EXPLAINING THE RELATIONSHIP BETWEEN HIGH SCHOOL STUDENTS' SELECTED AFFECTIVE CHARACTERISTICS AND THEIR PHYSICS ACHIEVEMENT

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

BY

ÖZLEM DOĞAN TEKİROĞLU

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

JUNE 2005

Approval of the Graduate School of Natural and Applied Sciences

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

Özlem Doğan Tekiroğlu

ABSTRACT

EXPLAINING THE RELATIONSHIP BETWEEN HIGH SCHOOL STUDENTS' SELECTED AFFECTIVE CHARACTERISTICS AND THEIR PHYSICS ACHIEVEMENT

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June 2005, 177 pages

The purpose of this study is to investigate the relationship between some of selected affective characteristics of high school students related to physics lesson and their physics achievement in electricity concept. These affective characteristics of the students includes their interest in physics, importance of physics, enjoyment of extra-curricular activities related to physics, physics course anxiety, physics test anxiety, achievement motivation in physics, student motivation in physics, self-efficacy in physics and self-concept in physics. Two causal models explaining the direction of the relationship between these affective characteristics and physics achievement was hypothesized and tested.

A questionnaire consisted of 10 sub-dimensions was used in order to determine the affective characteristics of high school students. The achievement scores were obtained by using Ninth Grade Electricity Test developed by the researcher. The Ninth Grade Electricity Test includes 29 items about the electricity concept. The Ninth Grade Electricity Test and the Affective Characteristics Scale were administered to 1457 students in 22 foreign language high schools in Ankara when they start to tenth grade in 2004-2005 academic year. The researcher was the data collector and was present in the class during administration of scale and test. The preliminary analyses were conducted by using Excel and SPSS 10.0 and the confirmatory analysis and testing of the hypothesized structural models were conducted by LISREL 8.30 for Windows.

The findings indicated that achievement in physics has a significant effect on high school students' affective characteristics. Since, affective characteristics of students are effective on achievement in later years, they should be firmly formed at high school years. Besides, affective characteristics should be improved whether they have an effect on achievement or not, because they have an effect on persistence in from of selection of courses which also may give the chance of being successful in a subject to a student.

Keywords: Physics Education, Students' affective characteristics, physics achievement, self-efficacy in physics, self- concept in physics, physics interest, motivation in physics, anxiety in physics course and anxiety in physics tests.

ÖZ

LİSE ÖĞRENCİLERİNİN SEÇİLMİŞ DUYUŞSAL KARAKTERLERİ İLE FİZİK BAŞARILARI ARASINDAKİ İLİŞKİNİN AÇIKLANMASI

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Haziran 2005, 177 sayfa

Bu çalışmanın amacı lise öğrencilerinin fizikle ilgili seçilmiş bazı duyuşsal karakterleri ile fizik dersinin elektrik konusundaki başarıları arasındaki ilişkinin incelenmesidir. Bu duyuşsal karakterler fizik ilgisi, fiziğin önemi, fizikle ilgili ders dışı aktivitelerden zevk alma, fizik ders kaygısı, fizik sınav kaygısı, başarı motivasyonu, fizik öz yeterlilik algısı ve fizik öz kavramı değişkenlerini kapsamaktadır. Bu duyuşsal karakterlerle fizik başarısı arasındaki ilişkinin yönünün açıklandığı bir model önerilmiş ve test edilmiştir.

10 alt boyuttan oluşmakta olan anket lise öğrencilerinin duyuşsal karakterlerini belirlemek amacıyla kullanılmıştır. Başarı skorları ise araştırmacı tarafından oluşturulmuş olan Dokuzuncu Sınıf Elektrik Testi ile ölçülmüştür. Test elektrik konusuyla ilgili 29 madde içermektedir. Dokuzuncu Sınıf Elektrik Testi ve Duyuşsal Karakteristikler Anketi Ankara'daki 22 yabancı dil ağırlıklı lisedeki 1457

öğrenciye, 2004-2005 öğretim yılında onuncu sınıfa başladıklarında uygulanmıştır. Araştırmacı kendisi data toplayıcı olup anketin ve testin uygulanması sırasında sınıflarda bulunmuştur. Ön analizler Excel ve SPSS 10.0 programları yardımı ile yapılırken, doğrulayıcı faktör analizi ve yapısal modellerin test edilmesi LISREL 8.30 ile yapılmıştır.

Bulgulara göre öğrencilerin fizik başarılarının fizikle ilgili duyuşsal karakteristikleri üzerinde anlamlı bir etkisi bulunmaktadır. Öğrencilerin duyuşsal karakteristikleri daha sonraki yıllarda başarı üzerinde etkili olduğundan, daha erken yıllarda sağlam biçimlendirilmelidir. Ayrıca duyuşsal karakteristikler başarı üzerinde direk etkili olsun olmasın geliştirilmelidir, çünkü öğrencinin ders seçimindeki karalılığı üzerinde etkisi vardır ve bu durum dolaylı olarak öğrenciye herhangi bir konuda başarılı olma şansını verebilir.

Anahtar Kelimeler: Fizik Eğitimi, Duyuşsal öğrenci nitelikleri, fizik başarısı, öğrencilerin fizik öz yeterlik algısı, öğrencilerin fizik öz kavramı, fizik ilgisi, öğrencilerin fizik motivasyonu, öğrencilerin fizik ders kaygısı ve öğrencilerin fizik sınav kaygısı.

To My Husband,

Mustafa Tolga Tekiroğlu

ACKNOWLEDGMENTS

I wish to express my deepest gratitude to my supervisor Assist. Prof. Dr. Ali Eryılmaz for his guidance, advice, and insight throughout the research. He always showed me the right way, and offered his wide knowledge whenever I needed. He encouraged me whenever I sank into despair. I sincerely thank him as he gave me the chance to study with him.

I am thankful to the committee members of my thesis, Assoc. Prof. Dr. Safure Bulut, Dr. Mehmet SANCAR, Dr. Ömer Faruk Özdemir, and Doc. Dr. Bilal Güneş for their comments and criticisms.

I would like to thank Almer Abak for helping me to gain knowledge in LISREL analysis, sharing her knowledge, answering my questions anytime I asked, her suggestions and comment about my research.

I would also like to thank to my job mates Ayşe Ela Köksal, Betül Yayan, Ayhan Kürşat Erbaş and other research assistants, and high school principals for their support and recommendations.

I am grateful to my neighbors who always gave me all kinds of help whenever I needed, especially Feryal and Fulya Çakır who were with me with all their hearts during my study.

Finally, I would like to express my indebtedness to my husband for his effort to encourage me, always being with me, helping me and his tolerance. I would also like to emphasize support of my mother Döne Doğan, my father Sinan Doğan, my sisters Duygu and Burcu and brother Alkan who encouraged and supported me emotionally in spite of being far away from me. I am also grateful to my husband's parents Mehmet and Remziye Tekiroğlu and our sister Selin Eda Tekiroğlu who never grudged any kind of help and support from me.

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LIST OF ABBREVIATIONS

INT	Interest in Physics
IMP	Importance of Physics
ENJ	Enjoyment in Extracurricular Activities Related to Physics
STUMOT	Student Motivation in Physics
ACHMOT	Achievement Motivation in Physics
SEFF	Self-Efficacy in Physics
SCON	Self-Concept in Physics
LOC	Locus of Control
PTANX	Physics Test Anxiety
PCANX	Physics Course Anxiety
ACH	Students' Achievement Score
AC	Affective Characteristics
ATT	Attitude
GOF	Goodness of Fit
FL	Foreign Language
ERIC	Educational Resources Information Center
IDA	International Dissertation Abstracts
SSCI	Social Science Citation Index
NAEP	National Assessment of Educational Progress
NSF	National Science Foundation
NGET	Ninth Grade Electricity Test
TIMSS	Third International Mathematics and Science Study
DPY	Devlet Parasız Yatılı Sınavı
OÖKS	Orta Öğretim Kurumları Sınavı
ÖSS	Öğrenci Seçme Sınavı

CHAPTER 1

INTRODUCTION

Science literacy for all persons is the foremost goal of science education (American Association for the Advancement of Science, 1993; National Research Council, 1996). The students of now will soon become our parents, teachers, business leaders, and politicians and they will make informed decisions regarding developments in technology and in all other fields of science. The best way to reach the goal of raising scientifically literate people is improving the quality of science education. When science education is considered, negative attitudes towards science lessons, low enrolments in science classes, and decreasing levels of achievement in science lessons are very common among high school students. One of the most problematic science courses is physics lesson (Abak, 2003). In order to find out the reason, the variables affecting the students' success should be investigated as a first step. There are numerous factors affecting student success. These can be categorized as the variables related to school, family, individual and social incentives and socioeconomic conditions. The variables related to individual can be grouped as cognitive and affective (Abak, 2003). When the research history is examined, it is revealed that until about 20 years, the variables in cognitive domain were focused mainly in education researches and recently the variables in affective domain defined by Krathwohl, Bloom and Masia (1964) has become the focus of considerable amount of research. Much of these recent attention stems from the belief that affective characteristics are as much important as cognitive variables in influencing learning outcomes, career choices and use of leisure time (Koballa, 1988). Studying affective domain variables is quite understandable because they are manipulative variables by external factors like family, teacher or school while others are relatively stationary variables and there is abundant evidence showing that student achievement is related to affective variables. Bloom (1976), analyzed the data of 17 countries on six different subject areas and suggested that 50% of variance in learning outcomes can be attributed to entering cognitive characteristics, 25 % can be attributed to affective characteristics and the remaining 25% of variance in learning outcomes can be attributed to quality of instruction which may also be affected by affective characteristics. Variables such as self-esteem, academic self-concept, fate control, locus of control, interest in science, attitude toward science and science teacher, and values comprise what Bloom refers to as entering affective characteristics.

The major problem with the studies in affective domain is the lack of clear definitions of affective variables. Many researchers have tried to define the concepts in affective domain (Haladayna & Shaugnessy, 1982; Hidi, 1990; Peterson & Carlson, 1979; Shiefele, 1991). In addition to this problem, there are very few appropriate, reliable and effective assessment instruments. So many studies were conducted to develop appropriate instruments (Abak, 2003; Germann, 1988; Hough & Piper, 1982; Kazelskis, 1998; Schibeci & Riley, 1986; Talton & Simpson, 1987)

As the affective domain is multidimensional and there are correlations within the subcomponents, a study covering as many variables as possible and analyzing all the relationships at the same time would give more satisfying results. In physics education, affective domain is rarely studied. There is only one study covering a wide range of variables in the affective domain in physics education and modeling the relationships within affective characteristics related to physics and their relationship with physics achievement at the university level (Abak, 2003). However, there is no study in high school level incorporating a large number of affective variables in one study.

The Affective Characteristics (AC) scale developed by Abak (2003) for university physics students was used after modification to high school students to collect data about affective variables related to physics including attitudes, interest, importance, motivation, test anxiety, self-concept, self-efficacy, and locus of control. The Ninth Grade Electricity Test (NGET) developed was used to obtain the achievement variable. Hence, physics achievement means the achievement in electricity concept of physics for the present study.

When the literature is examined, it is obvious that many studies investigated the relationship between achievement and affective characteristics of students; however a very limited number of researchers went a step further in order to seek causal relationships between those affective characteristics and achievement.

1.1 Problem

What structural model best describes the relationship between interest in physics (INT), importance of physics (IMP), enjoyment in extracurricular activities related to physics (ENJ), students motivation in physics (STUMOT), achievement motivation in physics (ACHMOT), self-efficacy in physics (SEFF), self-concept in physics (SCON), locus of control (LOC), physics test anxiety (PTANX), physics course anxiety (PCANX) and physics achievement (ACH)?

1.2 Null Hypotheses

The problem stated above was tested with the following hypotheses which are stated in null forms. The hypothesized relationships between the selected affective characteristics of students and their physics achievement are given in Figure 1.1 and 1.2.

H_{01}: The hypothesized structural model given in Figure 1.1 showing the relationship among INT, IMP, ENJ, STUMOT, ACHMOT, SEFF, SCON, LOC, PTANX, PCANX and ACH is not statistically significant.

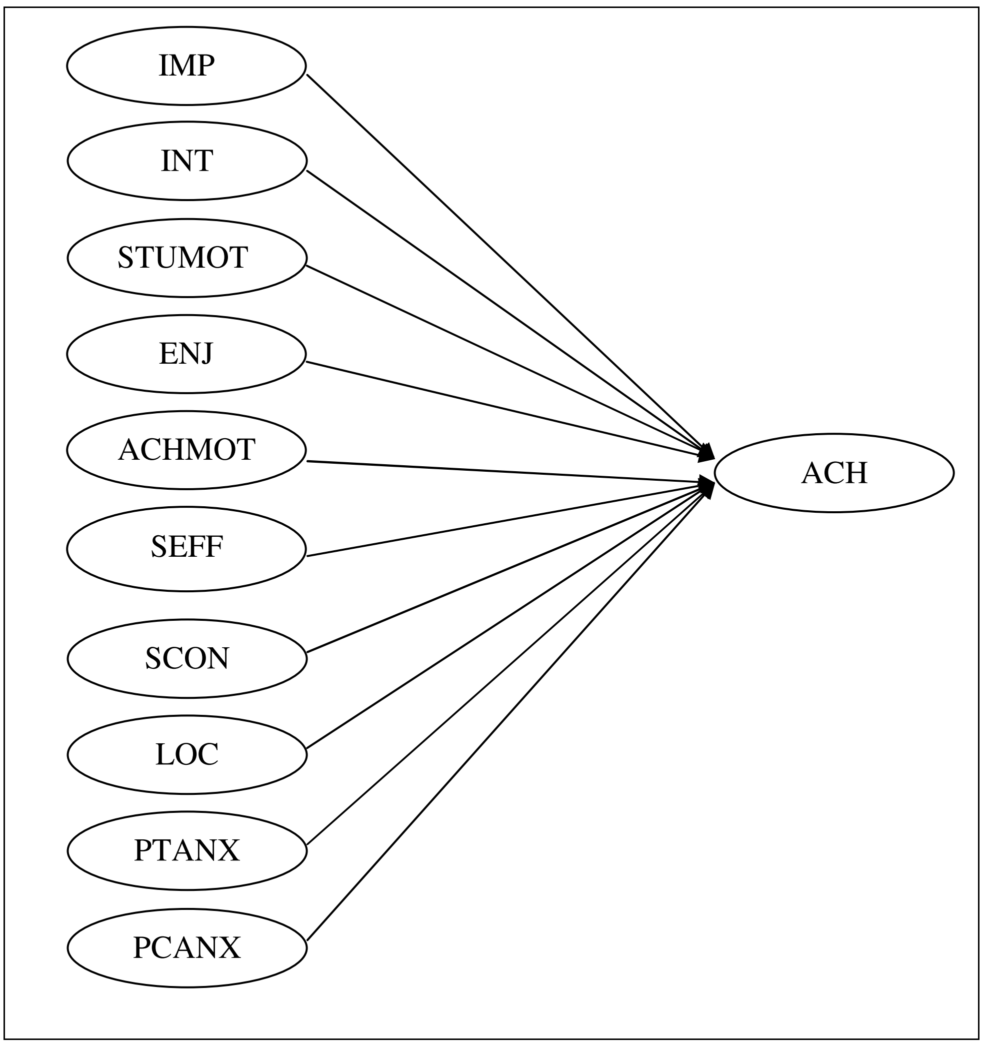

Figure 1.1 The Hypothesized Model 1

H_{02}: The hypothesized structural model given in Figure 1.2 showing the relationship among INT, IMP, ENJ, STUMOT, ACHMOT, SEFF, SCON, LOC, PTANX, PCANX and ACH is not statistically significant.

