). This goal orientation should cause to less adaptive attributional patterns such as attributing failure to lack of ability and lower perceptions of competence and self-efficacy (Wolters, Yu, & Pintrich, 1996). In general, extrinsic goals have been associated with maladaptive learning patterns including the use of superficial learning strategies (Meece et al., 1988), avoidance of taking on challenging learning tasks (Dweck & Leggett, 1988), and anxiety following failure (Jagacinski & Nicholls, 1987).

In general, findings in the literature suggest that intrinsic goal orientation is positively related to a number of motivational and cognitive processes, which should result in positive performance outcomes, while an extrinsic goal orientation can generate negative motivational and cognitive processes with concomitant negative performance outcomes (Pintrich & Schunk, 1996). In fact, Pintrich (1999) showed that intrinsic goal orientations were strongly positively related to the use of cognitive strategies as well as self-regulatory strategies and intrinsic goals were related to the actual performance in the class. However, according to the same study, performance or extrinsic goal orientation showed consistent negative relations to self-regulated learning and performance.

2.2.2 Expectancy-Value Theory, Self-efficacy, and Task Value

Some theorists, who are dealing with achievement motivation, try to explain people's choice of achievement tasks, persistence on those tasks, power in carrying them out, and performance on those tasks (Eccles, Wigfield, & Schiefele, 1998; Pintrich & Schunk, 1996). Accordingly, there are many theories in the literature focusing on individuals' beliefs about their competence and efficacy, expectancies for success or failure, and sense of control over outcomes. These beliefs are directly related to the question, "Can I do this task?" (Eccles, Wigfield, & Schiefele, 1998). In general, when people answer this question in a positive way, they tend to perform better and be motivated to select tasks that are more

challenging. Expectancy-value theorists claim that individuals' choice, persistence, and performance can be explained by their beliefs about how well they will do on the activity and the extent to which they value the activity (Atkinson, 1957; Eccles, Adler, Futterman, Goff, & Kaczala, 1983; Wingfield, 1994; Wingfield & Eccles, 1992). The most recent statement of expectancy-value model proposed by Eccles et al. is presented in Figure 2.1.

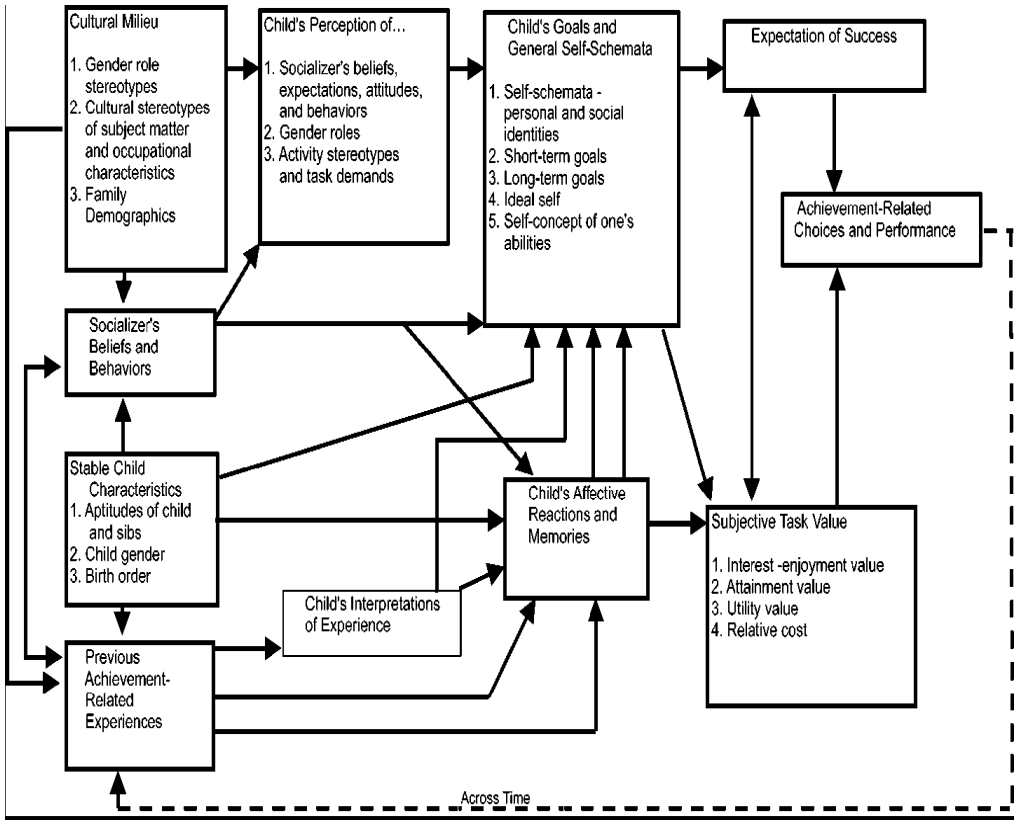

Figure 2.1 The Eccles and Wigfield (2002, pp. 119) expectancy-value model of achievement from Annual Review Psychology.

It can be seen from the Figure 2.1, expectancies and values are assumed to influence directly achievement choices. Eccles and her colleagues defined expectancies for success as learners' beliefs about how well they will do on upcoming tasks, either in the immediate or longer-term future. These expectancy beliefs are measured in a way analogous to measures of Bandura's (1997) personal efficacy expectations.

According to Bandura (1986), personal judgments about ones own aptitude to learn or perform at a designated level on a particular task refers to self-efficacy. The construct is based on the premise that a persons judgments of his or her own capabilities to organize and execute courses of action influence task performance (Schunk, 2000). Self-efficacy is related to motivation in that motivation is augmented when students perceive they are making progress in learning (Schunk, 1991). Bandura (1997) stated that; "perceived self-efficacy is concerned not with the number of skills you have, but with what you believe you can do with what you have under a variety of circumstances" (p.37). Accordingly, self-efficacy for learning refers to student's belief about their ability to apply knowledge effectively and skills that they already possess to novel situations that in turn create new cognitive skills (Butler & Winne, 1995; Schunk, 1989). When related literature is examined, it was found that there are many studies showing the relation between self-efficacy and achievement. As an example, Schunk (1991) found a positive correlation between self-efficacy and persistence on exercise problems during arithmetic learning. In addition, Schunk and Hanson (1985) discovered that students' ratings of problem difficulty before learning were related to performance measures after instruction on solving arithmetic problems. In other words, students who expected that they would have less difficulty in learning to solve the problems tended to learn more than students who anticipated having difficulty. Moreover, Pajares and Graham (1999) found that mathematics self-efficacy was the only motivation variable to predict mathematics performance for average-achieving and gifted middle school students. Across ability levels,

students whose self-efficacy is higher are more accurate in their mathematics computation and show greater persistence on difficult items than do students whose self-efficacy is low. Thus, many studies have reported that students' self-efficacy beliefs influence their motivation and learning (Bandura, 1986; Brophy, 1983; Corno & Mandinach, 1983; Pintrich & De Groot, 1990; Schunk, 1985). In fact, social cognitive theorists believe that students' perception of self-efficacy is key to motivating their efforts to learn (Zimmerman & Martinez-Pons, 1992). High self-efficacy leads people to mobilize a high level of effort especially in the face of difficulties or obstacles (Bandura, 1990). Therefore, students' self-efficacy is important for motivated learning.

To summarize, self-efficacy, which constitutes the expectancy component of the expectancy-value theory and defined as students' beliefs about whether they have the skills necessary to complete a task successfully, is associated positively with students' choice of activities, their goal setting within those activities, and their level of persistence at those activities.

On the other hand, value component of expectancy-value model of achievement include perceptions of the relevance, importance, and usefulness of the learning. In fact, Eccles et al. and Meece, and Midgley (1983) defined task value component in four motivational sub-components. These sub-components include attainment value, intrinsic value, utility value, and cost. They defined attainment value as the personal importance of doing well on the task. Drawing on self-schema and identity theories (e.g., Markus & Wurf, 1987), they also linked attainment value to the relevance of engaging in a task for confirming or disconfirming salient aspects of one's self-schema. On the other hand, intrinsic value is the enjoyment the individual gets from performing the activity, or the subjective interest the individual has in the subject. Utility value is determined by how well a task relates to current and future goals, such as career goals. A task can have positive value to a person since it facilitates important future goals. For example, students often take classes that they do not particularly enjoy but that

they need to take to pursue other interests, to please their parents, or to be with their friends. The fourth aspect of valuing, cost value is conceptualized as the worthwhileness of the time and effort for learning tasks. Cost is conceptualized in terms of the negative aspects of engaging in the task, such as performance anxiety and fear of failure and success as well as the amount of effort that needed to succeeds. In addition, cost value is defined in terms of the lost opportunities that result from making one choice rather than another. Feather (1988, 1992) empirically examined task-specific values in several studies of students' choices of college majors and activities to pursue. He found that values and ability perceptions are positively rather than inversely related, suggesting that values are determined by influences other than just the difficulty of the task - influences such as the features of the goal object itself, the valence of success and failure to the individual, and the probability of succeeding on the task. It appeared that individuals' values influence the attractiveness of different goal objects and, consequently, the motivation to attain these goals.

In the expectancy-value model presented in Figure 2.1 model choices are assumed to be influenced by both negative and positive task characteristics and all choices are assumed to have costs associated with them precisely because one choice often eliminates other options. Consequently, the relative value and probability of success of various options are key determinants of choice. Expectancies and values are assumed to directly influence performance, persistence, and task choice. Expectancies and values are assumed to be influenced by task-specific beliefs such as perceptions of competence, perceptions of the difficulty of different tasks, and individuals' goals and self-schema. On the other hand, these social cognitive variables are influenced by individuals' perceptions of other peoples' attitudes and expectations for them, by their affective memories, and by their own interpretations of their previous achievement outcomes. Individuals' task perceptions and interpretations of their past outcomes are

assumed to be influenced by socialite's behavior and beliefs and by cultural milieu and unique historical events (Eccles & Wigfield, 2002).

Empirical research in this area has found a relation between students' value for the material they are learning and their choice behavior. For example, Wolters and Pintrich (1998) found that middle school students who showed greater valuing of the material in a specific subject area were more likely to report using cognitive and self-regulatory strategies with regard to that subject area. Moreover, Bong (2001) examined between-domain relations of self-efficacy, task-value, and achievement goal orientations among 424 Korean middle and high school students. All motivational constructs demonstrated strong subject specificity in both age groups. Performance-approach and performance-avoidance goals were highly correlated across domains, whereas task-value and mastery goals were more distinct across domains. Self-efficacy perceptions were moderately correlated across subjects. High school students' academic motivation was more differentiated than that of middle school students. They have shown that ability self-concepts and expectancies for success directly predict performance in mathematics, English, computer activities, and sport activities, even when previous performance is controlled. Children's task values predict course plans and enrollment decisions more strongly than do expectancy-related beliefs. Pintrich and his colleagues (Pintrich, Smith, Garcia & McKeachie, 1993) also found that task value was correlated to performance but those relations were weaker than those for self-efficacy. These results show the importance of looking at not only competence and expectancy beliefs but also task values in understanding individuals' performance. Typically, researchers have demonstrated positive relations of task value beliefs to deeper levels of cognitive processing and performance (Pintrich 1999; Pintrich and Garcia 1991). Carol VanZile-Tamsen (2001) examined the predictive power of expectancy success and task value for self-regulated strategy use by using MSLQ scores from 216 undergraduates from a midsize regional state university. Carol VanZile-Tamsen found that expectancy

success and task value were positively related to the three self-regulated learning components (i.e, cognitive strategy use, metacognitive self-regulation and resource management). In addition, Pintrich and De Groot (1990) examined relationships between motivational orientation, self-regulated learning, and classroom academic performance for 173 seventh graders from eight science and seven English classes. Using the MSLQ, they found that self-efficacy, intrinsic value (interest in and perceived importance of the learning), cognitive strategy use (e.g., rehearsal, organization, elaboration), and self-regulation (effort management, metacognition) were positively correlated and predicted achievement. Test anxiety related negatively to self-efficacy. Regression analysis revealed that, depending on the outcome measure, self-regulation, self-efficacy, and test anxiety emerged as the best predictors of performance. Intrinsic value did not have a direct influence on performance but was strongly related to self-regulation and cognitive strategy use, regardless of prior achievement level. Moreover, Pintrich, Roeser, and De Groot (1994) administered the MSLQ to seventh graders to assess motivational beliefs (intrinsic value, self-efficacy, and text anxiety) and self-regulated learning (cognitive strategy use, self-regulation). Positive motivational beliefs were found to be related to higher levels of self-regulated learning. They also assessed students' perceptions of classroom experiences. Intrinsic value later in the school year was related to classroom experience more strongly than intrinsic value early in the year. Self-efficacy, cognitive strategy use, and self-regulation were related positively to classroom experience. The results support the idea that motivation and self-regulated learning bear a complex reciprocal relation to each other.

To sum up, researchers using the expectancy-value model of achievement motivation are interested in how different aspects of an individual's valuing of academic tasks, together with the individual's expectancies for success, contribute to achievement behaviors (DeBacker & Nelson, 1999). Empirical research in this area has shown a positive relation between expectancy-value and achievement behaviors.

2.2.3 Control Beliefs

Control beliefs refer to "beliefs about the causes of success and failure and how much perceived control one has to bring about outcomes or to control one's behavior" (Weiner, 1986). Control theories are another type of expectancy-based theory (Crandall, Katkovsky, Crandall, 1965; Rotter, 1966). Building on the seminal early work of Rotter (1966) and Crandall et al. (1965) on internal and external locus of control, theorists have elaborated broader conceptual models of control. According to these theories, internal control beliefs refer to students' perceptions that academic outcomes are contingent on their own actions, for example, increased effort or effective study techniques, rather than on external factors beyond their control, for example, task difficulty or a teacher's bias (Connell, 1985).

Connell (1985) added "unknown control" as a third control belief category and argued that younger children are particularly likely to use this category. He developed and validated to a scale to assess external control (in terms of "powerful others"), internal control (in terms of effort and ability), and unknown control for cognitive, physical, social, and general activities. He also showed that not knowing the cause of one's successes and failures undermines one's motivation to work on the associated tasks. On the other hand, Skinner and colleagues (e.g., Skinner, 1995; Skinner, Chapman, & Baltes, 1988) proposed a more elaborate model of control beliefs. In this model, Skinner described three critical control-related beliefs: strategy (or means-ends) beliefs, control beliefs, and capacity (or agency) beliefs. Strategy beliefs concern the expectation that particular causes can produce certain outcomes; these causes include Weiner's various causal attributions and Connell's (1985) unknown control. Control beliefs are the expectations of individuals that they can produce desired events, and prevent undesired ones. Capacity beliefs also are the expectations that one has access to the means needed to produce various outcomes (Skinner, 1995). All three sets of beliefs influence performance on achievement tasks. For instance, Skinner (1995) examined age

differences in both the structure and the mean levels of strategy beliefs, and found the factor structure becomes increasingly complex, as children get older. She also found the largest mean-level differences on some of the strategy beliefs. At all ages between 7 and 12, children believe effort is the most effective means. In contrast, older children are much less likely to believe that luck is an effective means than younger children. Similarly, Connell (1985) found a decrease in the endorsement of all three of his locus of control constructs (internal control, powerful others control, and unknown control) from grades 3 through 9. Skinner, Zimmer-Gembeck, and Connell (1998) assessed the development of control beliefs (strategy (or means-ends) beliefs, control beliefs, and capacity (or agency) beliefs) over the school years, and looked at relations of children's perceived control to the ways children perceived that teachers treated them. Their cohort-sequential design encompassed third through seventh grade children. They also measured children's engagement in school, and their perceptions of the structure and involvement provided by teachers, and examined predictive relations among these variables. Children who believed teachers were warm and supportive developed a more positive sense of their control over outcomes.

The general finding is that learner who believe they have more personal control of their own learning and behavior are more likely to achieve at higher level than learners who do not feel in control (Pintrich, 2003).