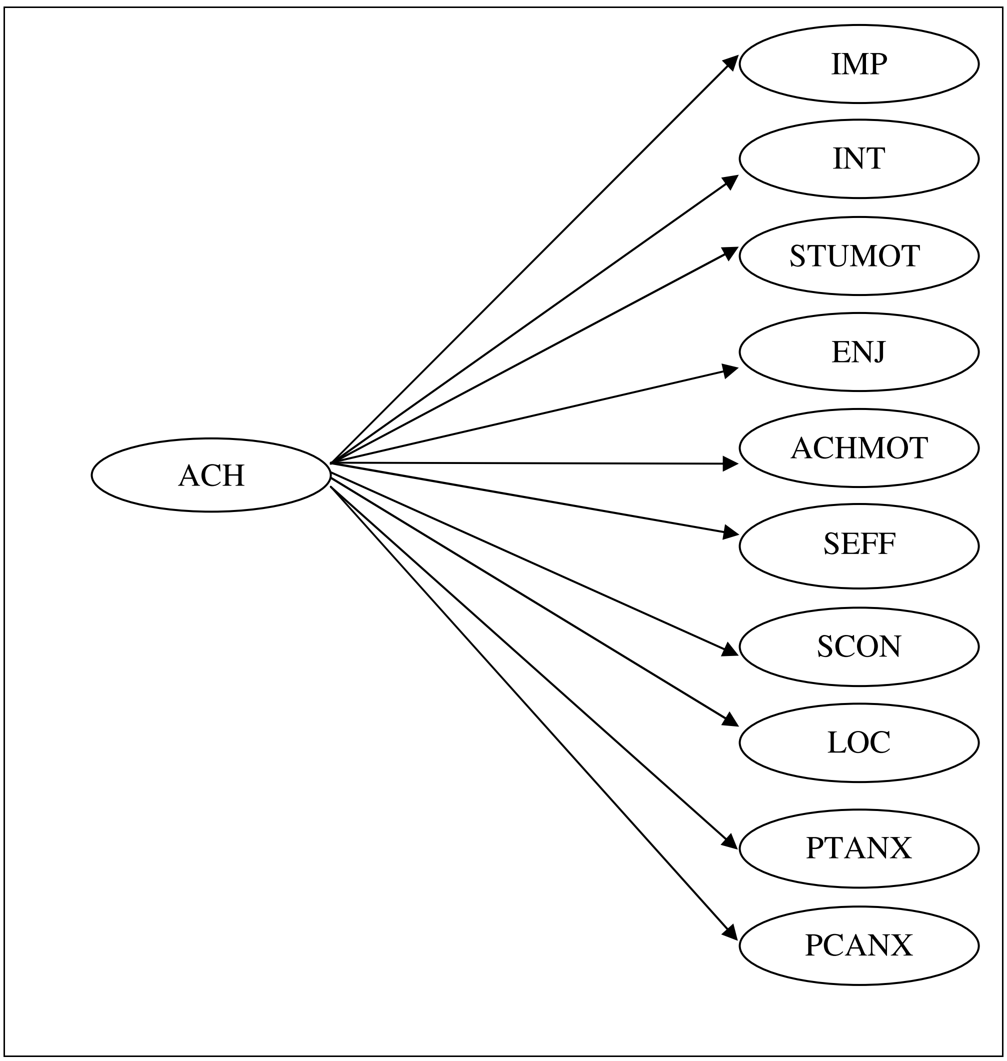

Figure 1.2 The Hypothesized Model 2

1.3 Definition of the terms

The constitutive and operational definitions of the important terms are given in this section. The definitions of the affective characteristics are adapted from the study of Abak (2003) and the references are as cited in Abak (2003).

1.3.1 Affective Characteristics related to physics (AC): the AC in this study refers to the students' INT, IMP, ENJ, STUMOT, ACHMOT, SEFF, SCON, PTANX, PCANX and LOC. It will be measured by the Affective Characteristics Scale developed by Abak (2003).

1.3.2 Attitude toward physics (ATT): 'Your attitude toward something is the way that you think and feel about it' (Sinclair, 1993, p.81). It is usually defined in pedagogical literature as 'a tendency to react favorably and unfavorably toward a designated class of stimuli, such as a national or ethnic group, a custom, or an institution' (Anastasi & Urbina, 1997, p.404).

1.3.3 Importance of Physics (IMP): 'The importance of something is its quality of being important, necessary, or significant in a particular situation' (Sinclair, 1993, p.728). The importance in this study is if students think that physics and physics courses are useful, necessary and important for them in their daily lives. It will be measured by the items in the IMP sub-scale.

1.3.4 Interest in Physics (INT): 'an interest in a problem, a topic, a subject is evidence that there is vital union between the student and the student's study' (Monroe, 1968, p.472). 'Interest is the accompanient of the identification through action, of the self with some object or idea for the maintenance of self-initiated activity. Self-initiated activity is essential component of interested behaviors' (Dewey, 1913, p.14). Schiefele (1991) has added that it is a content specific concept. It this study the content is electricity in the ninth grade physics course. Interest has two dimensions (Mitchell, 1993).

i. Personal Interest: It is an interest that people bring to some environment or context. It is the students' interests in physics courses in general.

ii. Situational Interest : An interest that people acquire by participating in an environment or context. It means the students' interest in the particular physics course taken during the application semester of the instrument. The course is related to electricity.

In this study only personal interest will be measured with the items in the INT sub-scale in the AC scale.

1.3.5 Enjoyment of Extra Activities (ENJ): It responds to the question to what degree that the students' like to do out of class activities related to physics. It will be measured with the items in the ENJ sub-scale in the AC scale.

1.3.6 Students Motivation (STUMOT): 'Broadly considered, motivation is the process of arousing, sustaining, and regulating activity a concept limited to some aspect such as the energetics of behavior or purposive regulation' (Gond, 1973, p. 375). 'Motivation may be viewed as referring to the contemporaneous, dynamic factors that influence such as the choice, initiation direction, magnitude, persistence, resumption and quality of goal directed (including cognitive) activity (Dweck & Elliot, 1983, p.645). It will be measured with the items in the STUMOT sub-scale in the AC scale.

1.3.7 Achievement Motivation (ACHMOT): ‘Achievement motivation is a combination of psychological forces which initiate, direct and sustain behavior toward successful attainment of some goal, which provides a sense of significance’ (Gond, 1973, p.375). Oliver and Simpson (1988) states that achievement motivation response to the question to what extend does the student try to do as well as possible when engaging in science, for this study in physics. It will be measured with the items in the ACHMOT sub-scale in AC scale.

1.3.8 Physics Anxiety (ANX): ‘Anxiety is a feeling of nervousness or worry about something’ (Sinclair, 1993, p.54). Then, physics anxiety is the feeling of nervousness and worry about physics. Different aspects of physics anxiety that included in this study are:

i. Physics Test Anxiety (PTANX): A feeling of nervousness and worry about the exams in the physics. It will be measured with the items in the PTANX sub-scale in the AC scale.

ii. Physics Course Anxiety (PCANX): A feeling of nervousness and worry about the physics course. It will be measured with the items in the PCANX sub-scale in the AC scale.

1.3.9 Physics Self-Concept (SCON): According to Marsh (1990), self concept is a ‘person’s perceptions regarding himself or herself’. Self-concept is a multidimensional and context-dependent learned behavioral pattern. Academic self-concept is one dimension of self-concept. Academic self-concept incorporates attitudes, feelings and perceptions relative to one’s intellectual or academic skills and presents a mixture of self-beliefs and self-feelings regarding general academic functioning (Lent, Brown & Gore, 1997). It will be measured with the items in the SCON sub-scale in the AC scale.

1.3.10 Physics Self-Efficacy (SEFF): Self-efficacy is the belief in one's capabilities to organize execute the sources of action required to manage prospective situations (Bandura, 1986). Academic self-efficacy is more directly related to one's feelings of mastery, or an ability to succeed in a given specific subject (Bong & Clark, 1999; Zimmerman, 1995). It will be measured with the items in the PSEF sub-scale in AC scale.

1.3.11 Locus of control (LOC): The construct of LOC describes a continuum of beliefs as to whether one's outcomes are a result of internal control (e.g. effort) or external control (e.g. powerful others or fate) (Ward, 1994). It is measured with the items in the LOC sub-scale in the AC scale.

1.3.12 Physics achievement: It refers to an outcome measure for some type of performance (Johnson, Johnson, & Stanne, 2000). In this study, the result of the NGET developed by the researcher about electricity concept in physics course was used as the students' physics achievement.

1.3.13 λ_y (lowercase lambda sub y) and λ_x (lowercase lambda sub x): These values refer to coefficients between the observed variables and latent variables. It responds to the question to what extent a given observed variable is able to measure the latent variable. (Schumacker & Lomax, 1996, p.81, 225).

1.3.14 The β (lowercase beta): This coefficient refers the strength and direction of the relationship among the latent dependent variables (Schumacker & Lomax, 1996, p. 225).

1.3.15 The γ (lowercase gamma): This coefficient refers the strength and direction of the relationship among the latent dependent variables and latent independent variables (Schumacker & Lomax, 1996, p. 225).

1.4 Significance of the Study

Science achievement is one of the major interests of educators. Although being not very frequent affective characteristics are also studied together with achievement in science education. However studies based on affective variables and achievement are not very common in physics education. In this study, the relationship between most of affective characteristics related to physics and physics achievement of high schools students was investigated. This relationship was studied previously at the university level (Abak, 2003) but at this level it was not done by including so many variables. In the literature there are studies reported some correlational results or found directional relations for some of these affective variables but this study exposed a more complete picture of the relationship between affective characteristics and physics achievement since all relations were examine at the same time by structural equation modeling. Moreover, a deep insight into the causal direction of these relationships was gained by the present study.

The conclusions gave a clear message about this direction that can be used by the physics teachers who wants to improve the awareness and perceptions about the problems of physics education in Ankara. Other educators who work with students who have similar characteristics to the sample of this study should be aware of the findings of this study. Moreover researchers investigating a relationship of this kind may use the findings of this study to compare the results of different samples. The results may also guide the parents for giving a perception about science and physics education to their children.

The AC scale adapted for high school students can be used by any researcher who wants to determine affective characteristics of students at high school level. In addition to this, the NGET developed in this study is open to usage of teachers, instructors or researchers who need to determine the achievement score for students in the electricity concept in physics at high school level.

CHAPTER 2

LITERATURE REVIEW

There is much concern about the science achievement of the students in high schools recently. Accordingly a strong emphasis is currently placed on improving the quality of science education (Morrel & Lederman, 1998).

Most education researchers studying on science achievement naturally restricted the influences in cognitive domain and found very satisfying results until Bloom (1976) declared the results of the analysis of data from 17 countries on 6 different content areas. According to this study, 50% of variance in science achievement is attributed to entering cognitive characteristics and 50% is attributed to how students feel toward what they are studying, school environment, self-concept and quality of instruction. These and some other variables such as self-esteem, academic self-concept, fate control, locus of control, interest, attitudes and values are important facets of affective domain (Simpson & Troost, 1982). Thus, the tendency to look at the affective variables to find a possible explanation of the relationships between affective variable and science achievement is quite understandable.

Schibeci (1983, as cited in Abak, 2003) examined the arguments and detected two distinct propositions for the reason to study affective characteristics. Some asserted that the attitudes and achievement are linked, so when cognitive achievement is being studied affective factor should be concerned. However, Willson (1983) in his meta-analysis found the relationship between attitudes and achievement was not very strong. But, this idea is meaningful when affective characteristics were assumed to be only consisted of attitudes. The second assertion is saying that affective factors rather than cognitive factors are more important goals of education. Payne (1977) argued that affective variables influence a person's ability to participate effectively in a democratic society, are necessary for healthy and effective life; interact with occupational and vocational satisfaction.

Over that past 20 years, major influences on the attitude toward science and achievement in science have been investigated with various research and statistical methods. A lot of qualitative data was collected to bring additional meaning and understanding of the relationships. Unfortunately, this extensive literature leaves unanswered questions about the direction of the relationship between affective characteristics and achievement. According to Bloom (1976) students' perceptions of their past and expected future performances in science are based on judgments have been made about their performances relative to others, which are announced by mark that is more public. In this sense, affect is clearly dependent on actual achievement. When Bloom's arguments are also considered, science related affect seems to be both an outcome and an antecedent of achievement. In this study it was hoped to include as many variables as possible in the affective domain and models could be tested representing the relationship and the direction of this relationship between these affective characteristics and achievements in physics.