2.2.4 Test Anxiety

Since people of all ages are be evaluated, assessed, and graded with regard to their abilities, achievements, or interests, test anxiety affects the lives of people in many ways. According to Dusek (1980), a general definition of anxiety is "an unpleasant feeling or emotional state that has physiological and behavioral concomitants, and that is experienced in formal testing or other evaluative situations". Similarly, Zeidner (1998) defined test anxiety as "the set of phenomenological, physiological, and behavioral responses that accompany

concern about possible negative consequences or failure on an exam or similar evaluative situation". Other researchers have defined additional dimensions of test anxiety. For example, Hong (1998) stated that test anxiety is "a complex multidimensional construct involving cognitive, affective, physiological, and behavioral reactions to evaluative situations". Sarason (1984) divided test anxiety into four dimensions: worry, tension, test-irrelevant thinking, and bodily symptoms. Liebert and Morris (1967) define test anxiety as consisting of a worry factor, which describes cognitive concern about academic performance and an emotionality factor, which describes physiological academic stress reactions.

Test anxiety includes two major components: worry or cognitive components and emotionality components (Liebert and Morris, 1967; Zeidner, 1998). Worry is cognitive distress connected to the testing situation; it consists of negative performance expectations, worry about the testing situation, and worry about being unable to finish the test. Emotionality is the affective dimension; it refers to the physical reactions of students to the testing situation. Examples of such a reaction can be nervousness, fear, and physical discomfort (Zeidner, 1998).

There are many researches on the negative effects of test anxiety on academic performance. Hembree (1988) found that test anxiety is negatively correlated with test performance. For instance, Jo-Ann Reteguiz (2006) has examined to measure and compare medicine clerkship student standardized patient (SP) examinations versus multiple choice question (MCQ) examination anxiety levels and to determine if level affected test performance. The Spielberger test attitude inventory was used to measure anxiety in 150 students rotating through the clerkship. This study has shown that students with low levels of test anxiety achieve higher scores on multiple choice question (MCQ) examinations than those with high anxiety levels. Reteguez also found that female students have been shown to have higher test anxiety levels than male students. Benmansour's (1999) study examined test anxiety on high school mathematics students in Morocco. Benmansour found four factors in the measurement of goal orientation and related

these to test-anxiety, self-efficacy, and learning strategies by using questionnaire data. He found that students with strong orientation to getting good grades had high levels of test anxiety and made greater use of passive rather than active learning strategies. Students with a stronger intrinsic motivation (a desire to learn mathematics out of interest) showed a negative relation with test anxiety and a greater use of active learning strategies. He also found greater levels of test anxiety in girls than boys. Based on these studies and others, higher levels of test anxiety have also been associated with lower classroom achievement (Pintrich & DeGroot, 1990).

2.3 Cognitive Learning Strategies

The term cognitive strategy refers to learners' cognitive actions that are performed in order to attain a particular learning goal or to accomplish a learning task at hand (Mayer, 1988; Paris, Byrnes & Paris, 2001; Schneider & Weinert, 1990). Some researchers emphasize that cognitive strategies are consciously generated by the person and involve both agency and control rather than mindless rule following (e.g., Paris et al., 2001; Paris, Lipson & Wixton, 1983; Wade, Trathen & Schraw, 1990). Hadwin and Winne (1996) made a connection between goals and strategy use. They denoted that "the term strategy use refers to occasions when students define their own short-term goals and overall goals for studying and select and coordinate alternative study tactics they expect will be helpful in achieving those goals". Actually, cognitive learning strategies play a major role in academic performance by providing the means for a learner to regulate cognitive efforts. In fact, many studies in the literature on cognitive strategies have demonstrated important linkages between cognitive learning strategies and academic performance (Paris et al., 2001; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Weinstein & Mayer, 1986, Zimmerman & Martinez-Pons, 1986). These studies suggested that effective, appropriate, and independent strategy use were assets of a skillful learner.

In the present study, cognitive learning strategies in relation to academic performance are examined under three categories: basic cognitive strategies, metacognitive strategies and resource management strategies.

2.3.1 Basic Cognitive Strategies

Literature in the fields of educational psychology, cognitive psychology, and education has focused on the ways in which students become active in their learning. Cognitive strategies assist the learner with attention and encoding of information. Three types of cognitive strategies focused on in the self-regulated learning literature are rehearsal, elaboration, and organization (Weinstein & Mayer, 1986). Rehearsal includes strategies such as repeating words, copying information, and underlining in textbooks (Weinstein & Mayer, 1986). Rehearsal strategies are generally associated with repetition, which aim to reproduce the material in some form. This strategy is simply related to the maintenance of information rather than elaboration or integration of new information with prior knowledge. Elaboration strategies can help students store new information into long-term memory by connecting new information with prior knowledge (Weinstein & Mayer, 1986). Summarizing and paraphrasing are good examples of elaboration. That is, when students paraphrase what they read, they can link new information with prior knowledge. Research on elaboration supports the effectiveness of elaboration as a strategy. A study by Johnsey, Morrison, and Ross (1992) concluded that adult learners recall, recognize, and apply content from learned material better when allowed to create their own elaborations for the material, rather than when elaborations are provided by external sources, such as instructors. This study demonstrated the importance of elaborations for personal improvements. Research by Weinstein (1982) also demonstrated the use of elaboration to enhance learning. Students who used elaboration techniques during studying performed better on immediate free recall and paired-association tasks, and on long-term reading comprehension and serial recall. Organizational strategies involve processes such as

grouping information, organizing information into meaningful categories, and outlining a concept map. The learner to construct connections among the information to be learned can use organizational strategies (Weinstein & Mayer, 1986). One good example of organizational strategies is students' selection of main ideas by building connections among the contents of a text. Weinstein and Mayer (1986) noted that students who incorporated information from several sources, such as texts, lectures, and discussions, into organized outlines performed better than students who only outlined reading material.

On the other hand, there is another body of research that takes a more macro-level approach to strategy use. Different types of learning strategies are often distinguished from each other by the well-known distinction between deep processing and surface processing strategies (Entwistle, 1988). Deeper level strategies involve processes such as retrieving concepts and ideas relevant to the current learning task, monitoring relationships between new knowledge and prior knowledge structures, elaboration, transforming information into meaningful schemata and critical thinking (Elliot et al., 1999; Hadwin & Winne, 1996). Surface level strategies involve memorisation, rehearsal, and rote learning (Elliot et al., 1999). Surface processing learning strategies involves minimal engagement with the task and focusing on simple memorization. The research in this field suggests that students' use of the deeper learning strategies (e.g., elaboration, organization) result in better performance and learning (Weinstein & Mayer, 1986). This categorization has been applied in some rather well known research instruments such as in Motivated Strategies for Learning Questionnaire (MSLQ by Pintrich, Smith, Garcia, & McKeachie, 1993) and in several empirical studies concerning strategy use and its relation to achievement, other learning processes, and motivation. Furthermore, Entwistle's categorization has been used as a model that puts strategies into an order of superiority, deeper level strategies representing a more advanced type of strategy use and surface level strategies representing less advanced type of strategy use. The research findings support the idea that deeper

level cognitive strategies, especially those that are related to solving problems and developing understanding, are essential in academic learning (e.g., Pintrich & De Groot, 1990; Pintrich, Brown & Weinstein, 1990; Pressley & McCormick, 1995). Strategies associated with transformative behaviour, such as organising, elaboration, goal setting and planning have been found to be associated with using meaningful approaches in problem-solving situations (Pape & Wang, 2003). They also reported that high achieving students reported using more strategies and many different types of strategies. On the other hand, some researches supported the use of cognitive strategies by college students' achievement. For example, Shu-Shen Shih (2005) investigated relations between achievement goals and students' use of cognitive strategies and motivational processes. He measured children's use of cognitive and self-regulated strategy, intrinsic interest in coursework by using adapted MSLQ to 198 sixth-grade Taiwanese children. To test the criterion-related validity of the scales, he used students' performance on the verbal achievement test as the criterion. Results of the analysis suggested that each of the scales was correlated with the criterion. Specifically, the scales of cognitive and metacognitive strategy use were related positively to the achievement test ($r = .19$, $p < .01$ and $r = .21$, $p < .01$, respectively). Zusho and Pintrich (2003) also investigated the relations between the motivational and cognitive components and achievement. Participants were 458 students enrolled in introductory college chemistry classes. Participants' motivation and strategy use were assessed at three time points over the course of one semester using self-report instruments. Results showed that the use of rehearsal strategies was related positively with achievement. In both of these studies, significant positive correlations were found between cognitive strategies and final course grade. Moreover, in terms of the relations between motivation and cognitive strategy use, research findings revealed that students with higher levels of self-efficacy, task value, and instrinsic goals tend to use more deeper-processing cognitive strategies such as elaboration and metacognition.

2.3.2 Metacognitive strategies

Metacognition, which coordinates the cognitive skills in memory, reading comprehension, and cognition, is often described as "thinking about thinking" and can be utilized to help students "learn how to learn" (Weinert & Kluwe, 1987). In fact, Tuckman (1996) defined metacognition as "the internal master control of thinking behavior designed to make sure that learning takes place". As a well-known scholar in metacognition research, Brown (1980) stated, "Metacognition refers to the deliberate conscious control of one's own cognitive actions". Metacognition, according to Brown (1980), implied both awareness and regulation of cognition. Alexander, Schallert, and Hare (1991) described metacognitive knowledge as "knowledge about knowledge". In addition, metacognitive knowledge can refer to people's understanding or knowledge about how they think and learn, or the factors that affect their thinking and learning. Within academic settings, metacognition or metacognitive knowledge has been emphasized as an important component of students' self-regulated learning (Borkowski, Carr, Rellinger, & Pressley, 1990; Zimmerman, 1986; Zimmerman & Schunk, 1989). Self-regulated learning describes the processes in which students initiate, monitor, and direct their own learning.

Although there have been several definitions of metacognition used in educational research (Pintrich, 1989), it is argued by Peverly (1994) that the primary metacognitive strategies, distinct from cognitive strategies and most relevant to academic achievement, are monitoring progress, planning an approach to a task, and utilizing feedback. Like motivation, metacognition is often viewed as a core element necessary for self-regulated learning (Butler & Winne, 1995; Pintrich, Wolters, & Baxter, 2000; Zimmerman, 1994). Historically, research on metacognition has roots that stretch into many areas of psychology including work focused on cognitive development, memory, executive processing, and learning strategies (Brown, Bransford, Ferrara, & Campione, 1983; Flavell, 1979; Kluwe, 1982; Pressley, Borkowski, & Schneider, 1987). In fact, metacognitive strategies

possess two aspects; (1) the awareness of and knowledge about cognition, and (2) the control and regulation of cognition (e.g., Bransford, Brown, & Cocking, 1999; Brown et al., 1983; Flavell, 1979; Paris & Winograd, 1990; Pintrich et al., 2000; Schneider & Pressley, 1997). Knowledge of cognition includes students' understanding or stored information regarding the thinking and learning process. This aspect of metacognition has been differentiated based on whether the knowledge pertains to the person, to tasks, or to strategies, and into declarative, procedural, and conditional forms of knowledge (Baker, 1994; Flavell, 1979; Schraw & Moshman, 1995). Narrowly defined, regulation of cognition describes students' efforts to monitor, control, or adjust their cognitive processing in response to shifting task demands or conditions (Baker, 1994; Brown, 1987). Strategies in regulation of cognition fall into three categories, planning, monitoring, and self-regulation. Activities typically viewed as efforts to regulate cognition include planning how to complete a task, selecting the cognitive strategies one will use, monitoring the effectiveness of the strategies one has chosen, and modifying or changing the cognitive strategies one is using when problems are encountered (Pintrich et al., 2000; Schraw & Moshman, 1995). Planning activities include setting goals for studying, skimming information and selecting the most relevant material to study, and generating questions before reading written material. Monitoring strategies allow the learner to assess the level of comprehension that is being achieved during learning. These strategies may include self-testing, tracking of attention, and assessing integration of new material with prior knowledge. The final category of strategies, self-regulation, is similar to monitoring activities. Students use information gained from monitoring activities in order to gain a better understanding of their level of comprehension of the material being tested.

Pintrich and Schrauben (1992) asserted that monitoring and regulation strategies are closely related. For example, a student monitors his attention while reading a text to ensure understanding of the text. When the student realizes through his monitoring activities that he has not understood a portion of the text,

the student will go back and reread a portion of the text. This rereading is a regulation strategy. Another regulation strategy involves slowing the pace of reading when confronted with difficult or unfamiliar text. Zimmerman and Martinez-Pons (1986) also explored the differences in metacognition in high- and low-achieving students. Using structured interviews, the researchers concluded that skilled learners used more strategies than less skilled learners did and that skilled learner' cognitive strategies were made more flexible with metacognitive skills. For instance, students use different strategies based on whether they read for learning, complete an essay, or study for an exam (Hadwin, Winne, Stockley, Nesbit, & Woszczyna, 2001). It is assumed that skilled learners' cognitive strategies involve shifting smoothly between different types of strategies and applying different strategies flexibly according to the demands of the task (Corno & Mandinach, 1983).

Furthermore, using items from the Motivated Strategies for Learning Questionnaire (McKeachie, Pintrich, Lin & Smith, 1986), Pintrich (1989) found significant relationships between scores on the metacognition subscale measuring planning, monitoring, and regulating strategies and exam and final course grade for a sample of college students in English, biology, and psychology classes. In addition, researchers also have shown that students who are "metacognitive" in their learning are more actively and cognitively engaged (Weinstein & Mayer, 1986). Students, who are metacognitive, are ones who reflect on their own thinking, actions, and behavior and monitor and regulate their own learning. A good example of metacognition is when a student finishes a section or chapter and stops to ask himself or herself what was just learned or understood, or what can be recalled about what was just read. This type of self-checking or self-questioning reflects students' monitoring of their own comprehension. After checking comprehension, metacognitive readers will go back and review parts of the text they do not understand very well. They will go back and "repair" their comprehension through re-reading of the text. This type of self-regulation of

reading is a key component of cognitive engagement in the classroom. Of course, these types of monitoring and regulating activities can be applied to all content areas, not just reading (Linnenbrink & Pintrich, 2003). Generally, the research on this side of metacognition indicates that students who more effectively regulate their cognitive strategy use tend to show more adaptive performance or achievement outcomes (Baker, 1994; Butler & Winne, 1995; Pressley et al., 1987; Schraw & Moshman, 1995).

To summarize, metacognitive knowledge refers to the beliefs, understanding, or information that students have about thinking and learning. These beliefs include knowledge about the self, tasks, and strategies, and can be linked to particular contexts or subject areas, or can be more generalized or universal.

2.3.3 Resource Management Strategies

Students must be skillful in management of their resources so that they can obtain maximum benefits from their study skills. Resource management strategies are related to the variety of strategies students use to manage their environments and resources within the environment. Pintrich, Smith, Garcia, and McKeachie (1991) suggested that resources management strategies could be utilized to help learners manage their time and study environment, effort, and support from peers, instructor, or others. The resource management strategies are general strategies that may help or hinder students' efforts for completing tasks but are not tied directly to student performance (Pintrich & Schrauben, 1992).

2.3.3.1 Time Management

Time is one of the most important resources available to a student. Time management involves scheduling, planning, and managing one's study time. Students must learn to manage their time effectively in order to assure that enough attention is paid to academics, and that this time factor is balanced with a social

schedule. Britton and Tesser (1991) sought to determine a link between student time management and cumulative grade point average (CGPA) in college students. Using a 35-item questionnaire, time management was measured by three subscales: short-range planning, time attitudes, and long-range planning. Using stepwise regression, Britton and Tesser (1991) found that time attitudes and short-range planning when entered first into the equation accounted for 21% of the variance in college GPA. SAT (subject achievement test) score was entered as a third variable accounting for 5% of the variance. Therefore, authors concluded that students' beliefs in planning time and their short-range planning were more strongly related to their academic achievement than were their SAT scores. In addition, by scheduling time blocks for study, learners can have more control over effective goal setting. Moreover, Garcia-Ros, Gonzalez, and Hinojosa (2004) analyzed the factorial structure, psychometric properties, and predictive capacity for academic achievement of a scale designed to evaluate the time management skills of Spanish high school students. An adaptation of the Time Management Questionnaire was presented to two samples of 350 Spanish high school students. The results of the Multiple Regression Analysis showed that the time management factors were reasonably good predictors of the academic performance of Spanish high school students. Furthermore, Zimmerman, Greenberg, and Weinstein (1994) found that time planning and management training helped students to better self-regulate their use of study time and, in turn, improved students' GPA.