2.1 Attitudes toward Physics

Attitude which is one of the most voiced variables in affective domain (Koballa, 1988) is an important outcome of education like achievement (Haladayna, Olsen, & Shaughnessy, 1982). However, attitude studies suffer from the lack of integrative findings (Ramsay & Hower, 1969), lack of clear definitions (Aiken & Aiken, 1969), and inadequate instruments to measure attitudes (Pearl, 1973). Definitions of science attitudes also vary greatly and selection of the variables seem to be asystematic (Haladayna & Shaughnessy, 1982). In addition to defining attitudes toward science in many different ways and researches on attitudes are disorganized and chaotic (Peterson & Carlson, 1979; Haladayna & Shaughnessy, 1982). However the relationship of attitudes to cognitive development and academic achievement is assumed a logical and inevitable connection, thus, how attitudes toward science are formed, shaped becomes an important area to study for educational researchers.

Since 1980s researchers have investigated the correlation of achievement with subject related attitudes with varying results. Literature indicates that there are many researchers reporting positive relationship between attitudes toward science and science achievement (Willson, 1983).

In the study of Shringley, Koballa, and Simpson (1988), it is suggested that the relationship between attitudes and achievement was correlational rather than literal, but still attitudes may be an important predictor of achievement in science. Like Shringley et al (1988), Oliver and Simpson (1988) investigated the relationships of three attitude sub-constructs, attitude toward science (enjoyment, interest), achievement motivation (effort), and science self-concept with the science achievement. They concluded that these attitude sub-constructs are significant predictors of achievement that account for 20% of variance in achievement of eleventh grade students and 30% of variance in achievement of twelfth grade students for chemistry.

There are other studies explored the relationship between science attitudes and science achievement and reported positive correlations ranging from low to moderated and strong between these constructs for varying grade levels from 4 to 11 (Barrington & Hendricks, 1988; Cannon & Simpson, 1985; Haladayna, Olsen & Shaughnessy, 1982; Morrel & Lederman, 1998; Oliver & Simpson, 1988). Moreover there are some findings indicating that students' attitudes are decreasing from beginning to the end of the school year (Cannon & Simpson, 1985), and some asserted that although students show fairly positive attitudes at elementary school years, when they come to middle or high school, their attitudes become less favorable (Barrington & Hendricks, 1988, Bohart, 1975 as cited in Cannon & Simpson, 1985, Aiken, 1979).

The Third International Mathematics and Science Study (TIMSS, 1999) created an index of positive attitudes towards sciences (PATS) to understand the eight-graders' view of the usefulness of the science and enjoyment of science as a school subject. There were 38 countries participated in the study and there were some countries where science was taught as separate subjects, in these countries students were asked about each subject separately. In other countries the science was taught as a single subject to the students. In these countries, students generally showed positive attitudes. On the other side, in countries where science was taught as separate subjects the attitudes of students were less positive, but there was a clear relationship between attitudes toward science and science achievement for many of countries. In the countries where science was taught as single subject boys showed significantly more positive attitudes toward science than girls while in countries where science was thought as separate subjects, boys indicated higher levels of positive attitudes in earth sciences, physics and chemistry than girls whereas girls had higher levels of positive attitudes in biology.

Simpson and Oliver (1990) proposed a comprehensive study to summarize major findings of the investigations conducted based on the National Science Foundation (NSF) data. According to their study, there was a strong relationship between attitudes toward science and science achievement. They also found a decline in attitude toward science from sixth grade to tenth grade, where attitudes toward science were higher among boys than girls while achievement motivation was higher among girls than boys.

The conventional effect of gender on attitudes toward science favoring boys was reported by also other researchers (Fraser, 1978; Lowery, Bowyer & Padillia, 1980 as cited in Weinburg, 1995; Morrel & Lederman, 1998; Schibeci, 1984; Simpson & Oliver, 1985). Weinburg (1995) conducted a meta-analysis covering the literature between 1970 and 1991 to examine the gender differences in student attitudes towards science and correlations between student attitudes towards science and science achievement. The student grades in the samples of this analysis included sixth to tenth grades, fourth, fifth, and sixth grades, seventh grade, fifth and tenth grades. 31 effect sizes and 7 correlations representing the testing of 6753 subjects were found in 18 studies. This study revealed that mean correlation between attitude and achievement were .50 for boys and .55 for girls. Although the correlations were stronger for girls, boys showed more positive attitudes than girls in all branches of science in this study.

Another study investigated gender differences were conducted by Jones, Howe and Rua (2000). They examined sixth grade students' attitude and experiences related to science and their study involved 437 students from different schools in U.S. The results indicated significant gender differences in science experiences for sixth grade students. Male students reported having more interest in physical sciences than their female peers. They showed that boys were more interested in atomic bombs, atoms, cars, computers, X-rays and technology. On the other side, girls reported more interest in science aesthetic and biology including animal communication, rainbows, healthy eating and AIDS and the differences between males' and females' attitude toward science widens as students move from elementary to secondary school.

The studies about attitude toward science and science achievement are generally reported correlational relationship between these constructs, only a few studies were interested in the causal nature of this relationship. Although the correlational studies and reported mean differences in this area are very informative, there might be causal relationship that should be investigated between science attitudes and science learning (Mattern and Schau, 2002). There are varying results reported about the causal relationship between student achievement and attitudes in the domain of science. For example Marsh and Yeung(1997) supported reciprocal effects between these constructs for three years of high school that is extended from seventh to tenth grade, Shavelson and Bolus (1982) for seventh grade, Marsh (1990) for eleventh and twelfth grades supported attitudes predominant model and Reynolds and Walberg (1992) supported achievement predominant model for tenth graders and Rennie and Punch (1991) for eighth graders. In addition to the directions of the causal relationships, previous research has suggested stronger support for skill-development model which implies that academic self-concept emerges principally as a consequence of academic achievement during elementary school years whereas support for a reciprocal effects model was stronger in high school years (Skaalvik & Hagtvet, 1990, Skaalvik, 1997, Wigfield & Karpatian, 1991).

Schibeci and Riley (1986) had analyzed the data of 17-year-olds during 1976-1977 National Assessment of Educational Progress (NAEP) survey. The purpose of their study was to investigate the influence of students' background and perceptions on attitude and achievement. The causal modeling procedures were used to identify the variables which influence attitudes toward science and science achievement and to test a model in which attitudes influence achievement and the reverse model in which achievement influence attitudes. The NAEP data was consisted of 3135 students; two random samples of 350 and 323 students were drawn from this population for testing these two models in the cross-validation procedure. The initial model with χ^2=78.95 (p=0.02) in cross-validated on the second sample and resulted in χ^2=64 (p=0.21). After testing the reverse model to establish the direction of causal relationship, they found that attitudes influence achievement rather that the reverse. The direction of the causal chain reported is perceptions $\rightarrow$ attitudes $\rightarrow$ achievement.

A meta-analysis for research results about the relationship between science achievement and attitude was conducted by Willson (1983). 43 studies yielding 280 coefficients were utilized in the study. The domain was from kindergarten through undergraduate level research on science attitude and achievement. In his study, Willson found the mean for all correlation coefficients was .16. Willson reported that 42 coefficients were based on studies in which attitude measured prior to achievement (r = .16); 24 coefficients for achievement prior to attitude (r = .16) and 193 coefficients were based on the studies in which two variables were measured simultaneously. The indifference in the magnitudes of correlations for either direction was underlined. For elementary level students when directionality is considered, he reported 11 coefficients with achievement preceding attitude with a mean correlation of .25 and 10 coefficients with attitude preceding achievement with a mean correlation of .12. At junior high school level the pattern is similar and there are 13 coefficients with causal order from achievement to attitude and 14 coefficients for causal order from attitude to achievement with mean correlations .24 and .15 respectively. At senior high and collage level this order was reversed in most studies. At this level there are 4 coefficients for the direction from achievement to attitude and 14 coefficients for the direction from attitude to achievement with mean correlations -.02 and .20 respectively. So according to these results, Willson concluded that at elementary and junior high levels there is higher correlation for achievement causing attitude than for attitude causing achievement, whereas attitude causes achievement for senior high and collage levels.

One of the most informative study about the direction of relationship between some of affective characteristics and achievement was conducted by Rennie and Punch (1991) at eighth grade. They investigated this relationship in two stages. First, a model was developed and tested for science related affect, the complex of students' attitudes toward, interest in, and perceptions about science at school. In the second stage they examined the direction of the relationship between science related affect and achievement. Their study found that science related affect was related more closely to previous achievement that substantial achievement. In this study, they concluded that there is stronger influence by achievement on later affect by affect on later achievement.

In addition to them, Reynolds and Walberg (1991) found similar results in this study. They found that cross-validated mediated-effects model fit the data significantly better than the direct-effects model in which they reported the variables home environment, motivation, instructional time and prior achievement had greatest total effect on achievement and the effect of home environment, motivation was mediated by prior achievement. They extended this study to include also attitudes and to test this model. This extended study included data on 2535 tenth grade public school students. Structural equation modeling was used for the analysis of data. Results revealed that prior science attitudes and achievement had significant direct effects on science attitude. Comparison of the effect of prior achievement on later attitude with negligible influence of prior attitude on later achievement suggested that the causal direction is recursive and from achievement to attitude rather than reciprocal or in the reverse direction. That is for that sample achievement is more likely causing attitude rather than reverse.

In a recent study, Mattern and Schau (2002) proposed four causal models describing the longitudinal relationships between attitudes toward science and science achievement based on the literature. These are: a) cross-effects over time between attitudes and achievement (which is called reciprocal), b) influence of achievement predominant over time, c) influence of attitude predominant over time and d) no cross-effects over time between attitude and achievement. They also tested the best fitting causal model for the invariance across gender. The data was collected from 1238 students in seventh and eighth grades. The findings indicated that the cross-effects model is the best fitting model for all students. For boys only, the best fitting model was no attitude path model, it imply that there is no important unique effect of previous attitudes on post attitudes but previous achievement affected post attitudes, so they interpreted this model is close to the achievement predominant model (Helmke & Van Aken, 1995, Newman, 1984, Reynolds & Walberg, 1992; Skaalvik & Hagtvet, 1990). The no cross-effects model was the best fitting model for girls that girls' subsequent achievement was not affected by their prior attitudes nor was their later attitudes toward science affected by their earlier science achievement.

There are not many studies including affective characteristics related to physics and physics achievement. Only the study of Abak (2003), conducted recently, included most affective variables (interest, importance, motivation, self-efficacy, self-concept and anxiety). The sample included university freshman physics students, the data was modeled for the within relationships in the affective characteristics and their relationships with the student achievement in freshman physics. Her study revealed that there is a positive relationship between affective characteristics and achievement (R^2= .26). The model included more variables than other studies reported in the literature, so accounted for 26 % of freshmen students' physics achievement that is higher than reported accounted variances in literature. The affective variables were grouped in three sub dimensions: attitude toward physics, physics motivation, and achievement motivation. Attitude dimension included interest, importance, and extra activities. She found a causal order from attitude to motivation, from motivation to achievement motivation, and from achievement motivation to achievement for university students.

What can be concluded from the literature, on the contrary to the declaration of Shringley et al, (1988), it is possible to find causal relationships between attitude and achievement. However the direction may be different according to grade level or sample properties. At elementary or middle school level and even in early years of high school it is logical to expect a direction of causality from achievement to attitude (Mattern & Schau, 2002; Reynolds & Walberg, 1992; Willson, 1983). For the students at university and in late years of high school the causal relationship changes its direction, accordingly at these levels, it is expected that students' attitudes influences their achievement.

2.2 Self Related Variables

The rationale for the research on self-related variables such as self- concept and self-efficacy stems from the theoretical model indicating that people who receive themselves to be more effective, more confident, and more able to accomplish than people with less positive self-perceptions. It is widely demonstrated that there is moderately strong relationship between children's academic achievement and self-related variables that children have in different subject areas (Helmke & Van Aken, 1995; Jacobowitz, 1983; Marsh, 1984; Marsh, 1990; Shavelson & Bolus, 1982; Simpson & Oliver, 1990; Skaalvik & Hagtvet, 1990).

Self-concept which can be defined as a person's perceptions regarding him or herself (Marsh, 1990) includes the feelings of self-worth that accompany competence beliefs. There are lots of arguments on the causal relationship between self-concept and achievement and the direction of this causality. Although there is no agreement about the causal ordering of these concepts, according to the logical grounds four possible pattern of causation can be argued theoretically (Skaalvik & Hagtvet, 1990).

1. A causes B. On the basis of this principle of deflected appraisals (Rosenberg, 1979, as cited in Skaalvik & Hagtvet, 1990), one may predict that academic achievement will influence self-concept through evaluations of significant others. When the social comparison theory is considered, where relative performance in a social group such as classmates is important, it can be suggested that students who compare themselves with more able schoolmates develop lower aspirations. This pattern of causation argues that self-concept is an outcome variable of achievement.
2. B causes A. According to self-consistency theory, it can be predicted that students with low academic self-concept will avoid situations that could change their self-concept, so makes less effort to do well in school. Also, self-worthy theory suggests that students with low expectations of success

may develop failure avoiding tactics, and finally destroy the will to learn which results in lower academic achievement.

3. A and B influence each other in a reciprocal manner. Marsh (1984) proposed a dynamic equilibrium model that suggesting that there is a reciprocal relationship between academic achievement, self-concept and self-attributions such that change in any one produces change in other to reestablish the equilibrium.
4. C causes both A and B. Maruyama et al (1981, cited in Skaalvik & Hagtvet, 1990) argued that the case that ‘third variables’ cause both achievement and self-concept.

Besides these patterns of causation, there are other theoretical approaches to this causality. Bryne (1984) supported the skill-development theory which implies achievement related successes and failures influence self-concept through various means. In other words, academic self-concept emerges principally as a consequence of academic achievement so that academic self-concept is enhanced by developing stronger academic skills. On the other hand; a high self-concept may be a favorable precondition for the initiation and persistence of effort in learning and achievement situations. On the basis of this view, some theorists have supported the self-enhancement theory (Calsyn & Kenny, 1977). According to this model the self-concept is the primary determinant of academic achievement. This approach suggested that enhancing self-concept of ability through the changes in perceived evaluations of significant others would change the functional limits on learning and improve students’ achievement.