2.3.3.2 Effort Management and Study Environment

Effort regulation or management is students' willingness to try hard even when work is difficult (Pintrinch & Johnson, 1990). Studying and preparing for class involves being able to manage one's effort and to be aware of the effectiveness of the environment in which one studies. Pintrich termed these strategies effort management and study environment (Pintrich, 1989). A student who exhibits self-regulated learning knows when to persist at a task that may require more effort and

which tasks require less than maximum effort (Pressley, 1986). Being able to coordinate effort management with appropriate learning strategies is also essential (Corno & Rohrkemper, 1985). Monitoring and managing effort provides learners with the ability to become aware of and persist through uninteresting tasks as well as distractions from those tasks. Effort management is important because it signifies goal commitment and regulates the continued use of learning strategies (Pintrinch & Johnson, 1990). For example, Pintrich and De Groot (1990) examined relations among self-regulatory skills which includes using of metacognitive and effort management strategies, cognitive strategy use (rehearsal, elaboration, and organizational strategies), and motivation for learning and performing well in class among seventh graders in science and English. Using the MSLQ, they found that self-efficacy, intrinsic value, cognitive strategy use, and self-regulation (effort management, metacognition) were positively correlated and predicted achievement. Another research also showed that effort regulation was a strong predictor of academic success (Doljanac, 1994; Lee, 1997).

On the other hand, study environment areas requires locating a place that is quiet and relatively free of visual and auditory distractions so that one can concentrate. Zimmerman and Martinez-Pons (1986) found that high achievers reported greater use of environment management than low achieving students, and self-regulated learners tend to restructure their physical environment to meet their needs.

2.3.3.3 Help Seeking

Karabenick and Knapp (1991) identify two types of help-seeking behavior that clarify the relationship with academic achievement, namely executive help seeking and instrumental help seeking. Executive help seeking involves soliciting aid for decreasing the effort needed to complete a task. Instrumental help seeking is designed to assist in learning the process instead of focusing solely on the solution to a problem. This type of

help seeking is less intensive and assists the student in being more independent in their learning.

Classroom studies of help seeking have consistently shown that students who are low in academic self-efficacy and performance are less likely to seek help (Karabenick & Knapp, 1991; Newman, 1990; Ryan & Pintrich, 1997). For example, using college students in English and biology classes, Karabenick and Knapp (1991) found that instrumental help-seeking behavior was significantly and positively related to self-esteem, engagement in achievement behaviors, and inversely related to students' perceptions that help-seeking is threatening. It appeared that these low-efficacy and low-achieving students thought that by asking for help, others such as teachers and peers would think they were unable or dumb; this threat inhibited them in asking for help. Nevertheless, self-efficacy beliefs have an important and positive relation to students' seeking of instrumental help in the classroom (Ryan & Pintrich, 1998).

In addition, research by Zimmerman and Martinez-Pons (1986) supports the notion that successful students use external resources significantly more than less successful students. High achievers reported seeking peer assistance nearly twice as often, teacher assistance twice as often, and other adult assistance four times as often as low achievers. In addition, high achievers reported using nonsocial sources, such as other texts, nearly three times more than low achievers. Research on reciprocal teaching has demonstrated that students' working alone with teachers is a very successful learning strategy (Palincsar & Brown, 1986). In fact, seeking help is a strategy that learners have used to provide support when course content needs to be clarified and explained. By managing their help resources, learners ask peers and instructors to support their understanding and expedite achievement.

In summary, an important component of success in the classroom is the learning strategies students utilize that allow them to better comprehend the material at hand. Cognitive strategies, such as rehearsal, elaborating, and

organizing, influence student comprehension through their effect on the information processing system. Metacognitive strategies such as monitoring, planning, and regulating allow students to better use their cognitive strategies, and thus indirectly affect information processing and comprehension. Of course, students must be properly motivated to utilize their cognitive and metacognitive strategies. Many students understand how to perform well, but choose not to exercise the necessary skills to do so.

To conclude, the use of cognitive learning strategies is affected by the learners' own skills, preferences, intentions and interpretations; and the learning context consisting of several elements such as task requirements, social environment, and tools available in the situation.

2.4 Self-regulation based on Social Cognitive Theory

Self-regulated learning has become an important field in educational research. There is plenty of empirical evidence indicating self-regulation as a critical factor for students' learning and achievement (Paris & Paris, 2001; Pintrich & De Groot, 1990; Pintrich & Schrauben, 1992; Zimmerman & Martinez-Pons, 1990). This is not to say that the researchers in the field share a single theoretical model of self-regulated learning comprised of the basic principles of phases and dimensions of self-regulated learning. Instead, there are various models proposed for self-regulated learning, which propose different constructs and conceptualizations (Boekaerts, 1997; Pintrich, 2000; Winne & Perry, 2000; Zimmerman, 2000). On the other hand, most models assume that an important aspect of self-regulated learning is the students' use of various cognitive and metacognitive strategies to control and regulate their learning and their motivation to use these strategies and regulate their cognition and effort (Pintrich & DeGroot, 1990; Pintrich, 1999; Vanderstoep et al., 1996). Therefore, recent research on self-regulated learning has focused on the importance of integrating motivational and cognitive components of classroom learning. According to Zimmerman's (1989,

2000, 2002) model based on social cognitive theory, self-regulation can be viewed as the interaction of personal, behavioral, and environmental triadic and at the same time cyclic processes (Bandura, 1986 as cited in Zimmerman, 2000). Personal processes include students' knowledge, metacognitive processes, goals and affect while behavioral processes include self-observation, self-judgment, and self-reaction. Enactive outcomes, modeling, and verbal persuasion constitute environmental processes. In general, students are described as self-regulated to the degree they are metacognitively, motivationally, and behaviourally active in their own learning processes and in achieving their own goals and active in their use of cognitive strategies for learning; thus motivation plays an important role in self-regulation (Zimmerman, 1989).

Based on social cognitive perspective, these self-regulatory processes and accompanying beliefs fall into three cyclical phases: forethought, performance or volitional control and self-reflection (Zimmerman, 2000). The forethought phase involves task analysis (i.e. goal setting and strategic planning) and self-motivational beliefs (i.e. self-efficacy, outcome expectations, intrinsic motivation or valuing and process versus outcome goal orientation). Forethought phase refers to processes that precede and prepare actions. The performance or volitional control phase includes two kinds of processes, namely self-control (i.e. self-instruction, imagery or mental picture forming, attention focusing and task strategies) and self-observation (i.e. self-recording and self-experimentation). Self-control processes help learners to concentrate on the task and optimise their efforts; for example, task strategies aid learning by reducing the task to its essential components and reorganising them in a meaningful manner (Zimmerman, 2000). Self-observation processes, on the other hand, refer to tracing specific aspects of one's own performance. Schunk and Ertmer (2000) also noted that maintaining self-efficacy and monitoring progress towards the achievement of goals are important motivational aspects of the performance process. The last phase, self-reflection involves self-judgment and self-reaction. Self-judgment

refers to self-evaluations of one's own performance and to causal attributions concerning the results; self-reaction includes self-satisfaction, i.e. perceptions of (dis)satisfaction and affect regarding performance and inferences about what will have to be changed in future self-regulation demanding situations. Therefore, self-reflection includes processes that occur after performance efforts and affect an individual's response to that experience while forethought includes processes that precede efforts to act.

Similar to the Zimmerman's model, Pintrich (2000) developed a general framework for self-regulated learning based on social-cognitive theory. Pintrich believed that self-regulatory activities mediated the relations between learners and their environments and influenced learners' achievements (Pintrich, 2000; Pintrich & Zusho, 2002). According to Pintrich's (2000, 2003, 2004) framework for self-regulated learning inspired by social cognitive theory, self-regulated learning is composed of four phases, namely forethought, monitoring, control, and reflection phases. Self-regulatory activities for each phase include regulation of cognition, motivation and affect, behavior, and context (Table 2.1). There are learning situations in which learners may engage in some but not all of the phases. Phases also are interactive in that individuals may simultaneously engage in more than one.

Table 2.1 Conceptual Framework for Studying Self-Regulation

Phases of Self-Regulation	Areas for Self-Regulation
Forethought	Cognition
Monitoring	Motivation
Control	Behavior
Reaction, reflection	Context

Firstly, the self-regulatory activities taking place in the forethought phase include prior content knowledge and metacognitive knowledge activation (cognitive), efficacy judgments and adoption of a goal orientation (motivation and affect), time and effort planning (behavior) and perceptions of task and context. Cognitions that can be self-regulated in this phase include goals, prior content knowledge, and metacognitive knowledge. Goals involve setting and adapting task-specific goals that serve as criteria against which to consider progress. Self-regulated learners activate their knowledge in a planful way by prompting and self-questioning. Activating metacognitive knowledge, existing automatically or through deliberate conscious control, includes declarative knowledge (learning strategies such as rehearsal and note taking), procedural knowledge (how to carry out these strategies), and conditional knowledge (when and why to use different strategies). Motivational self-regulation area for this phase includes goal orientations, self-efficacy, and perceptions of difficulty and ease of learning, task value, and interest. Goal orientations are the reasons learners engage in tasks; for example, why they want to take a high grade in a course. Self-efficacy refers to individuals' beliefs about their capabilities to learn or perform actions at designated levels (Bandura, 1986, 1997). Learners' ease of learning or task

difficulty judgments concern how easy or hard they believe the material will be to learn. Task value beliefs include perceptions of the relevance, importance, and usefulness of the learning. Interest refers to the degree of liking students have for the topic being learned. Behaviors that can be self-regulated are time and effort planning and planning for self-observation of behavior. Time and effort planning involves creating study schedules and allocating time for different activities. Contextual regulation area includes students' perceptions of the task and context. These might include perceptions about classroom features that may help or hinder learning, types of tasks to be completed, grading practices, and classroom climate factors (e.g., helpfulness of the teacher). In addition, the monitoring phase consists of attention and awareness of cognition, motivation, affect, time use, effort and task and context conditions. Cognitive monitoring includes dynamic metacognitive judgments of learning and metacognitive awareness (Pintrich, 2000). Judgments of learning involve beliefs about what learner knows and what learner does not understand. Motivational monitoring refers to being aware of one's self-efficacy, values, attributions, interests, and anxieties. Monitoring of behaviors includes time and effort management and adjusting based on assessments of their effects. Contextual monitoring refers to monitoring task conditions to determine whether they are changing. The next one, the control phase refers to the selection and adaptation of cognitive strategies for learning, thinking, motivation and affect, and regulation of effort, task, and context. Cognitive control includes cognitive and metacognitive activities that learners use to adapt and alter their cognitions (Pintrich, 2000). During cognitive control phase learners continue to use strategies, which are deemed effective or change them if learners believe better strategies are needed. In this phase, various cognitive and learning strategies (e.g., outlining, summarizing, and note taking) may be involved (Weinstein & Mayer, 1986; Zimmerman, 2000). Motivational control includes self-efficacy through positive self-talk, such as "I can do this activity". Learners also may make positive outcomes related to academic performance and they may attempt to control their

anxiety, such as by not thinking about test questions that they cannot answer. Behavioral control includes persisting, expending effort, and seeking help when needed. Good learners using self-regulation do not seek help in such manner but they need selectively to understand a particular point and from a source, they believe will be helpful. Contextual control includes strategies to make the context more assisting to learning. Contextual control may include efforts to eliminate or reduce distractions as well as attempts to renegotiate task requirements. Finally, the reflection phase involves cognitive judgments, affective reactions, making choices, and evaluation of task (Pintrich, 2000). Motivational reactions include efforts to enhance their motivation when students judge that their motivation has weakened. Maybe, these include attributing low performance to insufficient effort rather than low ability. Motivational reactions also can involve emotions; for example, when students feel pride after succeeding or they feel anger when they fail. Behavioral reactions refer to cognitions about learners' behaviors, such as whether learner has used time effectively or showed sufficient effort. Contextual reactions include evaluations of task demands and contextual factors. Good learners using self-regulation evaluate whether they will able to achieve the task, whether the environment is suitable for learning, and what changes are needed for good learning.

Pintrich's self-regulated learning model shares some assumptions with other models of self-regulation (Pintrich, 2000; Zimmerman & Schunk, 2001; Pintrich, 2004). A first assumption is that learners are active and constructive participants in the learning process. Second, learners have some options or they have some potential for controlling activities. A third assumption is that learners have a goal or criterion level of performance against which they can assess progress. A final assumption is that self-regulatory processes mediate the relation between personal factors and performance outcomes (Pintrich, 2004).

Many empirical studies have been conducted to test self-regulated learning model. For instance, Zimmerman and Martinez-Pons (1986, 1988) have developed

a structured interview, the self-regulated learning interview schedule (SRLIS), to test students' use of self-regulated learning strategies. SRLIS consists of a structured interview assessing 14 classes of self-regulated strategies, such as self-evaluating, organising, planning, and monitoring. SRLIS was used by Zimmerman and Martinez-Pons (1990) to investigate the relationship between learners' use of self-regulated learning strategies and learners' perceptions of both verbal and mathematical self-efficacy. This study showed that both verbal and mathematical self-efficacy measures were correlated with the use of self-regulated strategies. In addition to this, they found that older students' self-efficacy surpassed that of younger students; giftedness was related to high-perceived self-efficacy; boys' verbal self-efficacy was significantly higher than that of girls. On the other hand, Zimmerman and Bandura (1994) examined the role of four self-regulatory factors on writing attainment in university level students. These included self-efficacy beliefs concerning academic achievement, self-efficacy beliefs concerning self-regulation of writing, self-evaluation and goals. They showed that self-efficacy for academic achievement influenced writing course grades directly, but also indirectly through goal setting. The results also confirmed self-regulatory efficacy affected self-evaluations and students' self-regulatory self-efficacy predicted their self-efficacy for academic achievement; the higher the self-regulatory self-efficacy, the more confident the students were about their academic achievement. Similarly, Pintrich and De Groot (1990) conducted a study to determine relations among self-regulation, cognitive strategy use, and motivation for learning and performing well in class among seventh grade students in science and English. They discovered by using MSLQ that self-efficacy, intrinsic value (interest in and perceived importance of the learning), cognitive strategy use (rehearsal, organization, elaboration), and self-regulation (effort management, metacognition) were positively correlated and predicted achievement. They also found that test anxiety related negatively to self-efficacy. Moreover, Pintrich et al. (1994) assessed motivational beliefs (intrinsic value, self-efficacy, and text anxiety) and

self-regulated learning (cognitive strategy use, self-regulation) by administering the MSLQ to seventh graders. Positive motivational beliefs were found to be related to higher levels of self-regulated learning. The authors also assessed students' perceptions of classroom experiences (i.e., productive classroom work, teacher effectiveness, cooperative work). Intrinsic value later in the school year was related to classroom experience more strongly than intrinsic value early in the year. Self-efficacy, cognitive strategy use, and self-regulation were related positively to classroom experience. The results support the idea that motivation and self-regulated learning bear a complex reciprocal relation to each other. The relation between motivation and self-regulated learning was seen clearly in research by Wolters et al. (1996) with junior high students. In this study, they used regression analysis across three subject areas (English, social studies, mathematics). They found that among junior high students an approach performance goal of outperforming others related positively to self-efficacy and use of cognitive and self-regulatory strategies. In contrast, an extrinsic goal orientation reflecting a desire to obtain good grades was linked with maladaptive motivational and cognitive outcomes. In another study, Vanderstoep et al. (1996) examined college students' knowledge, motivation, and self-regulatory learning strategies in three different disciplines, English, psychology, and biology. The results showed that knowledge, motivation, and self-regulation distinguished high and low achieving students in psychology and biology college courses.

Taken together, much research by Pintrich and his colleagues and research by others supports the predictions of the conceptual framework by showing linkages between motivation, self-regulation, and academic learning (Chapman & Tunmer, 1995; Pokay & Blumenfeld, 1990; Schunk, 1996; Schunk & Swartz, 1993; Zimmerman& Martinez-Pons, 1990). The general conclusion is that students who display more adaptive self-regulatory strategies demonstrate better learning and higher motivation for learning (Pintrich, 2000).

After that, both Zimmerman's and Pintrich' models examined in this study at several aspects. Zimmerman's social cognitive theory is underlining social foundations of thinking and behavior. Pintrich's model too derives mainly from the social cognitive approach. As far as the empirical research is concerned, two major orientations seem to emerge, a motivation orientation and a strategy orientation in these models. Pintrich is mainly motivation oriented in his research. He studied that the relationships between motivational variables and academic achievement and has developed a questionnaire to assess motivational and cognitive variables influencing students' learning. Pintrich has examined the effects of several variables, such as classroom autonomy and discipline, on motivation, learning strategy use and achievement in college students. On the other hand, Zimmerman's research has been both motivation and strategy oriented. His motivation-oriented research includes his work on self-efficacy and his strategy-oriented research consists of the development and use of a structured interview to test students' use of learning strategies. Learning strategy use has been found to correlate with perceptions of self-efficacy. It shows that the models of Pintrich and Zimmerman resemble each other. However, the two models are not identical; for example, Pintrich has worked more on the role of goal orientations in self-regulated learning.

CHAPTER 3

PROBLEMS AND HYPOTHESES

This chapter includes main problem, related sub-problems, and the hypotheses of the study.

3.1 The Main Problems

The three main problems of this study are stated as follows;

1) What is the contribution of motivational beliefs in the prediction of Turkish high school students' achievement in biology?
2) What is the contribution of cognitive and metacognitive strategy use in the prediction of Turkish high school students' achievement in biology?
3) What is the relationship between motivational beliefs and cognitive and metacognitive strategy use among Turkish high school students in biology course?

3.2 The Sub-problems

Based on the first research questions, the following sub-problems to be addressed in this study are as follows:

1.1) Is there a significant contribution of intrinsic goal orientation to Turkish high school students' achievement in biology?

1.2) Is there a significant contribution of extrinsic goal orientation to Turkish high school students' achievement in biology?

1.3) Is there a significant contribution of task value to Turkish high school students' achievement in biology?

1.4) Is there a significant contribution of control of learning beliefs to Turkish high school students' achievement in biology?

1.5) Is there a significant contribution of self-efficacy for learning and performance to Turkish high school students' achievement in biology?

1.6) Is there a significant contribution of test anxiety to Turkish high school students' achievement in biology?

Based on the second research question, the following sub-problems to be addressed in this study are as follows:

2.1) Is there a significant contribution of rehearsal to Turkish high school students' achievement in biology?

2.2) Is there a significant contribution of elaboration to Turkish high school students' achievement in biology?

2.3) Is there a significant contribution of organization to Turkish high school students' achievement in biology?

2.4) Is there a significant contribution of critical thinking to Turkish high school students' achievement in biology?

2.5) Is there a significant contribution of meta-cognitive self-regulation to Turkish high school students' achievement in biology?

2.6) Is there a significant contribution of time and study environment to Turkish high school students' achievement in biology?

2.7) Is there a significant contribution of effort regulation to Turkish high school students' achievement in biology?

2.8) Is there a significant contribution of peer learning to Turkish high school students' achievement in biology?

2.9) Is there a significant contribution of help seeking to Turkish high school students' achievement in biology?

3.3 Hypotheses

The problems stated above are tested with the following hypotheses that are stated in null form.

The null hypothesis of the main problem 1:

► Ho 1: There is no significant contribution of motivational beliefs (intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy and test anxiety) in the prediction of Turkish high school students' achievement in biology.

The null hypothesis of the main problem 2:

► Ho 2: There is no significant contribution of cognitive and meta-cognitive strategy use (rehearsal, elaboration, organization, critical thinking, meta-cognitive self-regulation, time and study environment, effort regulation, peer learning, help seeking) in the prediction of Turkish high school students' achievement in biology.

The null hypothesis of the main problem 3:

► Ho 3: There is no relationship between motivational beliefs and cognitive and meta-cognitive strategy use among Turkish high school students in biology course.

CHAPTER 4

METHOD

In the previous chapters, problems and hypotheses of the study were presented, related literature was reviewed accordingly, and the significance of the study was justified. In the following chapter, population and sampling, description of the variables, instruments of the study, procedure, and methods used to analyze data and assumptions and limitations will be explained briefly.

4.1 Population and Sample

All tenth grade General and Anatolian high school students attending Mathematics and Science group in central Anatolia region in Turkey were identified as the target population of this study. Since it is not easy to reach to this target population, it was found to be appropriate to identify an accessible population. All tenth grade General and Anatolian high school students attending Mathematics and Science group in Yozgat were defined as the accessible population. This is the population for which the results of this study will be generalized. All of the schools involved in the present study were public schools.

General & Anatolian High Schools	Male	Female	Total
Number of Students	1738	1087	2825

In this study, the General and Anatolian high schools students were involved since only these schools involve Mathematics-Science groups at all tenth grade level.

The population being sampled in this study was 2825 students according to the Provincial Directorate of National Education in Yozgat. Accordingly, the desired sample size was determined as 282 students, which is approximately 10 % of the whole population. The sample of the study was chosen from the five districts in Yozgat (Sorgun, Yerköy, Boğazlıyan and Saraykent districts, and city center), by the convenience sampling method, and all General and Anatolian schools in that districts were non randomly selected. After that, all tenth classes math and science group in selected schools was administered the instrument.

Table 4.1 presents number of schools throughout the districts, number of selected schools throughout these districts, and number of students involved in the study from each of the districts. An average of 35-40 students per school corresponding to 2 or 3 classes were participated in the study.

Table 4.1 Numbers of Schools, Selected Schools, and Students through the Districts

Districts	Number of Schools	Number of Selected Schools	Number of Students
Center	8	8	270
Sorgun	2	2	105
Yerköy	2	2	87
Boğazlıyan	2	2	42
Saraykent	1	1	15
Total	15	15	519

Students' ages range from 15 to 18 years, with an overall mean age of 16.4 years (SD=0.6). Participants of the study were 214 girls (41.2%) and 305 boys (58.8%) tenth grade students. Their mean biology achievement grade in previous year was 3.44 out of 5. There were no substantial differences among schools involved in the study with respect to previous biology grades. In all schools, biology grades ranged from 1 to 5.

4.2 Variables

There are 16 variables involved in this study, which were categorized as dependent and independent. There is one dependent variable (DV) and 15 independent variables (IVs).

4.2.1 Dependent Variable

The dependent variable of the study is students' biology achievement scores as measured by the biology achievement test. It is a continuous variable and measured on interval scale. Students' possible minimum and maximum scores range from 0 to 20 for this variable.

4.2.2 Independent Variables

The independent variables included in the study are motivational beliefs (intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy and test anxiety), and cognitive and metacognitive strategy use (rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, help seeking).

4.3 Data Collection Instruments

In this study, two instruments were used in order to obtain data from students. These are the Turkish version of the Motivated Strategies for Learning Questionnaire (MSLQ) and Biology Achievement Test (BAT).

4.3.1 Motivated Strategies for Learning Questionnaire (MSLQ)

Motivated Strategies for Learning Questionnaire (MSLQ) was developed by Pintrich, Smith, Garcia, and McKeachie (1991). This is an 81 item self-report questionnaire, measuring 15 different constructs related to self-regulated learning processes. Students rate themselves on a seven point. Likert scale from "not at all true of me" to "very true of me" concerning motivation in learning and ability in using various learning strategies (see Appendix A).

There are two sections to the MSLQ, a motivation section, and a learning strategies section. The motivation section comprises 31 items that assess students' goals and value beliefs for a course, their beliefs about their skills to succeed in a

course, and their anxiety about tests in a course. Accordingly, the motivational scales are based on three general motivational constructs (Pintrich, 1989): expectancy, value, and affect. Expectancy components refer to students' beliefs that they can accomplish a task, and two MSLQ subscales are directed toward assessing perceptions of self-efficacy (judgments of one's ability to accomplish a task and confidence in one's skills to perform a task) and control beliefs for learning (students' beliefs that outcomes are contingent on one's own effort). Three subscales are included in the MSLQ to measure value beliefs: intrinsic goal orientation (a focus on learning and mastery); extrinsic goal orientation (a focus on grades and approval from others); and task value beliefs (judgments of how interesting, useful, and important the course content is to the student). The third general motivational construct is affect and has been operationalized in terms of responses to the test anxiety scale, which taps into students' worry and concern over taking exams.

The learning strategy section contains 31 items regarding students' use of different cognitive and metacognitive strategies. In addition, the learning strategies section includes 19 items concerning student management of different resources. Accordingly, stategy use section of the MSLQ consists of three general types of scales: cognitive, metacognitive, and resource management. Cognitive strategies include students' use of basic and complex strategies for the processing of information from texts and lectures. The most basic cognitive strategy subscale provides a measure of the use of rehearsal by students (e.g., repeating the words repeatedly to oneself to help in the recall of information). The use of more complex strategies is measured by two subscales concerning the use of elaboration strategies (e.g., paraphrasing, summarizing) and organization strategies (e.g., outlining, creating tables). In addition, a subscale on critical thinking is included that assesses students' use of strategies to apply previous knowledge to new situations or make critical evaluations of ideas. The second general category is metacognitive control strategies, measured by one large subscale related to the use

of strategies that help students control and regulate their own cognition. This subscale includes planning (setting goals), monitoring (of one's comprehension), and regulating (e.g., adjusting reading speed depending on the task). The third general strategy category is resource management, which includes four subscales on students' regulatory strategies for controlling resources other than their cognition. These strategies include managing one's time and study environment (e.g., using one's time well, having an appropriate place to study), as well as regulation of one's effort (e.g., persisting in the face of difficult or boring tasks). Finally, the remaining two subscales, peer learning (e.g., using a study group or friends to help learn) and help seeking (e.g., seeking help from peers or instructors when needed) focus on the use of others in learning.

Subscale scores on the MSLQ are constructed by taking the mean of the items that make up that scale. Some scales contain negatively worded items, and the ratings for those items were reversed before an individual's score is computed, so that the statistics reported represent the positive wording of all the items and higher scores indicate greater levels of the construct of interest.

In the present study, a Turkish version of the MSLQ translated and adapted into Turkish by Sungur (2004) was used. During validation of the instrument, two confirmatory factor analysis were conducted, one for the set of motivation items and the other for the set of learning strategies items. Three of the goodness of fit statistics used was the Root Mean Square Error of Approximation (RMSEA), Goodness of Fit Index (GFI), and the χ^2/df ratio. The RMSEA is based on the analysis of residuals and values below 0.10 indicate a good fit to the data, while GFI with values exceeding 0.90 indicate a good fit to data. The χ^2/df ratio is determined by taking the ratio of $\chi^2$and its degrees of freedom. χ^2/df ratios of less than 5 are interpreted as indicating a good fit to the data (Kelloway, 1998). The RMSEA and GFI values and the χ^2/df ratio for the motivation section were 0.09, 0.77 and 5.3, respectively. The learning strategies section of the MSLQ had a

RMSEA value of 0.08, a GFI value of 0.71, and a χ^2/df ratio of 4.5. The fit statistics, in general, were similar to those of the original version of the questionnaire. As Pintrich et al. (1991) claimed, the fit statistics appeared to indicate a good fit considering the fact that motivational attitudes and use of learning strategies may differ depending upon course characteristics, teacher demands, and individual student characteristics.

Subscales of the MSLQ, reliability coefficients for the original version, reliability coefficients for the present study and number of items are summarized in Table 4.2.

Table 4.2 Subscales of the MSLQ

	Scale	Reliability	Reliability (Original version)	Number of Items
Motivation	Intrinsic Goal Orientation	0.64	0.74	4
	Extrinsic Goal Orientation	0.54	0.62	4
	Task Value	0.79	0.90	6
	Control of Learning Beliefs	0.61	0.68	4
	Self-Efficacy for Learning and Performance	0.85	0.93	8
	Test Anxiety	0.56	0.80	5
Strategy Use	Rehearsal	0.66	0.69	4
	Elaboration	0.75	0.76	6
	Organization	0.68	0.64	4
	Critical Thinking	0.78	0.80	5
	Metacognitive Self-Regulation	0.77	0.79	12
	Time and Study Environment	0.61	0.76	8
	Effort Regulation	0.50	0.69	4
	Peer Learning	0.50	0.76	3
	Help Seeking	0.56	0.52	4

As shown in the table, in the current study, the reliability coefficients ranged from 0.54 to 0.85 for the motivation section and from 0.50 to 0.78 for the learning strategies section of the questionnaire (see Table 4.2).

4.3.2 Biology Achievement Test (BAT)

This is a 20-item multiple-choice test, which was developed by the researcher (see Appendix B). The items in the test were selected from University Entrance Examinations, which were held to admit students to universities in previous years. Answering the questions required higher levels of thinking. Topics included in the test were selected from 9th grade biology curriculum. Therefore, there were items in the test related to biology as a science, basic compounds of living things, cell structure and function, diversity and classification, and ecology (see Table 4.3). In order to determine the students' score on the test, a correct answer was coded as "1" and an incorrect response as "0". The total score obtained on the test was used as a measure of students' biology achievement. The reliability (Cronbach's alpha) of the test was found to be 0.79.

The following procedure was followed while developing the achievement test:

1. The content of the ninth grade biology curriculum was examined.
2. Six main units taught in ninth grade biology course and their proposed class hours were listed.
3. The web site of OSYM was searched for the questions that were asked in the University Entrance Examinations related with the ninth grade biology curriculum.
4. All related questions were collected and a multiple-choice question pool was formed.
5. Among six units, five of them were decided to be included in the test content since they account for the top highest-class hours in the ninth grade curriculum.
6. Questions to be included in the test were selected from the question pool in coordination with the experts in the field of science education, and biology teachers.
7. The number of questions representing each unit was decided according to the weight of the chapter in the ninth grade biology curriculum. The higher the class

hours of the chapter in the curriculum, the higher the number of items representing that chapter in the test.

8. Neither the body of the selected questions nor the distracters were modified during the preparation of the Biology Achievement Test.

Table 4.3 Names of the units, their proposed class hours in the ninth grade Biology curriculum, and the number of questions representing those units in the BAT.

Name of the Chapters	Proposed Class Hour	Number of Questions in BAT
Biology as a Science	8	1
Science of 2000s: Biology	4	-
Cell Structure and Function	20-22	7
Basic Compounds of Living Things	14-16	5
Diversity and Classification	10	2
Ecology	14-16	5

4.4 Procedure

The study started with defining the research problem specifically and identifying key words relevant to the problem of interest. Next, the related literature was reviewed in detail. After that, Educational Resources Information Center (ERIC), International Dissertation Abstracts, Social Science Citation Index (SSCI), Ebscohost, Science Direct, and Internet (e.g., Google) were searched systematically. Addition to studies in abroad, MS and PhD theses made in Turkey

were also searched from YÖK, Hacettepe Eğitim Dergisi, and Eğitim ve Bilim. The photocopies of the available documents were obtained from METU library and Internet. All of the relevant documents were organized and read carefully by the researcher.

After a detailed review of literature, Biology Achievement Test was prepared. Following the selection of the schools, which will be involved in the study, necessary permission was taken from the Ministry of Education for the administration of the measuring instruments.

The researcher administered the measuring instruments (MSLQ and BAT) to the selected 519 tenth grade students from 15 schools during the last six weeks of the spring 2004-2005 semesters. One class hour was given to the participants to complete all instruments. Directions were made clear and the researcher did necessary explanations. Students were also assured that any data collected from them would be held in confidence and that the grades of the BAT would not affect their biology grades. They were warned to complete each measuring tool without leaving any empty item as well. Due to the time restriction and impossibility of being present in each class during administration, the researcher occasionally requested teacher support. The teachers were informed about the study and about the directions that should be done prior to the administration. No specific problems were encountered during the administration of the measuring instruments.

4.5 Analysis of Data

The statistical analysis were done by using statistical package for the social sciences program (SPSS 11.5). The data obtained in the study were analyzed by using both descriptive statistics and inferential statistics.