As seen, there are different arguments on the patterns of causation in the literature. Surely, not all studies reported causal relationships between these concepts, but researches revealed that self-concept is an important contributional variable in achievement studies. For example, Jacobowitz (1983) reported a correlation coefficient of .45 between science self-concept and science achievement for 8^{th} grade students. Also, Oliver and Simpson (1988) showed that students scored higher in science reported more positive attitudes and higher self-concept in science. Although the relation between attitude and achievement were not so strong for this study, achievement motivation and self-concept were strong predictors of achievement.

Later, Simpson and Oliver (1990) found that self related variables were the strongest variables that predict achievement in science. They also added science self-concept is a good predictor for attitude toward science with science anxiety and achievement motivation.

There are not many researches investigating the causal relationship between self-concept and academic achievement despite its theoretical and practical significance. Bryne (1984) purposed to test the causal predominance between these variables and examined the studies. She noted that to establish a causal relationship between variables, the study should satisfy these three prerequisites:

a. A statistical relationship should be established.
b. A clearly established time precedence must be established in longitudinal studies.
c. A causal model must be established.

In her study, she claimed that there was no conclusions about causal ordering of self-concept and achievement based on the existing research. Later Bryne (1986) reported no effect of prior achievement on subsequent self-concept and prior self-concept on subsequent achievement, but she noted potential limitations in her research.

When the direction of causality between self-concept and achievement is the matter, studies also reflect the variety of patterns. Marsh (1990) tested the causal ordering of academic self-concept and academic achievement with the data that is collected in grades 10, 11, 12 and one year after graduation represented by T_1, T_2, T_3, and T_4 respectively. Three latent constructs were considered: a) academic ability (measured in T_1 only), b) academic self-concept (measured in T_1, T_2, and T_4) and c) school grades (measured in T_1, T_2, and T_3). In the study the grades of previous year preceded the academic self-concept and for each lag significant effect of academic self-concept on subsequent school grades was found. School grades had no effect on subsequent self-concept beyond the effect of previous self-concept but when previous grades and academic self-concept were controlled grades had positive effect on academic self-concept. Hence, it may be reasonable to argue for a reciprocal effects model based on these results.

Marsh and Yeung (1997) made a research to examine the relationships among academic self-concept, school marks and teacher ratings of achievement collected in English, math and science in each of three years. Structural equation modeling were used to evaluate the effects of prior academic self-concept on subsequent achievement after controlling for the effects of prior academic achievement and the effect of prior academic achievement on subsequent academic self-concept after controlling for the effects of prior academic self-concept. Results revealed that math self-concept influences subsequent mathematics achievement and at the same time mathematics achievement affected significantly the subsequent measure of math self-concept. That is models for mathematics supported reciprocal effects. For science; paths leading from science self-concept to subsequent science achievement were statistically significant and the paths leading from science achievement to subsequent science self-concept were also statistically significant but larger. Similar to models for mathematics, science models supported the reciprocal effects model. The models for English like the results of science models supported reciprocal effects.

There is a support for reciprocal effects models for the relations between academic self-concept and achievement based on these studies, but this relation was not examined developmentally. Wigfield and Karpathian (1991) asserted that once ability perceptions are more firmly established the relation likely becomes reciprocal. Students with high perceptions of ability would approach new tasks with confidence and success on those tasks is likely to bolster their confidence in their ability.

Skaalvik and Hagtvet (1990) researched this causal relationship among academic achievement, self-concept of ability and general self-esteem for cohort 75 and cohort72 who were in third and sixth grades respectively in Norwegian schools. Researchers used LISREL VII program to test their hypothesis. Results showed that for the cohort 75 which included students who were born in 1975, academic achievement seemed to have causal predominance over self-concept of ability, on the other side for cohort 72 who were born in 1972 predominant direction of causality from academic achievement to global self-esteem via self-concept was found, it was a modest but significant path from self-concept to academic achievement. This provided some evidence for the skill-development model during earlier school years while reciprocal effects model during higher school years. The authors reasoned that the age differences may reflect a developmental difference or the increased demands and change I evaluation procedures experienced by students in the Norwegian school system because during passing from sixth to seventh grade there is a distinct increase in the amount of homework and in the number of tests.

Calsyn and Kenny (1977) proposed the method of cross-lagged panel correlation to establish which of the two variables: achievement and self-concept was causally predominant and they found a reasonably consistent predominance of academic achievement over academic self-concept in a variety of comparisons thus supporting the skill-development model.

Bachman and O'Malley (1986) analyzed a longitudinal data to establish a causal model. Academic performance self-concept of ability and global self-esteem were measured at the end of 11th grade. The predominant causal direction were suggested to be from grades to self-concept of ability to global self-esteem and the data showed academic achievement affected global self-esteem via self-concept.

Additionally Harter and Connel (1984) provided evidence for the influence of achievement on later self-concept. Another study (Helmke & Van Aken, 1995) addressing the question of causal ordering of self-concept of ability and academic achievement during elementary school years. The questions were a) do self-concept and achievement influence each other? and b) does it make difference whether achievement is assessed by marks or tests? The structural equation modeling analysis resulted that it makes difference whether achievement was measured with only one indicator (either marks or test performance) or both indicators are integrated in the model. The former models which use only one indicator yielded a reciprocal model meaning that self-concept is both a cause and an effect, but the dominance of causality is from achievement to self-concept supporting the skill-development model, while later achievement depends almost completely to prior achievement rather than prior self-concept. The most complex model including both indicators of achievement clearly supports the skill development model. This indicates self-concept is mainly a consequence of cumulative achievement related success and failure.

Another research (Newman, 1984) consisted of a longitudinal analysis of children's achievement and self perceptions of ability in mathematics across grades 2, 5 and 10 found that between second and fifth grades and also between fifth and tenth grades children's self perceptions of their mathematics ability have no significant causal influence on later achievement. According to the results, it is evidenced that second grade math achievement was found to have a significant effect on self perceptions. Three years later however it is not clear if the same conclusion holds for the period between fifth and tenth grades. It is concluded that an important effect of achievement among younger children but not necessarily among older children, it seems to depend on the children's age. As seen, studies that attempted to determine the predominant direction of causal relationship between these constructs came over with varying results.

The other self related variable included in this study is self-efficacy. Pajares and Schunk (2001) asserted that self-efficacy is concerned with judgment about capabilities whereas self-concept includes the feelings of self-worth that accompany competence beliefs. Although they seem to differ slightly in meaning some researchers conceptualized them as unique factors that contribute independently and interactively to academic achievement or performance (Zimmerman, 1995). So, academic self-concept and self efficacy may be functioning in the same way in academic achievement studies.

At the outset of an activity, students differ in their self-efficacy for learning as a function of their prior experiences, personal qualities and school supports. As they engage in activities, students are affected by personal and situational influences that provide students with cues about how well they are learning. Self-efficacy is enhanced when students perceived that they are performing well or becoming more skillful (Pajares, & Schunk, 2001). Most studies about self-efficacy found positive relationships with academic achievement did not investigate or established any causal relationships or the direction of causality between these variables.

Multon, Brown and Lent (1991) hypothesized that self-efficacy influenced behavioral activities, persistence in face of obstacles and task performance and they explored this relationship between these variables in a meta-analysis. They found 39 studies including a measure of self-efficacy and academic performance or persistence with sufficient information to calculate effect sizes. Their investigation provided a support for the relationship of self-efficacy beliefs to academic performance and persistence that self-efficacy beliefs accounted for approximately 14% of academic performance and 12% of academic persistence. They also found that these relationships varied by students' academic achievement status; that is stronger relations were found among low-achieving students (.56) than among those making normative academic process. Also high school and collage student samples evidenced stronger effects sizes than elementary school students.

Sommerfield and Watson (n.d.) investigated the relation between self-efficacy, global self-concept and subject specific self-concept and their effects on students' future grade expectations. Thirty-four students, who are in the first year at Stanford University, participated in this study. According to their results one's beliefs about one's capabilities affect their prediction of their performance on specific tasks, and students experience two different types of self-reflection: one is global, and the other is content specific and these measures were positively correlated.

Pajares and Schunk, (2001) in their study introduced the perceived self-efficacy as a type of motivational process. They explained the similarities and differences of self-efficacy with some other constructs like outcome expectations, self-concept, effectance motivation and perceived control and also influences about family and school on the development of self-efficacy. Their comparison of self-concept and self-efficacy defines the self-concept beliefs as one's collective self-perceptions that are formed through experiences with and interpretations of the environment, and which are heavily influenced by reinforcements and environments by significant others (Shavelson &

Bolus, 1982) and self-efficacy as a ‘context related judgment of ability to organize and execute a course of action to attain designated levels of performance (Zimmerman, 1995, p.218).

Another study by Anderman and Young (1994), behaved self-efficacy as a motivational construct. They examined the individual and classroom-level differences in motivation and strategy use in sixth and seventh grade middle school science. The study indicated that measures of general motivation and cognition are moderately strong. The reported correlations in this study were: .45 between self-efficacy and science self-efficacy, .37 between self-efficacy and science expectancy, .23 between self-efficacy and science value and .34 between self-efficacy and science self-concept.

When these studies are considered, to reach any causal relations seems not to be possible, however according to Schunk (1985, as cited in Multon, Brown & Lent, 1991) self efficacy is developed as a result of aptitudes and past educational experiences about different cognitive tasks. The process takes place within a continuous feedback loop that self-efficacy and outcome expectations influence motivation which in turn determines performance outcomes. Performance feedback then affects subsequent self-efficacy and outcome expectations of students. As a result, here can be no doubt that self-efficacy is formed at least in part by prior achievement.

2.3 Interest in Physics

Interest is one of the most important variables in affective characteristics for achievement studies. Schiefele (1991) emphasized the significance of the interest that allows for complete and correct recognition of an object, leads to meaningful learning, promotes long-term storage of knowledge and provides motivation for further learning. As early as the beginning of 19th century the German philosopher Herbart (1965) recognized a close relationship between interest and learning. This relation between interest and learning is the heart of interest studies.

Some researchers behaved interest as a multidimensional variable. Thorndike (1935) declared that learning was not only personal interest but also the interestingness of tasks or objects. Hidi (1990) introduced a distinction between two ways of investigating the role of interest in cognition. According to her, individual interest might play a strong role in writing and intentional learning as well as in difficult learning and expertise, situational interest on the other hand is more relevant to reading and easier learning and both have profound effect on cognitive functioning and facilitation of learning. Tobias (1992) also suggested that interest contributes to learning that it has an energizing effect on learning and lead to students to use deep comprehension processes.

Based on the study of Häussler (1987) interest in physics show differences according to gender. In this research, a test was developed to determine students' interest in physics on the basis of a curricular model of physics education with three dimensions: topic, context, and activity. This test is administered to 4034 students in the 11-16 age arrange students attending different types of schools in Federal Republic of Germany. There were eight topics in the test: optics, acoustics, heat, mechanics, electricity and electronics, structure of matter, radioactivity and nuclear power. His study confirmed the general trend found by many other studies about the effect of gender and age that is overall interest in physics decreases as students grow older and boys show higher interest than girls. Although the decrease in interest by growing was only moderate, there were remarkable gender differences in the results. Girls liked equally or more than boys the topics like heat or acoustics and they were less attracted by all other topics. Girls also seemed rather uninterested in the quantitative mathematical aspects of physics and in physics as a basis for technical vocations, on the other had they were equally or more interested than boys in physics as a vehicle to enhance emotional experience and physics related to vocations like medicine and counseling. The last dimension activity revealed that younger students like 'learning by doing'.

In addition to those researchers Jones, Howe and Rua (2000) also examined the gender difference in students' interest and attitudes. Their sample was consisted of 437 sixth grade students and their results also confirmed the findings that males showed more interest in physical sciences whereas females showed more interest in science aesthetic and biology.

Häussler and Hoffman (2000) studied interest in a more comprehensive curriculum development study. The data was collected from 8000 students and information of the presently taught physics curriculum were sample longitudinal and cross-sectionally in various German States by questionnaire. Results revealed that students' interest in physics as a school subject is hardly related to their interest in physics but mainly to students' self-esteem of being good achievers.

In most of studies interest served as an independent variable while achievement served as the dependent variable. Most researchers (Schifele, Krapp, & Winteler, 1992) proposed that interest influence academic achievement. Schifele et al (1992) in a meta-analysis, examined the relation between interest and achievement in different school subjects: physics, biology and mathematics, social sciences, foreign languages and literature. In this study they reported an overall correlation of r= .30.

A study revealed a direction for the relationship between interest in physics and physics achievement is the study of Abak (2003). According to the results of her study student interest, and importance affect motivation and motivation affects achievement in physics. However it should be remembered that the sample of this study included university students and these results may not be in line with the results for high school students.

At high school level, Rennie and Punch (1991) conducted a research including interest in science at school with several affective variables with 390 eight graders in Australia. They examined the relationship between affective factors and achievement using Lisrel and multiple linear regression analysis. This model consisted of students' attitudes toward science, interest in science and perceptions about science at school. They have found that affective factors are more strongly related to previous than subsequent achievement. In other words, eighth grade students' achievement influenced their interest like attitudes.

That means the students who are successful in a subject or who feels more confident and efficient seem to be more interested in that subject. Moreover, Baumert, Schnabel and Lehrke (1998) analyzed a longitudinal data from several German and international studies in order to investigate the relationship between interest and achievement in mathematics. They used structural equation modeling and showed that interest had no effect on achievement after controlling for prior knowledge whereas achievement influenced interest even when prior interest was controlled. The relationship they found was another example for achievement predominant model. They interpreted for this direction that the effect of achievement on interest might be mediated by self-concept of ability. As Harter (1978, 1982) proposed that, students experienced an increase in perceived competence after an educational transition, showed gains in intrinsic motivation and school related affect.

Köller, Baumert and Schnabel (2001) hypothesized that interest has no substation effect on learning in lower secondary schools in Germany where the instruction is highly structured in lower years, but interest later becomes and important predictor of course selection and learning in upper secondary school when students have more options. Authors analyzed the data of 602 students who are selected for academic tracks during their seventh grade and twelfth grade. They examined the relationship of interest with achievement in mathematics. They revealed that interest had no significant effect over learning from grade 7 to grade 10 but affected the course selection. However interest at the end of the grade 10 had a direct and indirect effect on achievement in upper grades, suggesting that at least from grade 7 to 10 achievement affected interest. The assumption that interest in an important antecedent of successful academic learning is not supported empirically in lower grades secondary school level. They proposed that academic achievement or academic self-concept affected interest (Köller et al, 2001). However there is surprisingly little research incorporating academic self-concept and interest to inquiry the causal relations between and with academic outcomes.

Marsh, Trautwein, Lüdke, Köller and Baumert (2005) extended their study to include also academic interest. It was based on the data o two nationally representative samples of German seventh grade students. According to the results math self-concept and interest were both positively correlated with achievement. Reciprocal effect model was supported for the relationship between self-concept and achievement for both of studies, on the other side, this model was not supported for interest and achievement while it was supported in the second study.

Seemingly, the relationship and the direction of this relationship between interest and achievement at high school level is an achievement predominant model. Additionally, the relation seems to be affected by gender and age of students like the other affective characteristics mentioned. Thus, a prediction that interest may show the same relation pattern with others can be done easily. Moreover, some researchers have suggestions about mediated effects that the effect of achievement on interest may be mediated by the effect of self-concept (Baumert, Schnabel &Lehrke, 1998).

2.4 Importance of Physics

Importance is sometimes studied as an aspect of motivation or a dimension of attitude (Abak, 2003, Schibeci & Riley, 1986). Some researchers used usefulness of science or values of science instead of this construct (Barrington & Hendricks, 1988).

The importance of physics is not one of the frequently voiced variables in the literature. There are some studies in mathematics and rarely for science. Schifele (1991) reported the correlation of importance with mathematics .25; with achievement motivation .21 and with mathematical ability .06.

Berndt and Miller (1990) suggested that students' motivation to achieve in school is affected by their expectancies for success and by the value they attach to success in academics. Based on the data of 153 seventh graders, analysis revealed that expectancies and values were positively correlated to academic achievement.

In order to investigate the connection between student self-beliefs and science achievement, the TIMSS 2 data of Ireland was analyzed. Correlation results indicated that students who showed higher levels of science achievement tended to be more likely to agree that they enjoyed learning science, that science is an easy subject and that science is important to everyone's life. Finding from the multiple regression analysis of the entire sample indicated that students who showed higher levels of science achievement reported that they enjoyed learning science. Multiple regression analysis for females revealed that students enjoying science showed more achievement, for males revealed that students showing higher achievement in test scores, showed that they enjoyed learning science, that science is an easy subject, and that science is an important to everybody's life (House, 2000b).

The results of TIMSS 2 for Hong Kong exhibited association between science learning, importance of academics and enjoyment in science. The analysis indicated that students who had higher test scores were more likely to feel that science is an easy subject and it is important to everybody's life and that they enjoyed learning science. According to the findings of multiple regression analysis students who earned higher science test scores that were more likely to feel that science is important to everybody's life and that they enjoyed learning science (House, 2000a).

The only study incorporating importance of physics and physics achievement with other affective characteristics is the study of Abak (2003). She took importance of physics as a dimension of attitude with interest in physics and extra activities related to physics. She found that the importance is more related with self-concept and self-efficacy than with interest. In this study the causal chain was from attitude to motivation and from motivation to achievement. However, since this study was conducted at university level it does not give valid information about the direction of causality at high school level. Since interest is an attitudinal variable and at lower ages the causal models are generally achievement predominant models that means achievement determines students' attitudes. Thus, it is reasonable to expect that importance is affected by student achievement at high school level.

2.5 Anxiety in Physics

In mathematics the anxiety concept was seriously studied and it has probably received more attention than any other factor in affective domain (Kazelskis, 1998, McLeod, 1992). However few studies were conducted in the area of physics.

The studies on mathematics anxiety have a problem of lacking any agreement about what constitutes mathematics anxiety. Kazelskis (1998) examined the factor structure of the items of three commonly used measures of mathematics anxiety using a sample of 323 undergraduates enrolled in a required algebra course. The present factor analysis were the results of analysis of the item responses from Mathematics Anxiety Rating Scale (MARS) by Richardson and Suinn (1972), the Mathematics Anxiety Questionnaire (MAQ) by Wigfield and Meece (1998), and Mathematics Anxiety Scale

(MAS) by Fennema and Sherman (1976). Six oblique factors were identified: Mathematics Test Anxiety, Numerical Anxiety, Negative Affect toward Mathematics, Worry, Positive Affect toward Mathematics, Mathematics Course Anxiety. These six factors accounted for the 60.7% of the total variance.

The studies including achievement and anxiety are generally revealed correlational findings. In a meta-analysis conducted by Ma (1999) examined 26 studies on the relationship between anxiety toward mathematics and achievement in mathematics among elementary and secondary school students. This study suggested that the common population correlation was significant (-.27). The models of this study indicated that the relationship is consistent across gender, grade, and ethnic group.

A study including the science anxiety with other affective factors is conducted by Simpson and Oliver (1990). They found anxiety is negatively correlated with attitudes. Science self-concept, science anxiety and achievement motivation altogether accounted for 55% of variance in attitudes toward science and for only 11% of the variance in science achievement.

These studies have shown that anxiety was related to students' performance on standardized tests or achievement. However studies on anxiety were not integrative and extensive enough to conceptualize the causal relationships among anxiety, achievement and other affective characteristics at high school level. In Abak's (2003) study it was taken as a motivational variable and results showed that there is significant effect of motivation on students' physics achievement for university students.

Meece, Wigfield, and Eccles (1990) used structural equation modeling procedures to asses the influence of past math grades, math ability perceptions, performance expectancies and value perceptions on the level of math anxiety reported in a sample of seventh through ninth grade students. They also examined the relative influence of these performance, self-perceptions and affect variables on subsequent grades and enrollment intentions in mathematics. In this study researchers tested the models derived form expectancy-value theory (Eccles, 1983) and self-efficacy theories. These two theories maintain that in forming efficacy or ability judgments, individuals rely on information about their past performance. Researches had shown that successful performance does not necessarily enhance efficacy-related perceptions; the impact of this information depends on how it is cognitively appraised and interpreted (Bandura, 1986; Eccles, 1983; Meece et al 1982; Schunk, 1984). According to those researches the models predicted that students' self-efficacy related beliefs mediate the effects of prior academic performance on anxiety. The results demonstrated that, math ability perceptions affected students valuing of math and expectancies. Also math anxiety has only indirect effects on subsequent performance and enrollment intentions.

Concerning predictors of math anxiety, it was found that students' current performance expectancies in math and perceived importance have strongest direct effect on math anxiety, so they suggested that it is students' interpretations of their achievement outcomes and not these outcomes themselves have the strongest effects on students affective reactions. Past academic successes and failures arouse anxiety through their effects on perceived self-efficacy. For example if failures weaken students' sense of efficacy, they become anxious. Although it is indirect, successes and failures are effective on the level of anxiety. Hence, it can be concluded that achievement in form of performance on specific tasks are effective on their level of anxiety on those specific tasks.

2.6 Motivation

Motivation is one of the most important influences of achievement, like positive attitudes and other affective characteristics; motivation should be taken into consideration. Motivation is sometimes studied as a multidimensional factor (Kremer & Walberg, 1981; Uğurluoğlu & Walberg, 1979) and sometimes studied as an attitudinal variable with other variables such as enjoyment and self-confidence (Schibeci & Riley, 1986)

Uğurluoğlu and Walberg (1979) synthesized researches about the relationship between motivation and achievement to produce objective estimates of motivation-achievement correlation. They analyzed correlations of two samples of studies: a calibration sample of 22 studies and a validation sample of 18 studies. The grades included ranged from first to twelfth grade, 232 uncorrected observed correlations showed a mean correlation of .338 and studies indicated that motivation and achievement were more highly correlated for students in later grades.

Kremer and Walberg (1981), made a study to synthesize social and psychological research on science learning in grades 6 through 12, conducted under three rubrics: student motivation, home and family environment and peer group environment as a part of a longer effort to determine the factors that are productive of cognitive, affective and behavioral learning. They used self-concept, persistence, need-achievement and test anxiety as the measures of student motivation. Investigators examined 20 studies and concluded that all of the studies of student motivation and science achievement showed positive relationships. They found the mean correlation of student motivation and science learning was .37 that is higher than the correlation found by Bloom (1976) and Uğurluoğlu and Walberg (1979).

In the literate there is not any finding revealing directional relation between these constructs. Harter (1982) summarized findings of researches to explain the linkage among perceptions of competence, affective reactions and motivational orientation toward classroom learning. She suggested students had motivational orientations along a continuum from an intrinsic interest in learning to extrinsic motivation to perform in order to meet external standards and win rewards and she was interested in how this orientation is affected from the competence perceptions of children. According to her theoretical model first failures and successes and responses of social agents to those failures and successes have direct effect on child's perceived competence and these perceptions in turn affect motivational orientation. She found evidence that students who perceived themselves to be competent manifested more intrinsic motivation compared to students who perceived themselves less competent that they generally reported to be more extrinsically oriented and she asserted that success and failure component, in form of achievement level had an impact on child's perceived competence. Harter and Guzman (1986) in their study found that children's level of perceived competence is highly predictive of their choice of difficulty level. A similar study (Harter, 1978) revealed that the combination of the grades imposed by an impersonal evaluator, the focus on correct solution and social comparison attenuates children's interest in and enjoyment of learning process and moderated their preference for challenge. In addition these factors caused performance anxiety.

In summary; they evidenced children who perceived themselves to be component felt better and showed less anxiety about their school performance, maintain on intrinsic motivation and children with low levels of perceived competence was more anxious and extrinsically motivated. The high or low performance of child is at the beginning of this chain. The argument on motivation and achievement association shows that the level of achievement is effective on competence perceptions, motivation orientation and anxiety. However, literature research indicated that little attention was paid to motivation which deserved closer attention of science educators.

2.7 Achievement Motivation

Achievement motivation is also an important affective variable. It is generally studied with other constructs of affective domain (Cannon & Simpson, 1985; Oliver & Simpson, 1988; Simpson & Oliver, 1985; Simpson & Oliver, 1990; Talton & Simpson, 1986). Simpson and Oliver (1985) made a study as a part of an ongoing multidimensional study involving influences on science achievement, commitment to science and achievement in science. Data was collected from 4000 students in grades 6, 7, 8, 9 and 10. All students were administered an attitude toward science scale and achievement motivation scale at the beginning, middle and end of the year. The results showed that achievement motivation scores of adolescent students decreases from the grade 6 to 10 and within each year from beginning to end of the year. When the effect of gender was investigated it is seen that female students in this study were significantly more highly motivated to achieve than their male counterparts.

Talton and Simpson (1986) reported achievement motivation, with anxiety and self concept in science was significant predictors of attitude toward science. Moreover, Oliver and Simpson (1988) explored the relationship of three related attitude sub constructs, attitude toward science, achievement motivation and science self-concept with science achievement. They used multiple regression and found that achievement motivation and science self-concept were significant predictors of science achievement in sixth through tenth grades accounting for approximately 10% of the variance in science achievement scores.

However the cause-effect relationship was not a common issue for studies including achievement motivation that they generally reported correlational relations. Abak (2003) resulted that achievement motivation is affected by motivation and affected freshmen physics students' achievement. She also reported that achievement motivation is related to importance, self-related variables, and interest and she also found that achievement motivation had the second strongest relationship with achievement. This finding is really important since it confirmed the idea that achievement motivation is an important variable for achievement studies.

2.8 Locus of Control

Locus of control refers to a person's beliefs about control over life events in general meaning. Some people, feel personally responsible for the things that happen to them, are labeled as internals and others, feel that their outcomes are determined by forces beyond their control (e.g. fate, luck, and other people), and are labeled as externals (Findley & Cooper, 1983). A positive relation between locus of control and achievement is logical, that externals tend to exhibit less persistence at tasks, while internals have as greater likelihood of achievement.

Findley and Cooper (1983) reviewed the existing literature on the relation between locus of control and academic achievement with taking the characteristics of the participants like gender, age, race, and socioeconomic status into account. 208 potentially relevant studies were examined and they concluded that locus of control and academic achievement was positively related, however, the magnitude of this relation ranged from small to medium. Also the relation tended to be stronger for adolescents than for adults or children and for males than for females.

Locus of control is a very rarely faced construct in physics education. The correlation can be easily seen, but a direction for this relationship is not reported in the literature. If there is a causal relationship, it may be in accord with the other affective characteristics. At lower ages, achievement of students determines students' locus of control that they become external or internal. Then it affects their achievement in later grades.

2.9 Summary

The literature re review indicated the following conclusions:

1. Attitude studies show there is a positive correlation between attitude toward science and science achievement (Cannon & Simpson,1985; Oliver & Simpson, 1988; Shringley et al, 1988; Simpson & Oliver, 1990; Talton & Simpson, 1987; TIMSS, 1999; Willson, 1983).
2. There is a decline in positive attitudes from beginning to the end within each year and from elementary grades to higher grades (Barrington & Hendricks, 1988; Cannon & Simpson, 1985; Simpson & Oliver, 1990).
3. There are gender differences in students' science attitudes, that boys show higher positive attitudes toward science than girls (Abak, 2003; Jones et al, 2000; Mattern & Schau, 2002; Simpson & Oliver, 1990; TIMSS, 1999).
4. There are causal relations between student attitudes and achievement (Abak, 2003; Marsh, 1990; Marsh & Yeung, 1997; Mattern & Schau, 2002; Reynolds & Walberg, 1992; Shavelson & Bolus, 1982; Skaalvik & Hagtvet, 1990).
5. The direction of the causal relationships between attitudes and achievement is from achievement to attitudes in elementary grades and in early years of high schools (Mattern & Schau, 2002; Newman, 1984; Reynolds & Walberg, 1992) and in higher grades and at university level, it becomes a reciprocal relation (Marsh & Yeung, 1997) or attitudes

affect students' achievement (Abak, 2003; Marsh, 1990; Schibeci & Riley, 1986; Shavelson & Bolus, 1982).