4.5.1 Descriptive Statistics

Descriptive statistics such as mean, standard deviation, range, minimum, maximum, skewness, and kurtosis scores of students' achievement in biology,

motivational beliefs variables and cognitive and metacognitive strategy use variables were presented.

4.5.2 Inferential Statistics

In order to test the null hypotheses, statistical technique named Multiple Linear Regression Analysis and a Canonical Correlation Analysis were used.

4.6 Assumptions and Limitations of the Study

As in any research study, several considerations may affect the overall findings, or effective usefulness of the results. The following assumptions and limitations should serve to enrich the conclusions of this study by identifying both positive and negative aspects of the basic study's design.

4.6.1 Assumptions of the Study

The researcher made the following assumptions for this study:

1. The administration of the instruments was under standard conditions.
2. All students involved in the study responded sincerely and correctly to the items of the BAT, and MSLQ.

4.6.2 Limitations of the Study

The study was subjected to the following limitations:

1. Learner characteristics (e.g., demographic variables, family characteristics, health related factors, financial insecurity etc.) were not considered beyond the determination of the students' motivational beliefs, cognitive and metacognitive strategy use and biology achievement.
2. The teaching styles of the instructors were not measured during the study. While it is recognized that the teaching style employed by the instructor has a significant impact on the learning outcome, there was no opportunity to modify or

experiment with different teaching styles. Therefore, teaching style was not evaluated during the study.

3. This study was limited to 10^{th} grade students. Cross-age studies can be conducted to determine contribution of self-regulatory processes in different grade levels.

4. This study was limited to biology course. Further studies can be conducted to determine contribution of self-regulatory processes in different courses.

5. In this study, content of the Biology Achievement Test was limited to 9^{th} grade curriculum with 20 questions. Further studies can be conducted using biology achievement tests containing more items.

CHAPTER 5

RESULTS

This chapter is divided into three sections. Descriptive statistics are presented in the first section. The second section presents inferential statistics in which main problems and the null hypothesis were tested. Finally, the last section summarizes the findings of the study.

5.1 Descriptive Statistics

As part of descriptive statistics, mean, standard deviation, range, minimum, maximum, skewness, and kurtosis values for students' biology achievement, motivational beliefs variables and cognitive and metacognitive strategy use variables were calculated and presented in Table 5.1. As shown in the table, students' biology achievement test scores ranged from "2" to "20". Mean achievement score for all students were 9.15 with a standard deviation of 4.38. The skewness and kurtosis values for achievement scores lied between "-1" and "+1". As well as motivational beliefs and cognitive and metacognitive strategy use scores suggesting that, all scores are normally distributed.

Descriptive statistics concerning motivational beliefs showed that all related scores except for self-efficacy for learning and performance ranged from "1" to "7". In general, a higher mean score such as "4", "5", "6", or "7" was better than a lower core such like "1", "2", or "3". The only exception was the test anxiety, where a higher score meant more worrying.

Descriptive statistics related to cognitive and metacognitive strategy use variables (rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, help seeking) showed that except for metacognitive self-regulation and time and study environment, all strategy use scores ranged from “1” to “7”. Strategy use scores were measure of how often students use different kind of study skills and learning strategies. In the present study, organization strategy use with a mean of 6.64 apperead to be the most frequently used strategy in biology learning among students.

Table 5.1 Basic Descriptive Statistics Related to Motivational Beliefs Variables, Cognitive and Metacognitive Strategy use Variables and Biology Achievement Test Scores.

Variable	Mean	Std. Deviation	Range	Minimum	Maximum	Skewness	Kurtosis
IGO	5.37	1.23	6.00	1.00	7.00	-.733	-.048
EGO	5.19	1.25	6.00	1.00	7.00	-.591	-.289
TV	5.43	1.18	6.00	1.00	7.00	-.864	.492
CLB	6.00	0.93	6.00	1.00	7.00	-1.203	2.238
SELP	5.44	1.07	5.50	1.50	7.00	-.739	.192
TA	4.12	1.22	6.00	1.00	7.00	-.221	-.125
R	4.94	1.36	6.00	1.00	7.00	-.529	-.212
E	4.84	1.35	6.00	1.00	7.00	-.456	-.313
O	6.64	1.41	6.00	1.00	7.00	-.418	-.376
CT	4.40	1.37	6.00	1.00	7.00	-.247	-.513
MSR	4.90	1.01	5.08	1.92	7.00	-.253	-.444
TSE	4.78	1.00	5.25	1.75	7.00	-.320	-.035
ER	4.65	1.30	6.00	1.00	7.00	-.288	-.343
PL	4.22	1.34	6.00	1.00	7.00	.013	-.539
HS	4.44	1.35	6.00	1.00	7.00	-.332	-.357
ACHİE	9.15	4.38	18.00	2.00	20.00	.602	-.629

5.2 Inferential Statistics

In order to address the first and second hypotheses of the study, two Multiple Linear Regression Analysis were conducted. In addition, for third hypothesis Canonical correlation was conducted.

5.2.1 Assumptions of Multiple Linear Regressions

Multiple regressions have a number of assumptions namely, multicollinearity, sample size, outliers, normality, linearity, homoscedasticity, and independence of residuals assumptions. For the multicollinearity assumption the bivariate correlations among the independent variables were calculated (Table 5.2). All correlation coefficients were below 0.7 showing that there was no violation of the multicollinearity assumption for motivational beliefs and cognitive and metacognitive strategy use. For sample size, Tabachnick and Fidell (1996) give a formula for calculating sample size requirements, taking into account the number of independent variables used; $N > 50 + 8m$ (where m = number of independent variables). In this study, number of independent variables was six for the first multiple linear regression analysis and nine for the second multiple linear regression analysis. For the first multiple linear regression analysis, from formula $N>50+8.(6)$; $N>98$. Sample size in this analysis was 514 and $514 > 98$, so sample size of this analysis encountered this assumption. In addition, for the second multiple linear regression analysis, from formula $N>50+8.(9)$; $N>122$. Sample size in this analysis was 517 and $517 > 122$, so also sample size of this analysis encountered this assumption.

Outliers were checked by inspecting Mahalanobis distances. Mahalanobis distances are distributed as a chi-square (χ^2) variable, with degrees of freedom equal to the number of independent variables. The criterion for multivariate outliers is Mahalanobis distances at $p<.001$. The first research hypothesis about motivational beliefs included six independent variables. In this case, critical χ^2 at alpha=.001 for "6" df is 22.46 (Tabachnick & Fidell, 1996). For the first regression analysis, "5" cases exceeding the critical value of 22.46 were removed from the data as potential outliers.

Table 5.2 Correlations

	IGO	EGO	TV	CLB	SELP	TA	R	E	O	CT	MSR	TSE	ER	PL	HS	ACHI
IGO	1.000															
EGO	.098*	1.000														
TV	.520**	-.034	1.000													
CLB	.205**	.136**	.263**	1.000												
SELP	.470**	.068	.601**	.317**	1.000											
TA	.137**	.361**	.018	.115**	-.008	1.000										
R	.335**	.177**	.360**	.240**	.338**	.193**	1.000									
E	.420**	-.013	.547**	.175**	.452**	.052	.545**	1.000								
O	.385**	.071	.411**	.220**	.374**	.095*	.622**	.634**	1.000							
CT	.462**	-.051	.544**	.148**	.525**	.024	.394**	.685**	.492**	1.000						
MSR	.530**	.019	.576**	.265**	.552**	.030	.605**	.708**	.649**	.620**	1.000					
TSE	.355**	-.030	.424**	.165**	.406**	-.080	.398**	.493**	.424**	.390**	.581**	1.000				
ER	.351**	-.065	.420**	.183**	.483**	-.157**	.349**	.452**	.373**	.396**	.614**	.541**	1.000			
PL	.397**	.126**	.345**	.162**	.358**	.176**	.462**	.503**	.539**	.466**	.515**	.394**	.249**	1.000		
HS	.205**	.073	.274**	.030	.194**	.053	.339**	.362**	.335**	.295**	.381**	.319**	.209**	.457**	1.000	
ACHIE	.103*	-.227**	.213**	.098*	.126**	-.128**	.001	.173**	.142**	.153**	.177**	.200**	.154**	.037	.082	1.000

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

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

The second research hypothesis about cognitive and metacognitive strategy use which include nine independent variables. In this case, critical χ^2 at alpha=.001 for "9" df is 27.88. For the second regression analysis, just two cases exceeding the critical value of 27.88 were removed from the data (Tabachnick & Fidell, 1996). In addition, outliers for dependent variable were checked by inspecting a standardized residual and scatterplot. In this study, for the first research hypothesis, minimum standardized residual value was -1.985 and maximum standardized residual value was 2.868. They were between -3.3 and 3.3. In addition, for the second research hypothesis, minimum standardized residual value was -2.166 and maximum standardized residual value was 2.464. They were between -3.3 and 3.3. Thus, it appeared that there were no outliers on the dependent variable, which was biology achievement score.

Then, linearity, homoscedasticity, and independence of residuals assumptions were checked by examining the standardized residuals and it was found that all the assumptions were met with no serious violations (see Figure 5.1 & Figure 5.2).

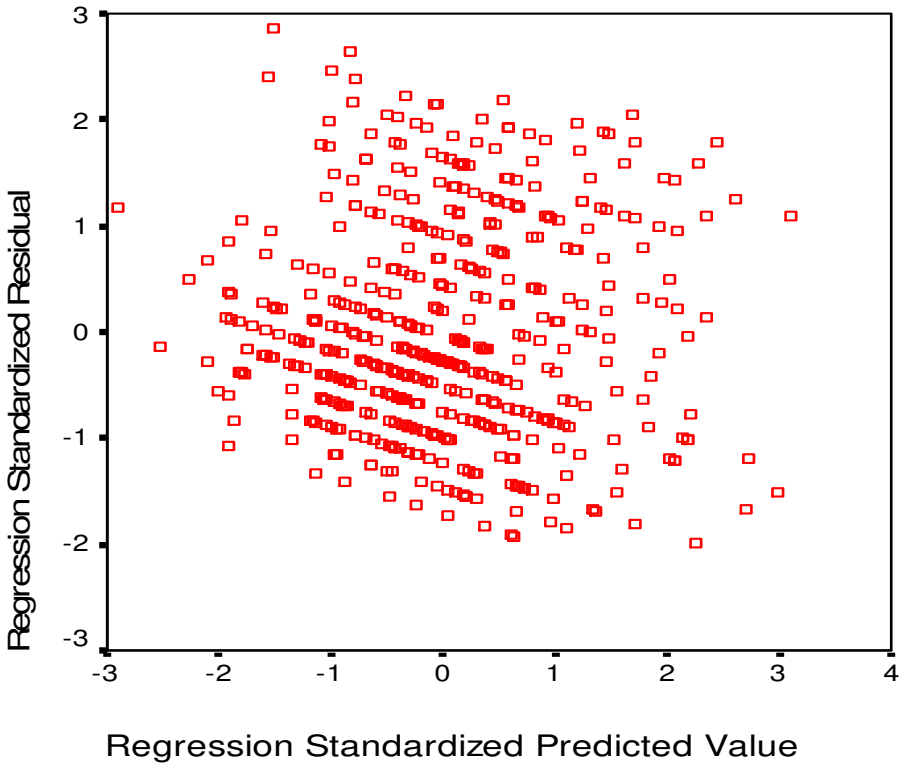

Figure 5.1 Scatterplot for Motivaional Beliefs

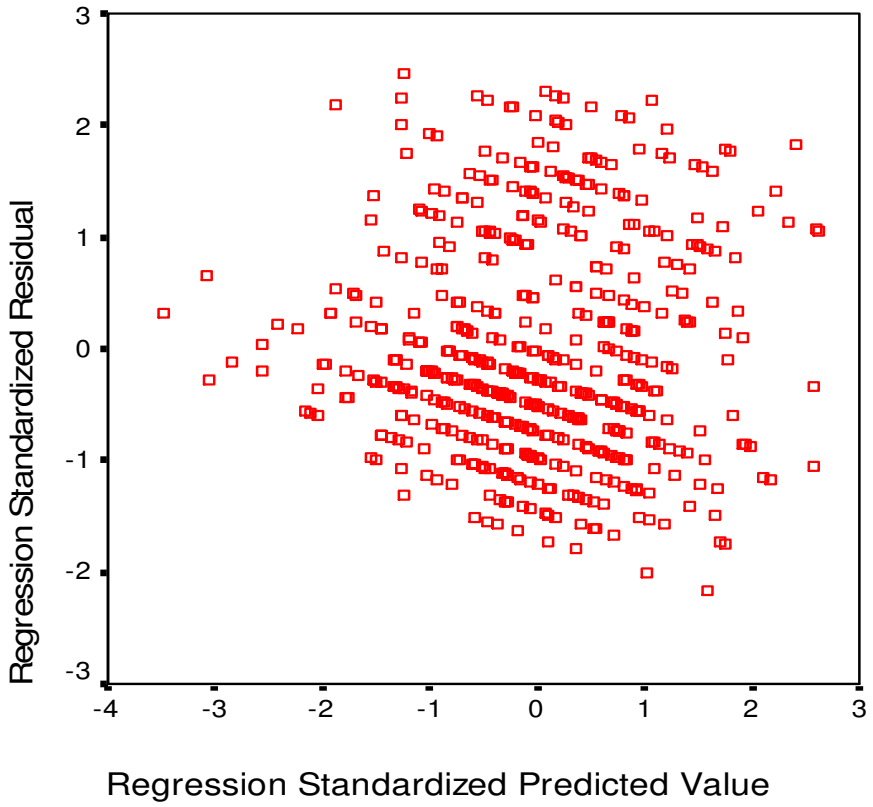

Figure 5.2 Scatterplot for Cognitive and Metacognitive Strategies

5.2.2 Main Problem 1

'What is the contribution of motivational beliefs in the prediction of Turkish high school students' achievement in biology?'

Ho 1: There is no significant contribution of motivational beliefs (intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy and test anxiety) in the prediction of Turkish high school students' achievement in biology.

Multiple Linear Regression Analysis was conducted to address this main problem. The results of the multiple linear regression analysis showed that the motivational beliefs significantly accounted for 10% of the variation in students' achievement (R= 0.32, F= 9.623, p < 0.05). More specifically, it was found that extrinsic goal orientation and task value each made a statistically significant contribution to the prediction of students' achievement ($p < 0.05$), while intrinsic goal orientation, control of learning beliefs, self-efficacy for learning and performance, and test anxiety failed to achieve significance ($p > 0.05$). The largest beta coefficient was -0.22, which was for the extrinsic goal orientation – indicating that this variable made the strongest unique contribution to explaining the dependent variable, when the variance explained by all other variables in the model is controlled for. Sign of the beta coefficient revealed that higher levels of extrinsic goal orientation were associated with lower levels of achievement. On the other hand, higher levels of task value were found to be associated with higher levels of achievement. Therefore, students who perceived biology as an important and useful course appeared to obtain higher scores on the achievement test. Beta coefficients and related significance values are presented in Table 5.3

Table 5.3 Contribution of motivational beliefs to achievement

Independent Variables	Beta	p
Intrinsic goal orientation	0.01	0.797
Extrinsic goal orientation	-0.22	0.000
Task Value	0.16	0.006
Control of Learning Beliefs	0.09	0.053
Self-Efficacy for Learning and Performance	0.03	0.606
Test Anxiety	-0.06	0.209

5.2.3 Main Problem 2

'What is the contribution of cognitive and metacognitive strategy use in the prediction of Turkish high school students' achievement in biology?'

Ho 2: There is no significant contribution of cognitive and metacognitive strategy use (rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, help seeking) in the prediction of Turkish high school students' achievement in biology.