6. Self related variables such as self-concept and self-efficacy are strongly related to student achievement (Jacobowitz, 1983; Oliver & Simpson, 1988; Simpson & Oliver, 1990).
7. Self-concept has causal relations with achievement. At lower gardes studies generally report achievement predominant model for this relation (Bachman & O'Malley, 1986; Newman, 1984; Skaalvik & Hagtvet, 1990) in later grades reciprocal effects model or the effect of prior self-concept on subsequent achievement are reported (Marsh, 1990; Marsh & Yeung, 1997; Skaalvik & Hagtvet, 1990).
8. Self-efficacy is developed as a result of aptitudes and post educational experiences (Schunk, as cited in Multon, Brown, & Lent, 1991).
9. There is a close relationship between interest and achievement (Hidi, 1990; Schiefele, 1991; Tobias, 1992).
10. Some studies report the effect of interest and achievement (Abak, 2003; Köller, Baumert, & Schnabel, 2001) and some claim that achievement affects interest (Baumert, Schnabel, & Lehrke, 1998; Rennie & Punch, 1991).
11. Importance of science sometimes named as usefulness or value of science and generally studied as an attitudinal variable is related to achievement

in science (Abak, 2003; Barrington & Hendricks, 1988; Berndt and Miller, 1990; Schibeci & Riley, 1986).

12. Science anxiety is negatively related to attitudes toward to science and science achievement (Kazelskis, 1998; Ma, 1999; Simpson and Oliver, 1990).
13. Some researchers asserted that the effect of achievement on anxiety is mediated by self-efficacy related beliefs (Meece, Wigfield, & Eccles, 1990).
14. Motivation is highly correlated with academic achievement (Kremer & Walberg, 1981; Uğurluoğlu & Walberg, 1979).
15. Motivational orientation of students is related to their achievement that high achieving students tend to be intrinsically motivated, and low achieving students tend to be extrinsically motivated (Harter, 1986).
16. Self perceived competence is effective on anxiety (Harter & Guzman, 1986).
17. There is a high relation between achievement motivation and achievement (Abak, 2003; Oliver and Simpson, 1988) and at university level the direction of this relation is from achievement motivation to achievement (Abak, 2003).
18. There are also relations between some affective characteristics reported, for example, self related variables and motivation (Abak, 2003); self related variables and anxiety are related (Meece, Wigfield & Eccles,

1990), anxiety in physics and self related variables; interest in physics and importance of physics, importance of physics and motivation in physics; interest in physics and anxiety in physics; self related variables and achievement motivation in physics and interest in physics and achievement motivation in physics are other related variables (Abak, 2003).

19. Self efficacy and self concept are reported to be related (Abak, 2003; Schunk, as cited in Multon, Brown, & Lent, 1991).

CHAPTER 3

METHODOLOGY

3.1 Population and Sample

All the ninth grade students in FL high schools of central administrative districts of Ankara (Altındağ, Çankaya, Etimesgut, Gölbaşı, Keçiören, Mamak, Sincan, and Yenimahalle) are the population of this study. There were total 56 schools of this type in the population and the list was taken from the web page of OSYM.

The stratified-random and convenience sampling methods were used to determine the sample of the present study. The districts were chosen as the strata of the sampling. Firstly, the percentages of the schools in each strata were calculated. The numbers and the percentages of schools in the strata and in the sample are given in Table 3.1.

A sample of 22 schools that is approximately 50 % of the population was determined and randomly selected from the strata according to the school percentages to maintain the equivalent percentages in the sample. The school list is given in Appendix A. The classes where the AC scale and the NGET were administered were selected by convenience sampling method during administration. The data was collected in the first semester of 2004-2005 academic year. The sample was consisted of 1457 students, where 936 students were female and 521 students were male.

Table 3.1 Population and Sample of the Study

Name of the Region	# of schools in the region	% of schools in the region	# of schools in the sample	% of schools in the sample
Gölbaşı	1	1.78 %	1	4.5 %
Çankaya	13	23.2 %	5	22.7 %
Keçiören	10	17.8 %	4	18.0 %
Etimesgut	2	3.6 %	1	4.5 %
Altındağ	9	16.0 %	3	13.6 %
Mamak	5	8.9 %	2	9.0 %
Sincan	3	5.3 %	1	4.5 %
Yenimahalle	13	23.2 %	5	22.7 %
Total	56	100 %	22	100 %

In the structural equation modeling researches for a stable solution in multiple regression analysis, the sample should include at least 5-50 students per a predictor (ACITS, 1996, as cited in Abak, 2003). Moreover, at least a sample of 250-500 subjects is necessary for the accuracy of the estimates to make sure the representativeness (Schumacker & Lomax, 1996).

On the other side, the number of items used in the AC scale is 81 so in order to use the factor analysis methods safely; the sample size should be ten times the number of items. This would also ensure the normal and elliptical distributions when the latent variables have multiple indicators (Bentler & Chou, as cited in Abak, 2003). Accordingly at least 810 students provide a sufficient sample for this study. The sample includes 1457 students, so it seems to be excessively enough for each criterion.

3.2 Measuring Tools

Two instruments were used in the data collection, one for identifying affective characteristics of students and other for measuring physics achievement in the concept of electricity of physics at ninth grade.

3.2.1 AC Scale: The AC scale developed by Abak (2003) was used to determine students' affective characteristics and it is given in the Appendix B. The original questionnaire was consisted of 83 items, which were prepared for university students who were taking freshman physics during that research. Hence, some of the items were slightly changed to adapt for high school students. However, two items did not fit any situation for high school students, thus deleted from the questionnaire. Finally, an 81-item scale was constructed, measuring the following variables; interest in physics (INT), importance of physics (IMP), student motivation in physics (STUMOT), enjoyment of extracurricular activities about physics (ENJ), physics test anxiety (PTANX), physics course anxiety (PCANX), physics self-concept (SCON), physics self-efficacy (SEFF), achievement motivation (ACHMOT), and locus of control (LOC). The item numbers in the subscales are given in Table 3.2. All the items in the affective characteristics questionnaire were scaled on a five point likert type scale: strongly agree scored as 5, agree scored as 4, undecided scored as 3, disagree scored as 2, and strongly disagree scored as 1. The items having negative meaning were reversely scored. Since the 8th item has an if-clause 'Fizik problemlerinin gerçek hayatla daha fazla ilgisi olsa, fizik dersinin daha iyi olacağını düşünüyorum', it was completely deleted and then 80 items were remained in the analysis.

3.2.1.1. Missing Data Analysis

Missing data analysis was conducted before the reliability and factor analysis. First of all, in order to see whether there were any data entered incorrectly the maximum and minimum values for each item were calculated in the frequency analysis of the SPSS 10.0 for Windows. Then the missing value percentages of missing values related to an item and related to a case were calculated. There was no item with more than 5% missing, so missing values per each case were considered. However the situation was different for missing values related to the cases, because there were a lot of students had forgotten to fill in one page of questionnaire completely. At that point the numbers of sub-scales included in those missing pages were taken into account. The percentages of the item included in those pages were 37% of all items for one of the page including 4 sub-scales completely missing and 32% of all items for the other page including 2 sub-scales completely missing. Although 32% was a high value, there were only two lost variables for each case, so these cases were not deleted. However 32 cases with missing percentages higher than 32% were deleted entirely from the data. 1425 cases were remained, but they still had missing values. These cases were carefully examined and completely or partly missing sub-scales were listed. Then the means of each sub-scale were calculated by simply adding the items of that sub-scale and dividing the number of items in that sub-scale. If a sub-scale was completely empty for a case the item values were replaced by that mean value. For example if a student did not respond all items in the IMP sub-scale, these empty cells were filled with calculated mean of IMP variable. If some of the items were empty for a case, the mean of the filled items in that sub-scale for that case was calculated and replaced by the empty values. However, these means were not exact numbers like coded values and included two decimals. While importing the data to LISREL program from SPSS, these mean values with two decimals caused the LISREL program automatically multiply all scores by 100. So the coded scores 5, 4, 3, 2, and 1 for each item were changed into 500, 400, 300, 200, and 100, respectively. Since the range of values for the scores were enlarged, descriptives and other calculate estimates such as measurement errors or λ coefficients in the model were also enlarged accordingly.

3.2.1.2 Reliability Analysis

Reliability analyses were conducted for the whole questionnaire and for each sub-scales in order to check the internal-consistency estimates of reliability. The reliability coefficients of the whole scale was .98 and reliability coefficients of each scale ranged from .87 to .95 except for the LOC sub-scale and they are summarized in Table 3.2. Since the scale and sub-scales were highly reliable they seem not to need any modification, however factor analysis of the items were conducted during the reliability analysis and some of the items which were disturbing the predetermined factor structure were deleted from the questionnaire. The items assumed to construct LOC subscale did not group in the factor analysis. Because they did not have a proper factor structure and high reliability coefficient, this sub-scale was not included in the analysis. Reliabilities of the sub-scales, item numbers, and deleted items were given in Table 3.2

Table 3.2 Item numbers in the sub-scales, deleted items and reliabilities of final scales

Name of the Sub-scale	Item Numbers in the scale	Deleted Items	Alpha Reliability Coefficient of the final
INT+ STUMOT	1, 2, 3, 5, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20,21, 22	16, 17	.96
IMP	4, 7, 9, 10, 23, 24, 25, 26, 27, 28, 29	4, 7, 9, 10	.87
ENJ	30, 31, 32, 33, 34, 35, 36, 37, 38, 39	34, 36, 39	.90
PTANX	40, 41, 42, 43, 44, 45, 46		.93
PCANX	47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59	47, 48, 52, 54, 55, 57	.91
SCON+ SEFF	60, 61, 62, 63, 64, 65, 66, 68, 77, 78, 79, 80, 81	68	.94
ACHMOT	73, 74, 75, 76		.90

After reliability and factor analyses, there were remaining 60 items in the AC scale with an alpha reliability coefficient of .98. The reliability analyses were recalculated after the structural equation procedures and reported in confirmatory factor analysis chapter 4.

3.2.1.3. Factor Analysis

The varimax rotated principle component analysis conducted for these remaining 60 items showed that there were seven distinct sub-dimensions in the questionnaire.

Table 3.3. Varimax Rotated Principal Component Analysis for AC Scale

Factor	Item No	Loading
INT + STUMOT (Percent of Variance = 13.4)	Q1	.708
	Q2	.645
	Q3	.686
	Q5	.558
	Q6	.560
	Q11	.697
	Q12	.692
	Q13	.737
	Q14	.695
	Q15	.627
	Q18	.469
	Q19	.518
	Q20	.561
	Q21	.496
	Q22	.499
IMP (Percent of Variance = 8.0)	Q23	.592
	Q24	.653
	Q25	.637
	Q26	.532
	Q27	.649
	Q28	.595
	Q29	.662
ENJ (Percent of Variance = 8.6)	Q30	.767
	Q31	.758
	Q32	.585
	Q33	.566
	Q35	.717
	Q36	.549
	Q37	.638
	Q38	.648
PTANX (Percent of Variance = 9.5)	Q40	.834
	Q41	.849
	Q42	.821
	Q43	.678
	Q44	.628
	Q45	.685
	Q46	.618

Table 3.3 (Continued)

PCANX (Percent of Variance = 7.5)	Q49 Q50 Q51 Q53 Q56 Q58 Q59	.558 .652 .645 .545 .663 .671 .613
SCON + SEFF (Percent of Variance = 12.6)	Q60 Q61 Q62 Q63 Q64 Q65 Q66 Q77 Q78 Q79 Q80 Q81	.618 .717 .666 .519 .610 .640 .560 .620 .713 .703 .725 .662
ACHMOT (Percent of Variance = 5.7)	Q73 Q74 Q75 Q76	.800 .825 .752 .709

Extraction Method: Principal Component Analysis.

Additionally, all the sub-scales were analyzed by using factor analysis to find evidence for their unidimensionality. Factor loadings of each sub-scale and explained variances are given and explained in following sections. After these factor structures were determined by varimax rotated principal component analysis, confirmatory factor analysis was conducted in order to check the accuracy of these factor structures. The final sub-scales and their reliabilities are given in confirmatory factor analysis section of chapter 4.

3.2.1.3.1 Interest in Physics and Student Motivation

The factor analysis of sub-dimension INT and STUMOT revealed that one factor explains 64.7 % of the total variance. The factor loadings of the INT and STUMOT items are given in Table 3.4

Table 3.4 Factor Loadings for INT and STUMOT Items

	Component 1
Q1	.883
Q2	.847
Q3	.856
Q5	.603
Q6	.730
Q11	.902
Q12	.886
Q13	.904
Q14	.834
Q15	.751
Q18	.763
Q19	.732
Q20	.769
Q21	.754
Q22	.792

Extraction Method: Principal Component Analysis.
1 components extracted.

3.2.1.3.2 Importance of Physics

The factor analysis of sub-dimension IMP indicated that one factor explains 55.9 % of the total variance. The factor loadings of the IMP items are given in Table 3.5.

Table 3.5 Factor Loadings for IMP Items

	Component 1
Q23	.665
Q24	.799
Q25	.717
Q26	.706
Q27	.805
Q28	.684
Q29	.842

Extraction Method: Principal Component Analysis.
1 components extracted.

3.2.1.3.3 Enjoyment in Extracurricular Activities

The factor analysis of sub-dimension ENJ showed that one factor explains 58.6 % of the total variance. The factor loadings of the ENJ items are given in Table 3.6

Table 3.6 Factor Loadings for ENJ Items

	Component 1
Q30	.811
Q31	.805
Q32	.759
Q33	.738
Q35	.810
Q36	.687
Q37	.707
Q38	.797

Extraction Method: Principal Component Analysis.
1 components extracted.

3.2.1.3.4 Physics Test Anxiety

The factor analysis of sub-dimension PTANX showed that one factor explains 71.3 % of the total variance. The factor loadings of the PTANX items are given in Table 3.7

Table 3.7 Factor Loadings PTANX Items

	Component 1
Q40	.826
Q41	.881
Q42	.920
Q43	.851
Q44	.817
Q45	.836
Q46	.770

Extraction Method: Principal Component Analysis.
1 components extracted.

3.2.1.3.5 Physics Course Anxiety

The factor analysis of sub-dimension PCANX revealed that one factor explains 66.2 % of the total variance. The factor loadings of the PCANX items are given in Table 3.8

Table 3.8 Factor Loadings PCANX Items

	Component 1
Q49	.818
Q50	.869
Q51	.873
Q53	.644
Q56	.816
Q58	.803
Q59	.850

Extraction Method: Principal Component Analysis.
1 components extracted.

3.2.1.3.6 Physics Self Related Variables (SCON and SEFF)

The factor analysis of sub-dimension Physics Self Related Variables (SRV) revealed that one factor explains 60.5 % of the total variance. The factor loadings of the SRV items are given in Table 3.9

Table 3.9 Factor Loadings Self Related Variables Items

	Component 1
Q60	.770
Q61	.728
Q62	.800
Q63	.688
Q64	.722
Q65	.775
Q66	.761
Q77	.792
Q78	.827
Q79	.852
Q80	.838
Q81	.767

Extraction Method: Principal Component Analysis.
1 components extracted.

3.2.1.3.7 Achievement Motivation in Physics

The factor analysis of ACHMOT showed one factor explains 76.6 % of the total variance. The factor loadings of the ACHMOT items are given in Table 3.10

Table 3.10 Factor Loadings ACHMOT Items

	Component 1
Q73	.874
Q74	.908
Q75	.863
Q76	.855

Extraction Method: Principal Component Analysis.
1 components extracted.

3.2.2 The Ninth Grade Electricity Test (NGET): In the present study, The NGET developed by the researcher will be used. It is given in Appendix C. Firstly, The curriculum for the ninth grade physics lesson by the ministry of Education and physics books were examined. Then an objective list given in Appendix D was written with the help of a private school ninth grade physics teacher who had an expertise of at least 5 years in teaching and was a doctoral student at the same time at METU. This list was examined by two high school physics teachers, one Anatolian high school physics teacher for the content validity and according to the recommendations necessary revisions were made. When the objective list was ready, the appropriate questions were searched in the University Entrance exams, Science Lyce Entrance Exams, Anatolian High school Entrance Exams, Anatolian Teacher High School Entrance Exams, Anatolian Technical Occupational Lyce Entrance Exams, the exams done by government (DPY), Private Schools Entrance Exams and physics books. Appropriate questions were determined. The test was consisted of 39 objective type items. There were 5 true-false, 1 matching, 1 fill-in type of questions and the remaining items are multiple-choice questions. Table of specifications prepared for the NGET is given in Appendix E

The 39-item Ninth Grade Electricity Test was applied to some students who are known by the researcher in order to measure how long it is taking to answer all of the question. However the testing time was longer than a lesson period of high school students and it probably was going to be a problem during administrations. Because of this reason, some of questions which were in the same cognitive level and measuring almost the same things were eliminated from the test. It decreased to a 29-item test given in the appendix and the required time to solve the questions was lessened to 25 minutes. It contained some directives about the test, and some questions regarding the gender and date of birth of students in the cover page.

3.2.2.1 Missing Data Analysis

At the beginning of the analysis missing data analysis were also conducted for the Ninth Grade Electricity Test. The students with more than 5 empty questions were completely removed from the data. Then the case with 5 missing questions were divided into two groups: first group who had 5 missing questions at the end of the test, they were assumed that the time was insufficient for them, so they were not deleted, those questions were coded as if they were wrong. Second group who had 5 randomly missing questions were deleted completely, since no interpretation was possible to understand that why they did not solve that questions. After these deletion procedures 1366 cases were left.

3.2.2.2 Reliability Analysis

After factor analyses were completed and factor names were determined, reliability analyses were also conducted for the achievement test and its sub-dimensions. The reliability coefficient of the whole test was .67. The reliability coefficients of each sub-dimension with item numbers and factor numbers are given in Table 3.11

Table 3.11 Factor Number, the Items in the Factor and Reliability Coefficients

Factor Number	Item Numbers	Alpha Reliability Coefficient of the final
1	2.2, 2.3, 2.4, 2.5	.63
2	4, 8, 5, 7, 3	.45
3	10, 13, 14, 18, 20, 21	.46
4	1.2, 1.4, 1.5, 2.1, 11	.47

Since questions 1.1, 6, 9, 12, 15, 16, 17, 19, 1.3 did not have a proper factor structure, so they were not included in the analysis, yet the sub-dimensions are not still highly reliable. This may be due to students' low achievement level in the NGET. Although the dimensions of test are not very reliable, they are used in the analysis because an alternative way to represent the achievement is to use the marks given by the physics teacher to students in that semester. However, different grades given by different teachers in different situations would not be a more reliable way to represent the achievement.

3.2.2.3. Factor Analysis

The Varimax rotated principle component analysis conducted for the Ninth Grade Electricity test. The remaining 20 items showed that there were four distinct sub-dimensions in the test. These four dimensions explained 35% of the total variance. The questions did not have a proper factor structure, as seen they are generally grouped according to subjects or difficulty level of questions. The explained variances of each factor because of this reason are not very high. Moreover, students did not solve problems in order, this may also cause complex patterns and affect factor structure. Factor analysis outputs are summarized in Table 3.12.

Table 3.12. Varimax Rotated Principal Component Analysis for Ninth Grade Electricity Test

Component Names	Elements of a circuit	Conductivity and Resistance	Electrostatics	Electrostatics and Electrical Circuit
Q2.2	.838			
Q2.4	.826			
Q2.3	.506			
Q2.5	.397			
Q4		.615		
Q8		.582		
Q5		.581		
Q7		.504		
Q3		.346		
Q1.2			.655	
Q1.4			.588	
Q1.5			.505	
Q2.1			.492	
Q11			.460	
Q21				.582
Q20				.528
Q13				.499
Q18				.491
Q14				.483
Q10				.422
% of Total Variance Explained	10%	8%	8%	8%

Extraction Method: Principal Component Analysis.

The sub-dimensions of the test were also analyzed and according to the results of these factor analyses the items grouped in each sub-dimension were examined and named. The names are given as sub titles in the following sections.

3.2.2.3.1 Elements of a Circuit

The factor analysis of this sub-dimension showed that one factor explains 48.7 % of the total variance. The factor loadings of these question are given in Table 3.13.

Table 3.13 Factor Loadings of the Questions in Element of a Circuit

	Component 1
Q2.2	.812
Q2.3	.580
Q2.4	.837
Q2.5	.502

Extraction Method: Principal Component Analysis.
1 components extracted.

3.2.2.3.2 Conductivity and Resistance

The factor analysis of this sub-dimension showed that one factor explains 31.4 % of the total variance. The factor loadings of these questions are given in Table 3.14.

Table 3.14 Factor Loadings of the Questions in Conductivity and Resistance

	Component 1
Q3	.430
Q4	.681
Q5	.593
Q7	.533
Q8	.534

Extraction Method: Principal Component Analysis.
1 components extracted.

3.2.2.3.3 Electrostatics

The factor analysis of this sub-dimension showed that one factor explains 32.3 % of the total variance. The factor loadings of these questions are given in Table 3.15.

Table 3.15 Factor Loadings of the Questions in Electrostatics

	Component 1
Q1.2	.640
Q1.4	.575
Q1.5	.494
Q2.1	.590
Q11	.530

Extraction Method: Principal Component Analysis.
1 components extracted.

3.2.2.3.4 Electrostatics and Electrical Circuits

The factor analysis of this sub-dimension showed that one factor explains 27.0 % of the total variance. The factor loadings of these questions are given in Table 3.16.

Table 3.16 Factor Loadings of the items in Electrostatics and Electrical Circuits

	Component 1
Q10	.534
Q13	.537
Q14	.481
Q18	.447
Q20	.542
Q21	.567

Extraction Method: Principal Component Analysis.
1 components extracted.

3.3 Procedures

In fall semester of 2003-2004 academic year the topic and the research problem of the present study was clearly defined. In this semester, the Advanced Data Analysis course was completed which helped to understand Structural Equation Modeling and how to use LISREL computer program. During this semester, a small literature review including internet search was conducted, relevant studies were examined and relevant references were gathered. At the end of this semester, the population and the sample of the study were determined and the names of the schools were listed.

In the spring semester of this year, the AC scale used for university students (Abak, 2003) was modificated to high school students. the construction of Ninth Grade Electricity Test was completed. In March, the objectives were written, expert opinions were taken and revisions were done. The objective list and table of contents for NGET are given in Appendix D and Appendix F respectively. Until the end of May the books that gave the questions of the past ÖSS, OÖKS, DPY, Anatolian High Schools and Anatolian Teacher High Schools Entrance Exams, Occupational Lyce Entrance Exams, and Private Schools Entrance Exams were examined and some of questions in the test were determined from these books and some were written by researcher which were given in Appendix E. At the end of May, 39item NGET was completed. In order to measure how long the test is taking it was applied to a few high school students. However the testing time was longer than a lesson period of high schools. Since it was a problem for convenience of test administration, some of the items deleted from the test and the number of items in the test was decreased to a 29 and the required time to solve the questions was lessened to 25 minutes which was more convenient.

In April, in order to take permission for the administration of the Affective Characteristics Scale and the NGET in June, the application was given to the Ministry of Education. However, as the bureaucratic procedure of taking permission for researches was changed, it did not conclude until the summer when schools start for the holiday. Consequently, collection of data was started in September, 2004.

During the second semester of 2004, the literature search on the computer was extended to include Educational Researches Information Center (ERIC), Social Science Citation Index (SSCI), and International Dissertations Abstracts (IDA). Also in summer research for the related references was continued to include web search, and METU Library.

In September, data collection was started and lasted for nearly one and a half month. During the administrations, nearly 5 minutes were spent for introducing the study, explaining the purpose and giving necessary information about filling in the scale and answering the test. 25 minutes were given for the test and 15 minutes for the scale. Thus, one lesson period was sufficient for each class to finish data collection. The researcher administered instruments in most of the schools except two, Keçiören Lyce and Ahmet Yesevi Lyce. Since the head of Keçiören Lyce did not approve being in class for the researcher and because of a time problem in Ahmet Yesevi Lyce, teachers administered the scale and the test in these two schools. The collection of data of 1457 high school students had been completed by the end of October, 2004. Then the data was entered to computer which took nearly one month time.

As soon as the entering of data was finished, preliminary analyses were conducted including: missing data analysis, reliability analysis, factor analysis and data screening procedures. By the end of March 2005, measurement and Structural models were constructed and data analysis had been completed.

During the data analyses, the search for the literature continued to do modifications and additions to the study. At the end of second semester of 2005 writing of all chapters were completed.

3.4 Data Collection

Although the data of the present study was planned to be collected at the end of ninth grade, when they had just finished the electricity concepts, because of the lameness in the permission procedure, it could be collected at the starting of tenth grade. It totally lasted for one and a half month. The application time was one lesson period and it was done in class where researcher was present in most cases.

3.5 Data Analysis

After the administration of the test and scale, the first step was entering the data manually in Excel Program for Windows. The statistical analyses were performed by using SPSS.10 software program for Windows and testing of the measurement and structural models were conducted by LISREL 8.30. The significance level is the criterion used for rejecting the null hypothesis. Traditionally researchers use either the .05 or .01 level, the choice of these levels is largely subjective. However .05 is the generally used value of significance level, so it was set to .05. As these p values are confounded, the effect size of a study should also be reported. For effect size strength interpretation (Cohen & Cohen, 1983) the following guidelines was suggested that .02 corresponds to a small effect size, .15 to a medium and .35 to a large effect size. In a similar study (Abak, 2003) reported a medium effect size of .15, so the effect size is thought to be medium size f^2=.15 for the present study. The sample size is 1366 and there are 10 variables in the model so, k_B =10 and the index of power (L) is found to be 203.25 and the statistical power corresponding is greater than 99% for this study.

The first analysis conducted was missing data analysis to detect the missing values and outliers by Excel program. Missing percentages per item and per case were calculated and mean replacements were done. Then the reliability analyses were conducted on the SPSS 10.0. The Cronbach α reliability coefficients for instruments and sub-scales were computed. During this analysis varimax rotated principle component analysis was conducted for both the AC Scale and the NGET to construct the sub components and to check the unidimensionalities of these sub-constructs. In the construction of model, items in the scale were used directly under the sub-dimensions formed by factor analysis. In the test, this procedure was different that the scores for the variables were calculated by summing-up the remaining reliable individual question scores of that sub-dimension. There were four sub-dimensions used in the model as the observable variables of the latent variable achievement. Then the data file was imported to PRELIS 2.30 for Windows in order to get the distributions of the variables and to check their normalities.

LISREL 8.30 for Windows with SIMPLIS command language was used for confirmatory factor analysis and the measurement model of affective characteristics and achievement variables were established. In the final step, this program was used to formulate and estimate the model representing the relationships between affective characteristics and achievement scores of high school students in Ankara.

SEM is a statistical technique that consists of several distinct steps (Hoyle, 1995).

1. Model Specification: First a system of linear equations is specified based on theoretical arguments and previous research. In order to hypothesize the model for the present study, the relationships were drawn from literature and a model that includes all necessary variables was examined carefully (Abak, 2003)

2. Model Identification: This step means determining whether the parameters in the system of linear equations can be uniquely estimated.

3. Estimation: The parameters in the model are estimated. The covariance matrix of the observed variables is used instead of raw data including individual observations and the parameters are estimated so that covariance matrix implied by the model closely reproduces the covariance matrix of the observed variables.

4. Testing Fit: The fit of the model is assessed in this step. This step has several aspects including assessing the statistical significance of individual parameter estimates, comparing the parameter estimates to what was expected a priori, comparing the fit of the model to the fit of plausible alterative models and determining how well the covariance matrix implied by the model reproduces the covariance matrix of observed

variables. Traditionally, the hypothesis test of exact fit between populations implied covariance matrix and population observed covariance matrix has been conducted by using a test statistic having an asymptotic chi-square distribution. However, chi-square test statistic is directly related to the sample size N, that is good-fitting models may be rejected for large samples. But, the Normed Chi-Square that is calculated by χ^2/df less than 5 is an acceptable value for a good model fit to the data (Kelloway, as cited in İş, 2003). As a result, other measures of overall fit (fit indices) have been proposed. The goodness-of-fit (GOF) criteria and acceptable fit interpretation are summarized in Table 3.17. The most often used index is standardized root mean squared residual fit index (SRMR) which should be less than .05 to indicate a good fit. The other issue is checking for significance of the relationships between variables. A significant relationship is indicated by an absolute t-value greater than 1.96. The squared multiple correlation (R^2) indicating whether observed variables are reliable measures of a factor should also be examined.