The second multiple linear regression analysis indicated that cognitive and metacognitive strategy use significantly accounted for 9 % of the variation in students' achievement (R=0.29, F= 5.299, $p < 0.05$). More specifically, it was found that rehearsal strategy use, organization strategy use, management of time and study environment, and peer learning each made a statistically significant contribution to the prediction of students' achievement ($p < 0.05$). The largest beta coefficient was -0.22, which was for the rehearsal strategy use – indicating that this variable made the strongest unique contribution to explaining the dependent variable, when the variance explained by all other variables in the

model is controlled for. Signs of the beta coefficients indicated that there were reverse relationships between rehearsal strategy use, peer learning and achievement scores. In addition, it was found that as level of organization strategy use and time and study environment management increased, students' achievement scores increased. Beta coefficients and related significance values are presented in Table 5.4

Table 5.4 Contribution of cognitive and metacognitive strategy use

Independent Variables	Beta	p
Rehearsal	-0.22	0.000
Elaboration	0.08	0.250
Organization	0.13	0.047
Critical Thinking	0.04	0.478
Metacognitive Self-Regulation	0.10	0.228
Time and Study Environment	0.15	0.008
Effort Regulation	0.01	0.854
Peer Learning	-0.12	0.032
Help Seeking	0.04	0.414

5.2.4 Main Problem 3

'What is the relationship between motivational beliefs and cognitive and metacognitive strategy use among Turkish high school students in biology course?'

Ho 3: There is no relationship between motivational beliefs and cognitive and metacognitive strategy use among Turkish high school students in biology course.

In order to address third main problem, a canonical correlation analysis was performed between the set of motivational beliefs variables and the set of cognitive and metacognitive strategy use variables. The first canonical correlation was 0.31 (10 % overlapping variance). The remaining five canonical correlations were effectively zero. With all six canonical correlations included, $\chi^2(54) = 98.27$, $p < 0.001$. Subsequent χ^2 tests were not statistically significant. The first canonical variate, thus, accounted for the significant relationships between the two sets of variables.

Data on the first canonical variate were presented in Table 5.5. As shown in the table, with a cutoff correlation of 0.30 (Tabachnick & Fidell, 1996), the variables in the motivational beliefs set that were correlated with the first canonical variate were intrinsic goal orientation, task value, self-efficacy for learning and performance, and test anxiety. The first canonical variate was positively associated with all these variables but test anxiety. Among the strategy use variables, elaboration, organization strategy use, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, and peer learning positively correlated with the first canonical variate. The first pair of canonical variates indicated that higher levels of intrinsic goal orientation, task value, and self-efficacy for learning and performance were associated with higher levels of cognitive and metacognitive strategy use except rehearsal strategy use and help seeking. In addition, it was revealed that there was a negative association between test anxiety and use of various strategies.

Moreover, the percent of variance values indicated that the first canonical variate pair extracts 28 % of variance from the motivational beliefs variables and 32 % of variance from the cognitive and metacognitive strategy use variables.

Also, redundancy values revealed that the first motivational beliefs variate accounts for 3 % of the variance in the cognitive metacognitive strategy use variables. Similarly, the first cognitive and metacognitive strategy use variate accounts for 3 % of the variance in the motivational beliefs variables.

Table 5.5. Correlations, Standardized Canonical Coefficients, Canonical Correlations, Percents of Variance, and Redundancies between Motivational Beliefs Variables and Cognitive and Metacognitive Strategy Use Variables.

	First Canonical Variate	
	Correlation	**Coefficient**
Motivational Beliefs Variables		
Intrinsic Goal Orientation	0.46	0.08
Extrinsic Goal Orientation	-0.28	-0.11
Task Value	0.83	0.64
Control of Learning Beliefs	0.12	-0.06
Self-Efficacy for Learning and Performance	0.68	0.27
Test Anxiety	-0.49	-0.47
Percent of Variance	0.28	
Redundancy	0.03	
Cognitive Metacognitive Strategy Use Variables		
Rehearsal	0.17	-0.40
Elaboration	0.65	0.29
Organization	0.41	0.04
Critical Thinking	0.65	0.29
Metacognitive Self-Regulation	0.60	-0.18
Time and Study Environment	0.69	0.29
Effort Regulation	0.84	0.65
Peer Learning	0.39	0.06
Help Seeking	0.29	0.04
Percent of Variance	0.32	
Redundancy	0.03	
Canonical Correlation	0.31	

5.3 Summary of the Results

The results of this study can be summarized as follows:

- The mean achievement scores suggested that biology achievement was very low for the subjects of this study.
- Extrinsic goal orientation made a statistically significant contribution to the prediction of students' achievement in biology.
- Higher levels of task value were found to be associated with higher levels of achievement.
- Rehearsal strategy use variable made the strongest unique contribution to explaining biology achievement.
- Organization strategy use, management of time and study environment, and peer learning each made a statistically significant contribution to the prediction of students' achievement in biology.
- As level of organization strategy use and time and study environment management increased, students' achievement scores increased.
- The variables in the motivational beliefs set that were correlated with the first canonical variate were intrinsic goal orientation, task value, self-efficacy for learning and performance, and test anxiety.
- The first canonical variate was positively associated with intrinsic goal orientation, task value, self-efficacy for learning and performance, but negatively with test anxiety.
- Among the strategy use variables, elaboration, organization strategy use, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, and peer learning positively correlated with the first canonical variate.
- The first pair of canonical variates indicated that higher levels of intrinsic goal orientation, task value, and self-efficacy for learning and performance

were associated with higher levels of cognitive and metacognitive strategy use except rehearsal strategy use and help seeking

- There was a negative association between test anxiety and use of various strategies.

CHAPTER 6

CONCLUSIONS, DISCUSSIONS, AND IMPLICATIONS

This chapter presents the summary of the research study, conclusions, and discussion of the results, internal and external validity of the study, and finally announces the implications of the study and recommendations for further studies.

6.1 Summary of the Research Study

In order to investigate the specified purposes of this study, 519 tenth grade students chosen from an accessible population were administered the Turkish version Motivated Strategies for Learning Questionnaire (MSLQ-TV) and Biology Achievement Test (BAT) during the spring 2004–2005 semester. To obtain the representative sample, convenience random sampling was used. Correlational research was the research methodologies utilized during the course of this study.

6.2 Conclusions and Discussions

This study aimed at quantitatively investigating which self-regulatory learning processes are related to Turkish high school students' achievement in biology. For the specified purpose, a Turkish version of the MSLQ that was originally developed by Pintrich et al. (1991) was used for measuring the various aspects of self-regulatory learning. The MSLQ, which was founded on social cognitive theory, was designed to focus on course level assuming that students' motivation varies for different courses and that their strategy use can differ as well depending on the nature of the academic tasks (Duncan & McKeachie, 2005).

Therefore, in the present study, emphasis was given on course level and Turkish high school students' academic achievement in relation to self-regulatory processes in biology course was investigated. Results showed that Turkish high school students' biology achievement was related to the following self-regulated learning processes: extrinsic goal orientation, task value, rehearsal strategy use, organization strategy use, management of time and study environment and peer learning. When the contribution of motivational beliefs to students' achievement in biology was considered, it was found that as the level of extrinsic motivation increased students' achievement scores decreased. Therefore, students who studied for the reasons of showing their abilities to others and receiving just good grades without the ultimate aim of mastering the task tended to get lower scores. This can be due to the fact that items in the achievement test required higher level of thinking. Therefore, students who studied just to get good scores without trying to understand the content deeply and to learn meaningfully might have experienced difficulty in the test. On the other hand, although contribution of intrinsic goal orientation to achievement was not statistically significant, the direction of the relation between intrinsic goal orientation and achievement was found to be positive. Therefore, students with personal intention to master a task tended to get better grades. In addition, students who obtained higher scores on the achievement test appeared to perceive biology more interesting, important, and useful than low achievers. These results were in congruence with the findings of the studies conducted among American students (Pintrich et al., 1991, VanderStoep et al., 1996). Actually, intrinsic goal orientation and task value are among the motivational variables that are adaptive and positively associated with students' academic performance. In fact, according to McCoach and Siegle (2003), if students value neither the task nor the outcome, they will not be motivated to put their best effort when completing the task. In the present study, canonical correlations also revealed that higher levels of task value were positively related with higher levels of learning strategy use. Therefore, students who perceived

biology as important and useful appeared to put greater effort in their learning using various strategies and managing their time and study environment more effectively. Actually, all the motivational beliefs, except extrinsic goal orientation and test anxiety, were found to be positively related with the use of all learning strategies measured by the MSLQ. This finding supports the findings in the literature that motivation is essential for the use of various cognitive and metacognitive strategies, and persistence in a task (Pintrich & DeGroot, 1990; Zusho & Pintrich, 2003). In fact, a review of the research conducted in the United States using the MSLQ suggests that self-efficacy, task value beliefs, and intrinsic goal orientation are positively related to use of learning strategies (Pintrich, 1999, Wolters et al., 2003). It was consistently found that students who are self-efficacious in their learning are more likely to report using various learning strategies, with regression coefficients ranging from 0.10 to 0.67. Similarly, students who value school work, also report more strategy use, with coefficients ranging from 0.03 to 0.73. In addition, students with intrinsic goal orientation tend to use report higher levels of strategy use, with coefficients ranging from 0.06 to 0.73.

When cognitive, metacognitive, and regulatory strategy use were considered, it was found that students with a high level of organization strategy use like outlining and time and study environment management obtained higher scores on the test. However, rehearsal strategy use was inversely related to achievement, which is in contrast to findings in the United States. Actually, many of the studies conducted in the United States indicated a positive correlation between the use of rehearsal strategy use and academic achievement. This contradictory result can be due to the nature of the items in the test requiring students to organize what they know and apply it to new situations to be able find the correct answer. Thus, in order to answer the questions, memorization or simple recall was not sufficient, but students had to employ deep processing strategies such as paraphrasing, summarizing, outlining and generative note taking which

can help them integrate and connect their knowledge. Actually, Kuyper et al. (2000) reported a similar finding and they proposed that operationalizations of the self-regulation variables and the way how achievement is measured may explain the contradictory findings in the literature. Therefore, the current study suggests that before analyzing the results concerning the relations of various self-regulatory processes to achievement, achievement as a construct should be clearly defined. It should be clear how students' achievement was measured since some self-regulatory processes may have predictive ability for an achievement test measuring higher order thinking skills but not for a test requiring just simple recall. In addition, it should be noted that the nature of tasks and tests can shape students' strategy use and that students are highly adaptive in using these strategies to get better grades even if they may not lead to deeper levels of learning (Wolters et al., 2003). For example, results of a study by Purdie and Hattie (1996) which extended contextual differences in the use of self-regulatory strategies to the cross-cultural dimension showed that Japanese students, who are stereotypically viewed as rote learners, consider memorization as the most important strategy in their learning. Actually, the use of rehearsal strategy was not found to result in low achievement among Japanese students. On the other hand, in Turkish secondary school biology curriculum, which has been implemented countrywide since 1998, objectives were formulated in such a way that students no longer should memorize the knowledge as facts and principles, but that they should comprehend the knowledge and integrate it to their daily lives. Consequently, it appears to help students to identify practical applications of concepts making connections between concepts and real world experiences in ways that enhance the understanding of concepts. Therefore, due to the differences in contexts and the curricular approaches that students experience in different countries, there is need for much research on the use of self-regulatory strategies in different contexts and countries to determine the generalizability of theoretical models and practical implications of self-regulation (Olaussen & Braten, 1999).

In addition, concerning the contribution of peer learning in the prediction of Turkish high school students' achievement in biology, it was found that there is a negative relationship between peer learning and achievement. This can be due to the fact that some important goals and objectives requiring students to work in a group, share their ideas have not been emphasized in Turkish biology curriculum. There are some goals like thinking independently, making criticism independently which are necessary for an individual, but there are no goals and objectives to foster interaction among students. However, as King (2002) claimed some peer learning tasks such as working together to solve ill-structured problems and analyzing and integrating ideas to build knowledge demand a higher, more complex level of cognitive processing, which may lead to a better academic achievement. Therefore, it is expected that students who cooperate with their peers and appreciate the importance of cooperation in their learning have higher levels of achievement. However, similar to our findings among Turkish students, Pintrich et al. (1991) found a negative relationship between peer learning and achievement. Therefore, perhaps it is better to conduct analysis at classroom level to be able to determine effect of the contextual factors on peer learning and achievement.

Another issue that can be addressed in this study is related to the measurement of self-regulated learning. At this point, it should be noted that in the present study, the MSLQ – developed from a student approach to learning (SAL) perspective – was used as a measure of students' self-regulation. SAL models are derived from students' own reports of their learning and studying processes. Although self-report questionnaires like the MSLQ (developed from SAL perspective) can provide information about student motivation and general capabilities for self-regulation, they may be limited in capturing the actual events or on-going dynamic processes of self-regulation. For instance, although the MSLQ is an instrument which provides a valid and reliable measure of students' motivation and use of various learning strategies, and is therefore used by a large number of researchers in different countries, it does not contain scales assessing

the use of strategies to control motivation and affect or students' perceptions of the task and context (Pintrich, 2004). Thus, while interpreting the results of the present study, limitations of the MSLQ in assessing students' self-regulation should be taken into consideration.

Therefore, although there are some differences, in general the results of the present study were in congruence with the findings in the literature. However, there is a need for conducting similar studies in other subject areas to ensure generalizability of the findings. In addition, the present study suggests that structural equation modeling techniques can be used to explore complex and reciprocal relationships among various variables related to academic achievement. Moreover, there is need for developing instruments to measure different aspects of self-regulation. The current study also proposes that future research should investigate the effects of different instructional methods on various self-regulatory processes. According to Paris and Paris (2001), teachers should create open-ended environments with emphasis placed on working together to guide students to more effective approaches to learning and less emphasis on workbook exercises and routine tasks in order to promote self-regulated learning. In addition, these authors suggested that teachers should use performance-based assessment, which can motivate students and provide opportunities for self-regulated learning. In line with this idea, the effects of student centered approaches involving authentic tasks and assessment, such as problem based learning on students' self-regulatory skills, can be investigated. Actually, there should be a synergy between classrooms practices and research on self-regulated learning to promote positive learning outcomes and life-long learning.

6.3 Internal Validity of the Study

Internal validity of the study refers to the degree to which the observed differences on the dependent variables are directly related to the independent variables, not to extraneous variables that may affect the results of the research

(Fraenkel & Wallen, 2003). Possible threats to internal validity and methods to cope with them were discussed in this section.

The schools are selected in a convenience manner rather than randomly selected. Since the groups were already formed, random assignments of subjects to groups were not possible.

Location and instrumentation could not be threats to the study since the instruments were administered to all groups in similar conditions and mostly by the researcher.

Data collector characteristics and data collector bias threats were assumed to be controlled by training and informing the teachers to ensure standard procedures under which data were collected.

Finally, confidentially was not a threat in this study, since names of the students were not used anywhere. Their names were known only by the researcher.

6.4 External Validity of the Study

The external validity is the extent to which the results of the study can be generalized. Population generalizability and ecological generalizability are the two types of external validity. Population generalizability refers to the degree to which a sample represents the population of interest. Ecological generalizability refers to the degree to which the results of the study can be extended to other settings or conditions (Fraenkel & Wallen, 2003).

After selecting districts by convenience sampling, all schools in those districts non-randomly selected were used to obtain a representative sample of the population. In this study, 519 tenth grade students were involved, which is 18.4 % of the whole population. This ratio was over than 10 % of the whole population, which is advised ratio (Fraenkel & Wallen, 2003). Hence, there is no limitation to generalize the findings of the study. Therefore, the results and conclusions found in the study can easily be applied to the accessible population.

Since all the administration procedure took place in ordinary classrooms during regular class hours, there were possibly no remarkable differences among the environmental conditions. Therefore, it was believed that external effects were sufficiently controlled by the settings used in the study.

6.5 Implications of the Study

Based on the findings of this study and previous research following suggestions can be offered:

1. Educators and teachers should be aware of the differences that exist among students rather than assuming that everyone learns in the same way.
2. Teachers should try to motivate students in their classrooms by using the suggestions below:
    - De-emphasize grading as much as possible and encourage students to develop their intrinsic goal orientation.
    - Overemphasizing exams and making them difficult to complete in the allotted time may promote anxiety and focus on rote memorization. To increase interest and motivation in learning, use evaluative methods that encourage conceptual learning without threatening students.
    - Try to encourage the growth of intrinsic satisfaction and the rewards of learning in students.
    - Communicate to students that you believe each of them can learn biology meaningfully without memorizing. Students should know they can learn biology and that the teacher expects them to do so.
    - Praise student effort and performance only when it is deserved. Teachers must be specific with their praise and use their professional judgment to decide the frequency of praise that is most appropriate for each student in their class.

- Stress the importance of self-improvement rather than performing better than others in the class.
- Stress the usefulness and importance of biology. Students who believe that learning biology is necessary to succeed in school, daily life and in jobs will be more highly motivated than students who see no real purpose for learning biology.
- Use a variety of teaching strategies and materials. A teacher who effectively uses models, pictorial aids, simulations, and activities instead of textbook explanations is likely to keep all students motivated.
- When students make a mistake or get a low grade, encourage them to try again and harder rather than letting them broad about their failure. Students who learn to keep trying are believed to go a long way toward becoming highly motivated and are more likely to learn how to handle with the classroom difficulties.
- Encourage students to use of different learning strategies for promoting meaningful learning.

6.6 Recommendations for Further Research

Current study has suggested a variety of useful topics for further studies. These are briefly as follows:

- Further study can investigate the effects of different instructional methods on various self-regulatory processes;
- Further study can examine gender differences in motivational beliefs and strategies use;
- Similar studies can be conducted to different grade levels and in different science courses;

- Further study can be conducted in different schools and different regions to get results that are more accurate and to provide a generalization for Turkey.

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APPENDIX A

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

ÖGRENMEDE GÜDÜSEL STRATEJİLER ANKETİ

Sevgili Öğrenciler;

Bu çalışmada, sizlerin biyoloji dersine yönelik tutumunuzu, motivasyonunuzu ve öğrenme stratejilerinizi belirlemek için; *I. bölümde* "Öğrenmede Güdüsel Stratejiler Anketi", *II. bölümde* ise "Biyoloji Başarı Testi" uygulanacaktır. **Lütfen her cümleyi dikkatle okuduktan sonra, size uygun gelen seçeneği mutlaka işaretleyiniz. Bu araştırma sizler ve sizden sonraki öğrencilerimiz açısından çok önemlidir. Yaptığınız ve yapacağınız katkılardan dolayı teşekkürler.**

Necmettin YUMUŞAK
ORTA DOĞU TEKNİK ÜNİVERSİTESİ
Yüksek Lisans Öğrencisi

Ad, Soyad:
Geçen dönem Biyoloji Dersi karne notunuz:
Okulunuzun adı:
Cinsiyetiniz: ☐ **kız** ☐ **erkek**
Sınıf:
Yaş:
Annenizin mesleği:
Babanızın mesleği:

I. BÖLÜM ÖĞRENMEDE GÜDÜSEL STRATEJİLER ANKETİ

Bu anket iki kısımdan oluşmaktadır. İlk kısımda biyoloji dersine karşı tutumunuzu, motivasyonunuzu, ikinci kısımda ise biyoloji 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**

A. Motivasyon (Güdülenme)

1. Biyoloji dersinde yeni bilgiler öğrenebilmek için, büyük bir çaba gerektiren sınıf çalışmalarını tercih ederim.	1	2	3	4	5	6	7
2. Eğer uygun şekilde çalışırsam, biyoloji dersindeki konuları öğrenebilirim.	1	2	3	4	5	6	7
3. Biyoloji sınavları sırasında, diğer arkadaşlarıma göre soruları ne kadar iyi yanıtlayıp yanıtlayamadığımı düşünürüm.	1	2	3	4	5	6	7
4. Biyoloji dersinde öğrendiklerimi başka derslerde de kullanabileceğimi düşünüyorum.	1	2	3	4	5	6	7
5. Biyoloji dersinden çok iyi bir not alacağımı düşünüyorum.	1	2	3	4	5	6	7
6. Biyoloji dersi ile ilgili okumalarda yer alan en zor konuyu bile anlayabileceğimden eminim.	1	2	3	4	5	6	7

7. Benim için şu an biyoloji dersi ile ilgili en tatmin edici şey, iyi bir not getirmektir.	1	2	3	4	5	6	7
8. Biyoloji sınavları sırasında bir soru üzerinde uğraşırken, aklım sınavın diğer kısımlarında yer alan cevaplayamadığım sorularda olur.	1	2	3	4	5	6	7
9. Biyoloji dersindeki konuları **öğrenemezsem** bu benim hatamdır.	1	2	3	4	5	6	7
10. Biyoloji dersindeki konuları öğrenmek benim için önemlidir.	1	2	3	4	5	6	7
11. Genel not ortalamamı yükseltmek şu an benim için en önemli şeydir, bu nedenle biyoloji dersindeki temel amacım; iyi bir not getirmektir.	1	2	3	4	5	6	7
12.Biyoloji dersinde öğretilen temel kavramları öğrenebileceğimden eminim.	1	2	3	4	5	6	7
13.Eğer başarabilirsem, biyoloji dersinde sınıftaki pek çok öğrenciden daha iyi bir not getirmek isterim	1	2	3	4	5	6	7
14. Biyoloji sınavları sırasında bu dersten başarısız olmanın sonuçlarını aklımdan geçiririm.	1	2	3	4	5	6	7
15. Biyoloji dersinde, öğretmenin anlattığı en karmaşık konuyu anlayabileceğimden eminim.	1	2	3	4	5	6	7
16. Biyoloji derslerinde öğrenmesi zor olsa bile, bende merak uyandıran sınıf çalışmalarını tercih ederim.	1	2	3	4	5	6	7
17. Biyoloji dersinin kapsamında yer alan konular çok ilgimi çekiyor.	1	2	3	4	5	6	7
18. Yeterince sıkı çalışırsam biyoloji dersinde başarılı olurum.	1	2	3	4	5	6	7
19. Biyoloji sınavlarında kendimi mutsuz ve huzursuz hissederim.	1	2	3	4	5	6	7
20. Biyoloji dersinde verilen sınav ve ödevleri en iyi şekilde yapabileceğimden eminim.	1	2	3	4	5	6	7
21. Biyoloji dersinde çok başarılı olacağımı umuyorum.	1	2	3	4	5	6	7
22. Biyoloji dersinde beni en çok tatmin eden şey, konuları mümkün olduğunca iyi öğrenmeye çalışmaktır.	1	2	3	4	5	6	7
23. Biyoloji dersinde öğrendiklerimin benim için faydalı olduğunu düşünüyorum.	1	2	3	4	5	6	7
24. Biyoloji dersinde, iyi bir not getireceğimden emin **olmasam** bile, öğrenmeme olanak sağlayacak ödevleri seçerim.	1	2	3	4	5	6	7
25. Biyoloji dersinde bir konuyu **anlayamazsam** bu yeterince sıkı çalışmadığım içindir.	1	2	3	4	5	6	7

26. Biyoloji dersindeki konulardan hoşlanıyorum.	1	2	3	4	5	6	7
27. Biyoloji dersindeki konuları anlamak benim için önemlidir.	1	2	3	4	5	6	7
28. Biyoloji sınavlarında kalbimin hızla attığını hissederim.	1	2	3	4	5	6	7
29.Biyoloji dersinde öğretilen becerileri iyice öğrenebileceğimden eminim.	1	2	3	4	5	6	7
30. Biyoloji dersinde başarılı olmak istiyorum çünkü yeteneğimi aileme, arkadaşlarıma göstermek benim için önemlidir.	1	2	3	4	5	6	7
31. Dersin zorluğu, öğretmen ve benim becerilerim göz önüne alındığında; biyoloji dersinde başarılı olacağımı düşünüyorum.	1	2	3	4	5	6	7

B. Öğrenme Stratejileri

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

beni hiç yansıtmıyor **beni tam olarak yansıtıyor**

32.Biyoloji dersi ile ilgili bir şeyler okurken, düşüncelerimi organize etmek için konuların ana başlıklarını çıkarırım.	1	2	3	4	5	6	7
33. Biyoloji dersi sırasında başka şeyler düşündüğüm için önemli kısımları sıklıkla kaçırırım.	1	2	3	4	5	6	7
34. Biyoloji dersine çalışırken çoğu kez arkadaşlarıma konuları açıklamaya çalışırım.	1	2	3	4	5	6	7
35. Genelde, ödevlerime rahat konsantre olabileceğim bir yerde çalışırım.	1	2	3	4	5	6	7
36. Biyoloji dersi ile ilgili bir şeyler okurken, okuduklarıma odaklanabilmek için sorular oluştururum.	1	2	3	4	5	6	7
37. Biyoloji dersine çalışırken kendimi çoğu zaman o kadar isteksiz ya da o kadar sıkılmış hissederim ki, planladıklarımı **tamamlamadan** çalışmaktan vazgeçerim.	1	2	3	4	5	6	7
38. Biyoloji dersiyle ilgili duyduklarımı ya da okuduklarımı ne kadar gerçekçi olduklarına karar vermek için sıklıkla sorgularım.	1	2	3	4	5	6	7

39. Biyoloji dersine çalışırken, önemli bilgileri içimden defalarca tekrar ederim.	1	2	3	4	5	6	7
40. Biyoloji dersinde bir konuyu anlamakta zorluk çeksem bile hiç kimseden yardım almaksızın kendi kendime çalışırım.	1	2	3	4	5	6	7
41. Biyoloji dersi ile ilgili birşeyler okurken bir konuda kafam karışırsa, başa döner ve anlamak için çaba gösteririm.	1	2	3	4	5	6	7
42. Biyoloji dersine çalışırken, daha önce okuduklarımı ve aldığım notları gözden geçirir ve en önemli noktaları belirlemeye çalışırım.	1	2	3	4	5	6	7
43. Biyoloji dersine çalışmak için ayırdığım zamanı iyi değerlendirebiliyorum.	1	2	3	4	5	6	7
44.Eğer biyoloji dersi ile ilgili okumam gereken konuları anlamakta zorlanıyorsam, okuma stratejimi değiştiririm.	1	2	3	4	5	6	7
45. Biyoloji dersinde verilen ödevleri tamamlamak için sınıftaki diğer öğrencilerle çalışırım.	1	2	3	4	5	6	7
46. Biyoloji dersine çalışırken, dersle ilgili okumaları ve ders sırasında aldığım notları defalarca okurum.	1	2	3	4	5	6	7
47. 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
48. Biyoloji dersinde yaptıklarımızdan **hoşlanmasam bile** başarılı olabilmek için sıkı çalışırım.	1	2	3	4	5	6	7
49. Dersle ilgili konuları organize etmek için basit grafik, şema ya da tablolar hazırlarım.	1	2	3	4	5	6	7
50. Biyoloji dersine çalışırken konuları sınıftaki arkadaşlarımla tartışmak için sıklıkla zaman ayırırım.	1	2	3	4	5	6	7
51. Biyoloji dersinde işlenen konuları bir başlangıç noktası olarak görür ve ilgili konular üzerinde kendi fikirlerimi oluşturmaya çalışırım.	1	2	3	4	5	6	7
52. Çalışma planına bağlı kalmak benim için zordur.	1	2	3	4	5	6	7
53. Biyoloji dersine çalışırken, dersten, okuduklarımdan, sınıf içi tartışmalardan ve diğer kaynaklardan edindiğim bilgileri bir araya getiririm.	1	2	3	4	5	6	7
54. 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
55. Biyoloji dersinde işlenen konuları anladığımdan emin olabilmek için kendi kendime sorular sorarım.	1	2	3	4	5	6	7

56. Çalışma tarzımı, dersin gereklilikleri ve öğretmenin öğretme stiline uygun olacak tarzda değiştirmeye çalışırım.	1	2	3	4	5	6	7
57. Genelde derse gelmeden önce konuyla ilgili bir şeyler okurum fakat okuduklarımı çoğunlukla **anlamam.**	1	2	3	4	5	6	7
58. İyi anlamadığım bir konuyu öğretmenimden açıklamasını isterim.	1	2	3	4	5	6	7
59. Biyoloji dersindeki önemli kavramları hatırlamak için anahtar kelimeleri ezberlerim.	1	2	3	4	5	6	7
60. Eğer bir konu zorsa ya çalışmaktan vazgeçerim ya da yalnızca kolay kısımlarını çalışırım.	1	2	3	4	5	6	7
61. Biyoloji dersine çalışırken, konuları sadece okuyup geçmek yerine ne öğrenmem gerektiği konusunda düşünmeye çalışırım.	1	2	3	4	5	6	7
62. Mümkün olduğunca biyoloji dersinde öğrendiklerimle diğer derslerde öğrendiklerim arasında bağlantı kurmaya çalışırım.	1	2	3	4	5	6	7
63. Biyoloji dersine çalışırken notlarımı gözden geçirir ve önemli kavramların bir listesini çıkarırım.	1	2	3	4	5	6	7
64. Biyoloji dersi için bir şeyler okurken, o anda okuduklarımla daha önceki bilgilerim arasında bağlantı kurmaya çalışırım.	1	2	3	4	5	6	7
65. Ders çalışmak için devamlı kullandığım bir yer (oda vs.) vardır.	1	2	3	4	5	6	7
66. Biyoloji dersinde öğrendiklerimle ilgili ortaya çıkan fikirlerimi sürekli olarak gözden geçiremeye çalışırım.	1	2	3	4	5	6	7
67. Biyoloji dersine çalışırken, dersle ilgili okuduklarımı ve derste aldığım notları inceleyerek önemli noktaların özetini çıkarırım.	1	2	3	4	5	6	7
68. Biyoloji dersinde bir konuyu anlayamazsam sınıftaki başka bir öğrenciden yardım isterim.	1	2	3	4	5	6	7
69. Biyoloji dersiyle ilgili konuları, ders sırasında öğrendiklerim ve okuduklarım arasında bağlantılar kurarak anlamaya çalışırım.	1	2	3	4	5	6	7
70. Biyoloji derslerinde verilen ödevleri ve derse ilgili okumaları zamanında yaparım.	1	2	3	4	5	6	7
71. Biyoloji dersindeki konularla ilgili bir iddia ya da varılan bir sonucu her okuduğumda veya duyduğumda olası alternatifler üzerinde düşünürüm.	1	2	3	4	5	6	7
72. Biyoloji dersinde önemli kavramların listesini çıkarır ve bu listeyi ezberlerim.	1	2	3	4	5	6	7
73. Biyoloji derslerini düzenli olarak takip ederim.	1	2	3	4	5	6	7

74. Konu çok sıkıcı olsa da, ilgimi **çekmese** de konuyu bitirene kadar çalışmaya devam ederim.	1	2	3	4	5	6	7
75.Gerektiğinde yardım isteyebileceğim arkadaşlarımı belirlemeye çalışırım.	1	2	3	4	5	6	7
76. Biyoloji dersine çalışırken iyi anlamadığım kavramları belirlemeye çalışırım.	1	2	3	4	5	6	7
77. Başka faaliyetlerle uğraştığım için çoğu zaman biyoloji dersine yeterince zaman ayıramıyorum.	1	2	3	4	5	6	7
78. Biyoloji dersine çalışırken, çalışmalarımı yönlendirebilmek için kendime hedefler belirlerim.	1	2	3	4	5	6	7
79. Ders sırasında not alırken kafam karışırsa, notlarımı dersten sonra düzenlerim.	1	2	3	4	5	6	7
80. Biyoloji sınavından önce notlarımı ya da okuduklarımı gözden geçirmek için fazla zaman **bulamam**.	1	2	3	4	5	6	7
81. Biyoloji dersinde, okuduklarımdan edindiğim fikirleri sınıf içi tartışma gibi çeşitli faaliyetlerde kullanmaya çalışırım.	1	2	3	4	5	6	7

APPENDIX B

BIOLOGY ACHIEVEMENT TEST

(BAT)

BİYOLOJİ BAŞARI TESTİ

1. ‘ Bütün bitkisel hücrelerde kloroplast bulunur.’ hipotezini kanıtlamaya çalışan bir bilim adamı, bitkileri meydana getiren hücre türlerinin büyük bir kısmında kloroplast bulunmadığını saptamıştır.

Bu bilim adamının yapacağı <u>ilk iş</u> aşağıdakilerden hangisidir?

A) Hipotezini değiştirmek.
B) Yeni kanıtlar aramak.
C) Hipoteze dayalı tahminler yapmak.
D) Kontrollü deneyler düzenlemek.
E) Nicel gözlemler yapmaya çalışmak.

2. Doğada, bir besin ve enerji piramidinde bulunan canlılar arasındaki etkileşimle ilgili olarak, aşağıdaki ifadelerden hangisi **<u>yanlıştır?</u>**

A) Üst basamağa doğru gidildikçe toplam birey sayısı azalır.
B) Bir basamaktaki canlıların tükettikleri enerji toplamı, bir üst basamaktakinden daha fazladır.
C) Bir basamaktaki türün birey sayısındaki artış, sadece alt basamaktaki enerji kaynağını etkiler.
D) Alt basamak bireylerinde depo edilen toplam enerji miktarı daha fazladır.
E) Enerji bir üst basamağa sadece besin yoluyla geçer.

3. Bir balık türü, yaşamının;

I. evresinde bakteriler, su pireleri ve küçük bitkilerle
II. evresinde eklembacaklılar, salyangozlar ve küçük balıklarla

beslenmektedir.

Bu balık türünün I. ve II. evrelerindeki beslenme biçimlerinin adları aşağıdakilerden hangisinde doğru olarak verilmiştir?

	I	II
A)	Otobur	Karışık
B)	Karışık	Otobur
C)	Otobur	Etobur
D)	Etobur	Etobur
E)	Karışık	Etobur

4. Vitaminlerle ilgili bazı özellik şunlardır;

I. Bazılarının suda, bazılarının ise yağda çözünmesi
II. Bazılarının heterotrof canlıların vücudunda depolanması
III. Her vitaminin, yalnızca kendine özgü reaksiyonun gerçekleşmesinde rol alması.
IV. Heterotrof canlılar tarafından doğrudan sentezlenememesi

Bu özelliklerden hangileri, heterotrof canlılarda, bir vitamin eksikliğiyle ortaya çıkan bozukluğun, başka bir vitamin çeşidiyle <u>giderilememesinin</u> nedenidir?

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

5. Canlıların bilimsel olarak adlandırılmasında kullanılan yönteme göre;

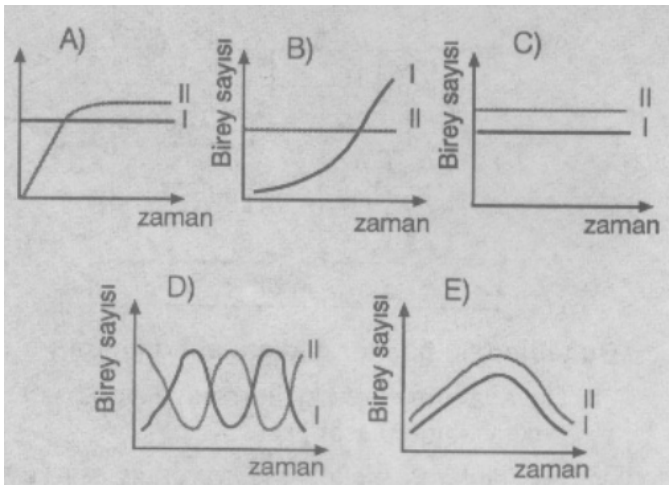
I. Capra domesticus
II. Felis domesticus
III. Canis lupus
IV. Felis leo

olarak adlandırılan canlıların cins ve tür adlarına bakarak, hangilerinin birbirleriyle diğerlerinden daha yakın akraba olduğu düşünülebilir?

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

6. Bir arada yaşayan iki canlı türünden I ile gösterilen II ile gösterilen canlı ile beslenmektedir.

Bu iki canlı türüne ait birey sayısının, zamana göre değişimini aşağıdaki grafiklerden hangisi gösterir?



7. Bir hücrede oksijenli solunum, protein sentezi, fotosentez olaylarının tümünün gerçekleşebilmesi için, bu hücrede;

I. Ribozom
II. Kloroplast
III. Mitokondri
IV. Sentrozom

organellerinden hangilerinin bulunması <u>zorunludur?</u>

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

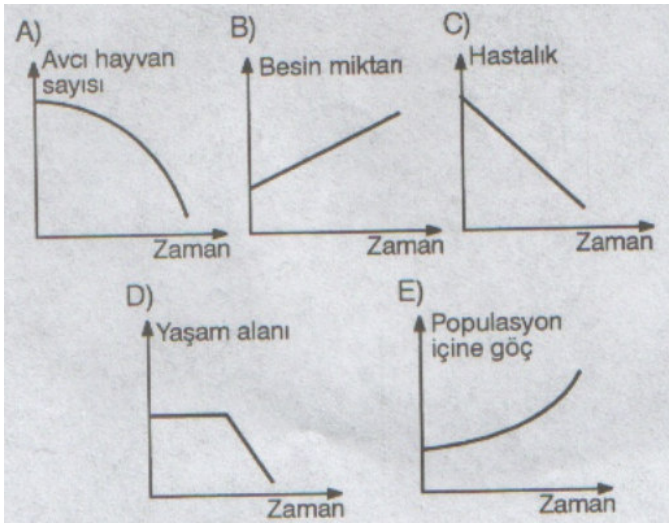
8. Bir DNA zincirinin birinci kolundaki adanenli nükleotitlerin (A) sitozinli nükleotitlere (S) oranı A / S = 2 / 3 tür. Bu kolun karşısındaki kolda 900 guaninli nükleotit bulunmaktadır.

Bu DNA'nın birinci kolunun, m-RNA sentezinde kalıp olarak kullanılması durumunda gereken urasilli nükleotit sayısı kaçtır?

A) 300
B) 600
C) 900
D) 1500
E) 1800

9. Belirli bir bölgede yaşayan bir hayvan populasyonunda birey sayısının zamanla azaldığı gözlenmiştir.

Aynı zaman dilimi içinde, ortamda aşağıdaki grafiklerin hangisinde gösterilen değişmenin gerçekleşmesi, bu azalmanın nedeni olabilir?

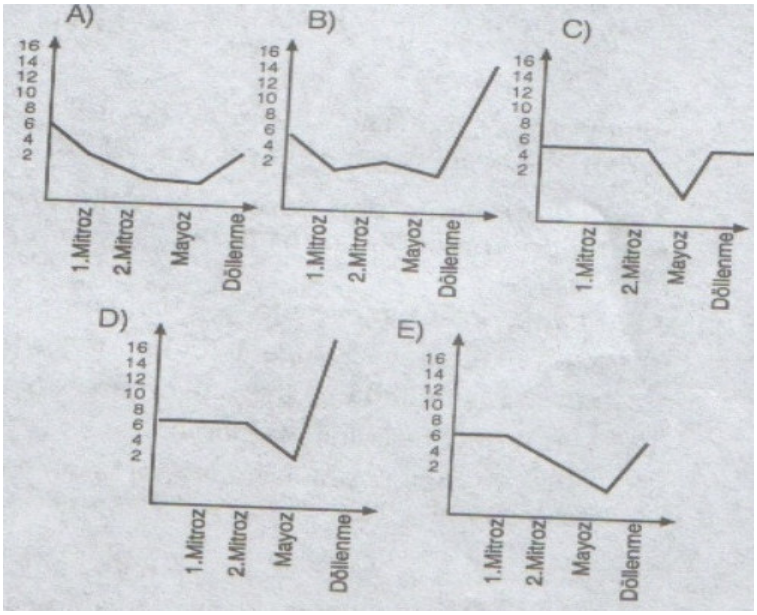


10. Gelişmiş organizasyonlu tipik bir bitki hücresinde, **aşağıdakilerden hangisinde verilenlerin her ikisi de bulunur?**

A) Kromoplast ve sentrozom
B) Ribozom ve mitokontri
C) Pinositoz cebi ve selüloz çeper
D) Lignin ve vurgan (kontraktil) koful
E) Glikojen ve lökoplast

11. Sekiz kromozomlu bir hücre iki defa mitoz bir defa mayoz geçiriyor. Oluşan hücrelerden biri dölleniyor.

Yukarıda sözü edilen evrelerden geçen hücrenin kromozom sayısında görülen değişmeler hangi grafikte gösterilmiştir?



12. Aşağıdaki olaylardan hangisinde bir hücre, kalıtım materyalinin niceliği bakımından kendisinden **<u>farklı</u>** hücreler oluşturabilir?

A) Kurbağanın erbezinde spermlerin oluşması
B) Kertenkelenin kopan kuyruğunun onarılması
C) Bezelye tohumlarının çimlenmesi
D) Bira mayasının tomurcuklanması
E) Dikilen fidanın filiz vermesi

13. Işıklı bir kültür ortamında, glikoz ve oksijen varlığına ya da yokluğuna göre, bir bakteri türünün gelişimi incelenmiştir. Değiştirilen koşullarda, bakterinin üremesiyle ilgili sonuçlar aşağıdaki tabloda verilmiştir.

OKSİJEN	**GLİKOZ**	**BAKTERİ ÜREMESİ**
VAR	VAR	VAR
YOK	VAR	VAR
VAR	YOK	YOK

Tablodaki bilgilere göre, bu bakteri türü ile ilgili olarak;

I. Hetetrof beslenir.
II. Ototrof beslenir.
III. Oksijenli solunum yapar.
IV. Oksijene gereksinimi yoktur.

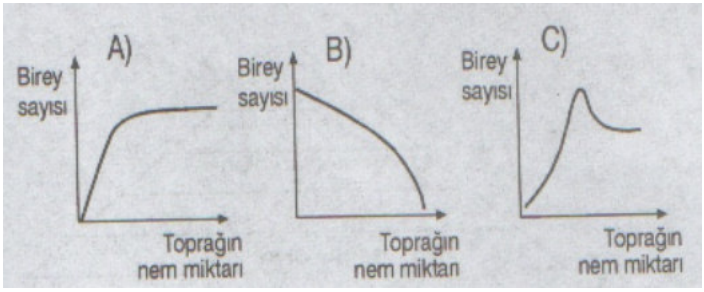
ifadelerinden hangileri doğrudur?

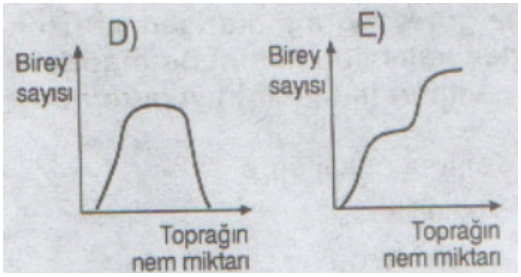
A) yalnız II
B) yalnız III
C) I ve III
D) II ve IV
E) I ve IV

14. Gelişmesini toprakta gerçekleştiren bir bitki zararlısı ile mücadele edilirken, toprağa ya çok az ya da çok fazla miktarda su verilmektedir.

Böylece zararlının populasyon büyüklüğü ile toprağın nem miktarı arasındaki ilişkiden yararlanılarak, ilaç kullanılmadan toprak bu zararlıdan tamamen temizlenmektedir.

Buna göre zararlının populasyon büyüklüğü ile toprağın nem miktarı arasındaki ilişki, aşağıdaki grafiklerden hangisi ile gösterilebilir?





15. Ototrof bir organizmada, glikozdan protein, yağ ve polisakkarit sentezlenirken,

I. Klorofil
II. Enzimler
III. ATP
IV. Madensel tuz

moleküllerinden hangileri <u>harcanır?</u>

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

16. Aşağıdakilerden hangisi, mitoz bölünme ile mayoz-I bölünmesinin ortak özelliklerinden biridir?

A) Homolog kromozomların ayrı kutuplara çekilmesi
B) Kromatitler arsında parça değişimi gerçekleşmesi
C) Tetratların oluşması
D) Bölünme tamamlandığında, kromozomların taşıdığı tüm özelliklerin yavru hücrelere eşit olarak aktarılmış olması.
E) Başlangıçtaki kromozom sayısının iki katına çıkması.

17. Aşağıdaki tabloda verilen A, B, C ayıraçlarından biri protein, biri yağ, biri de nişasta ayıracıdır. Bu ayıraçların bulunduğu tüplere, biri bitkisel kaynaklı, biri hayvansal kaynaklı, biri de bu ikisinin karışımı olan özütler eklenmiştir. Bu deneyden tablodaki sonuçlar alınmıştır.

	A ayıracı	B ayıracı	C ayıracı
BİRİNCİ ÖZÜT	+	+	+
İKİNCİ ÖZÜT	+	-	+
BİRİNCİ ÖZÜT + İKİNCİ ÖZÜT	+	+	+

(" + " işareti, ayıraç etkisiyle renk değişiminin gerçekleştiğini, " – " işareti renk değişiminin gerçekleşmediğini göstermektedir.)

Buna göre;

I. Birinci özüt hayvansaldır; A, protein ayıracıdır.
II. İkinci özüt hayvansaldır; B, nişasta ayıracıdır.
III. Birinci özüt bitkiseldir; C, yağ ayıracıdır.

yargılarından hangileri <u>kesinlikle</u> doğrudur?

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

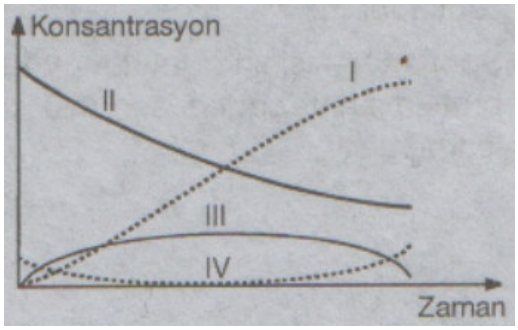
18. Bir hücrelilerde bulunabilen bazı organellerin işlevleri, insanlarda bulunan bazı organların işlevlerine benzer.
Aşağıdakilerin hangisinde, verilen organel ile organ arasında işlev (görev) yönünden benzerlik <u>yoktur?</u>

A) Mitokondri - Karaciğer
B) Sindirim kofulu - Mide
C) Boşaltım kofulu - Böbrekler
D) Kamçı - Bacaklar
E) Hücre zarı – Deri

19. Hücrede, enzimlerle gerçekleşen bir biyokimyasal olay şematik olarak şöyle gösterilebilir;

Substrat + Enzim → { Substrat / Enzim / Kompleksi } → Ürün + Enzim

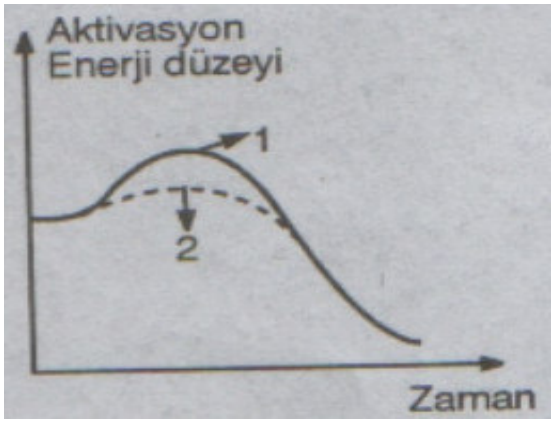
Aşağıdaki grafikte, numaralanmış eğriler, hücrede gerçekleşen kimyasal olay sırasında , substrat, enzim, substrat-enzim kompleksi ve ürün konsantrasyonundaki değişmeleri göstermektedir.



grafikteki substrat, enzim, substrat-enzim kompleksi ve ürün konsantrasyonlarını gösteren eğrilerin numaraları aşağıdakilerin hangisinde doğru olarak verilmiştir?

	Substrat	Enzim	Substrat-Enzim Kompleksi	Ürün
A)	I	III	IV	II
B)	II	III	I	IV
C)	II	IV	III	I
D)	IV	II	I	III
E)	IV	III	II	I

20. Aşağıdaki grafik bir kimyasal olayın iki ayrı enerji düzeyinde de gerçekleşebileceğini göstermektedir.



Bir hücrede, bu olayın 2. eğrideki gibi gerçekleşmesini;

I. Reaksiyona giren molekül sayısının azalması
II. Enzimlerin reaksiyona girmesi
III. Reaksiyona giren molekül sayısının artması

durumlarından hangileri sağlar?

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