5. Re-specification: Finally if the model does not fit the data adequately, the model may be modified (Hoyle, 1995). Modification suggestions are made by the researcher and the LISREL modification suggestions are considered and meaningful changes are done in the model and the analysis is conducted again.

Table 3.17 GOF Criteria and Acceptable Fit Interpretation

GOF Criterion	Acceptable Level	Interpretation
Chi-Square (χ^2)	Tabled χ^2 value	Compares obtained χ^2 value with tabled value for given df
Goodness-of-fit Index (GFI)	0 (no fit) to 1 (perfect fit)	Value close to .90 reflects a good fit.
Adjusted GFI (AGFI)	0 (no fit) to 1 (perfect fit)	Value adjusted for df with .90 a good model fit
Root-Mean-Square (RMR)	Researcher defines level	Indicates the closeness of observed covariance matrix and model implied covariance matrix
Root-Mean-Square error of approximation (RMSEA)	$< .05$	Values less than .05 reflects a good model fit.

Schumacker & Lomax (1996)

CHAPTER 4

RESULTS

The results of this study are presented in two sections. In the first section, the descriptive statistics of the variables and bivariate correlations of the items are reported. Second, in the inferential statistics, solutions of the hypothesized models are explained.

4.1 Descriptive Statistics

The reliability and factor analyses of the AC Scale and the NGET were conducted as explained within the Section 3.2. The items which were used to construct each variable were selected according to the factor analysis results. The achievement variables were formed by simply calculating the average value of the items grouped in each factor in the factor analysis of the NGET and named as ACH1, ACH2, ACH3, and ACH4, and the latent variable was named as ACH. Here, the ACH variable refers to the score taken from the NGET.

The construction of variables of AC Scale was a little different. The bivariate correlations of the items of the scale were examined and some of the items were combined since there were values higher than .70 in bivariate correlations, which may cause collinearity effect. Collinearity problem occurs when there is a linear dependency between variables and that may cause the non-positive definite matrix in structural equation modeling.

The bivariate correlations of each variable are given in the following Tables. The bivariate correlations of the items of the INT variable are given in Table 4.1.

Table 4.1 The Bivariate Correlations of the Items of the INT Variable

	Q1	Q2	Q3	Q5	Q6	Q11	Q12	Q13	Q14	Q15
Q1										
Q2	.799									
Q3	.770	.740								
Q5	.505	.476	.486							
Q6	.659	.619	.597	.477						
Q11	.836	.773	.749	.494	.643					
Q12	.798	.746	.718	.489	.646	.874				
Q13	.841	.759	.764	.502	.648	.861	.841			
Q14	.708	.661	.706	.475	.582	.741	.729	.771		
Q15	.617	.615	.621	.479	.497	.640	.619	.665	.618	

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

The items Q11and Q12 were firstly combined since they had a correlation coefficient of .874. Then the bivariate correlations were checked again including this new variable formed by combining the items Q11 and Q12. Then Q13, Q1, Q2 and Q3 were combined to this new variable one by one and the final form of new variable was named as INTTOP6.

The bivariate correlations of the items of the STUMOT variable are given in Table 4.2. The items Q21 and Q22 of the STUMOT variable were combined and named as SM2122.

Table 4.2 The Bivariate Correlations of the Items of the STUMOT Variable

	Q18	Q19	Q20	Q21	Q22
Q18					
Q19	.671				
Q20	.658	.719			
Q21	.513	.506	.576		
Q22	.579	.549	.571	.845	

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

The bivariate correlations of the items of the IMP variable are given in Table 4.3. Since none of the items have correlation coefficient higher than .80, none of them were combined.

Table 4.3 The Bivariate Correlations of the Items of IMP Variable

	Q23	Q24	Q25	Q26	Q27	Q28	Q29
Q23							
Q24	.455						
Q25	.423	.484					
Q26	.371	.454	.406				
Q27	.442	.540	.595	.503			
Q28	.393	.448	.352	.487	.442		
Q29	.460	.735	.495	.499	.639	.503	

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

The bivariate correlations of the items of the ENJ variable are given in Table 4.4. As seen in the table none of the items were combined.

Table 4.4 The Bivariate Correlations of the Items of ENJ Variable

	Q30	Q31	Q32	Q33	Q35	Q36	Q37	Q38
Q30								
Q31	.794							
Q32	.531	.547						
Q33	.508	.506	.525					
Q35	.629	.630	.559	.562				
Q36	.418	.400	.426	.482	.468			
Q37	.451	.423	.467	.428	.473	.614		
Q38	.573	.569	.581	.520	.600	.479	.533	

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

The bivariate correlations of the items of PTANX variable are given in Table 4.5. The items Q40 and Q41 were firstly combined and then Q42 was then combined to this new variable and named as PTAN2.

Table 4.5 The Bivariate Correlations of the Items of the PTANX Variable

	Q40	Q41	Q42	Q43	Q44	Q45	Q46
Q40							
Q41	.829						
Q42	.744	.814					
Q43	.618	.693	.775				
Q44	.555	.613	.692	.705			
Q45	.598	.661	.729	.644	.663		
Q46	.524	.572	.655	.580	.613	.647	

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

The bivariate correlations of the items of the PCANX variable are given in the Table 4.6 and the two items Q50 and Q51 in the PCANX variable were combined and named as PCANX1.

Table 4.6 The Bivariate Correlations of the Items of the PCANX Variable

	Q49	Q50	Q51	Q53	Q56	Q58	Q59
Q49							
Q50	.693						
Q51	.684	.831					
Q53	.447	.479	.491				
Q56	.628	.651	.632	.442			
Q58	.566	.595	.602	.437	.619		
Q59	.609	.643	.679	.493	.650	.734	

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

The bivariate correlations of the items of the SCON variable are given in Table 4.7. As seen in the table none of the items were combined.

Table 4.7 The Bivariate Correlations of the Items of the SCON Variable

	Q60	Q61	Q62	Q63	Q64	Q65	Q66
Q60							
Q61	.606						
Q62	.626	.588					
Q63	.496	.396	.574				
Q64	.507	.457	.677	.562			
Q65	.610	.551	.631	.520	.562		
Q66	.568	.476	.577	.511	.539	.701	

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

The bivariate correlations of the items of the ACHMOT variable are given in Table 4.8. Two items Q73 and Q74 in the ACHMOT variable were combined and named as ACHMOT1.

Table 4.8 The Bivariate Correlations of the Items of the ACHMOT Variable

	Q73	Q74	Q75	Q76
Q73				
Q74	.802			
Q75	.643	.678		
Q76	.609	.687	.705	

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

The bivariate correlations of the items of the SEFF variable are given in Table 4.9. As seen in the table none of the items of this variable were combined.

Table 4.9 The Bivariate Correlations of the Items of the SEFF Variable

	Q77	Q78	Q79	Q80	Q81
Q77					
Q78	.666				
Q79	.766	.749			
Q80	.686	.769	.791		
Q81	.593	.693	.655	.698	

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

Finally, the total number of items in affective characteristics variables decreased to 50 with 5 items in the INT, 4 items in the STUMOT, 7 items in the IMP, 8 items in the ENJ, 5 items in the PTANX, 6 items in the PCANX, 3 items in the ACHMOT, and 5 items in the SEFF.

The descriptive statistics and skewness and kurtosis values of all variables for 1366 students are summarized in Table 4.10.

Table 4.10 Results of Descriptive Statistics for All Items

ITEM	Mean	SD	Skewness	Kurtosis	Max	Min
Q5	281.73	122.61	.071	-1.020	500	100
Q6	344.36	125.23	-.530	-.771	500	100
Q14	286.16	128.48	.031	-1.196	500	100
Q15	264.47	118.78	.293	-.831	500	100
INTTOP6	313.67	115.88	-.303	-.984	500	100
Q18	338.09	135.16	-.366	-1.112	500	100
Q19	271.32	128.61	.263	-1.007	500	100
Q20	238.94	116.86	.482	-.597	500	100
SM2122	296.16	117.22	-.109	-.936	500	100
Q23	294.22	125.62	.001	-1.037	500	100
Q24	292.97	136.23	.070	-1.207	500	100
Q25	300.59	121.29	-.125	-.983	500	100
Q26	403.14	99.05	-1.196	1.292	500	100
Q27	305.92	110.66	-.116	-.768	500	100
Q28	353.14	111.19	-.423	-.545	500	100
Q29	306.77	122.85	-.102	-1.016	500	100
Q30	343.01	122.77	-.487	-.802	500	100
Q31	321.37	122.92	-.259	-1.001	500	100
Q32	260.34	130.35	.299	-1.083	500	100
Q33	328.21	122.33	-.415	-.869	500	100
Q35	331.53	128.77	-.417	-.962	500	100
Q36	369.27	121.28	-.826	-.234	500	100
Q29	306.77	122.85	-.102	-1.016	500	100
Q30	343.01	122.77	-.487	-.802	500	100
Q31	321.37	122.92	-.259	-1.001	500	100
Q32	260.34	130.35	.299	-1.083	500	100
Q33	328.21	122.33	-.415	-.869	500	100
Q35	331.53	128.77	-.417	-.962	500	100
Q36	369.27	121.28	-.826	-.234	500	100
Q37	355.58	130.86	-.552	-.878	500	100
Q38	298.75	127.33	-.036	-1.119	500	100
Q43	266.11	138.45	.228	-1.312	500	100
Q44	273.64	140.78	.147	-1.355	500	100
Q45	235.85	125.31	.471	-.975	500	100
Q46	276.85	139.64	.121	-1.354	500	100
PTAN2	223.06	120.02	.711	-.576	500	100
Q49	290.25	133.91	-.019	-1.252	500	100
Q53	304.43	118.65	-.212	-.951	500	100
Q56	301.97	126.32	-.193	-1.128	500	100
Q58	326.01	131.94	-.396	-1.021	500	100

Table 4.10 (Continued)

Q59	320.79	134.76	-.360	-1.129	500	100
PCAN1	310.69	130.66	-.275	-1.124	500	100
Q60	314.36	119.88	-.317	-.834	500	100
Q61	344.61	109.62	-.509	-.257	500	100
Q62	284.69	114.68	.097	-.733	500	100
Q63	286.22	114.17	.002	-.924	500	100
Q64	300.37	121.50	-.015	-1.000	500	100
Q65	292.73	119.89	-.029	-.941	500	100
Q66	303.30	120.08	-.183	-.956	500	100
Q75	381.66	114.50	-.932	.138	500	100
Q76	373.93	115.38	-.818	-.112	500	100
ACMOT1	392.81	102.07	-1.011	.633	500	100
Q77	365.46	117.52	-.693	-.303	500	100
Q78	292.54	115.24	-.030	-.633	500	100
Q79	334.09	117.44	-.436	-.562	500	100
Q80	306.16	111.76	-.122	-.528	500	100
Q81	290.39	121.56	-.012	-.787	500	100
ACH1	2.5468	1.2998	-.456	-.941	4.00	.00
ACH2	3.0302	1.2716	-.384	-.453	5.00	.00
ACH3	4.6672	.6766	-2.706	9.761	5.00	.00
ACH4	1.9346	1.4345	.480	-.407	6.00	.00

The skewness and kurtosis values were examined in Table 4.10 in order to check the normalities of variables and items. Moreover, histograms obtained by data screening procedure conducted using PRELIS 2.30 for Windows are also given in Appendix F in which the values of skewness and kurtosis may be checked at the same time with histograms.

According to Kunnan (as cited in Abak, 2003) skewness and kurtosis values should be between +2 and -2 to have a normal distribution. As seen in the table most of the values are in the +2 and -2 range, so the data is assumed to be approximately normal. Only one variable ACH3 exceeded these values, however deleting this variable did not make any improvement in the model, thus it remained in the data analysis.

In addition to items, descriptives of variables are also summarized in Table 4.11. As can be seen in the table all values are near or slightly above an average value for each variable that indicates that students show medium interest and motivation in physics lesson, give medium importance to physics lesson. They enjoy in physics lesson and they have more anxiety in tests than courses of physics lesson. Students have more than medium self-concept and feel medium self-efficacy in physics lesson and finally they show achievement motivation above a medium value.

Table 4.11 Descriptive Statistics for Affective Variables

Variable	Mean	SD	Max	Min
INT	1788.46	598.78	3000	600
STUMOT	858.39	317.21	1500	300
IMP	2256.74	618.29	3500	700
ENJ	1279.31	394.42	2000	400
PTANX	1020.40	453.31	2000	400
PCANX	1545.11	526.07	2500	500
SCON	1822.52	554.60	3000	600
SEFF	1270.91	408.09	2000	400
ACHMOT	1148.40	296.35	1500	300

4.2 Inferential Statistics

4.2.1 Confirmatory Factor Analysis

The confirmatory factor analysis was conducted in order to check the appropriateness of the factor structures found by principal component analysis. Firstly the measurement model was constructed and proposed according to the factor analysis results. The SIMPLIS syntax of this model is given in Appendix G. However, this model did not show a good fit to the data. The Goodness of Fit (GOF) indices are given in Table 4.12.

Table 4.12 Conventional Global Fit Indices of the First Measurement Model.

Index	Value	Criterion
χ^2 (df, p)*	7246,19 (1349, .00)	p>.05
χ^2/ df*	5.37	χ^2/ df < 5
GFI*	.84	GFI > .90
AGFI*	.82	AGFI > .90
SRMR	.042	SRMR < .05
RMSEA	.057	RMSEA < .05

* unacceptable

As seen in the table only standardized root man square residual (SRMR) and root mean square error of approximation show a good fit to data, but Normed Chi-square (NC), goodness of fit (GFI) and adjusted goodness of fit (AGFI) are not acceptable. In order to improve the measurement model SM2122, Q56, Q32, Q77, Q33, Q36, Q38, PTAN2, and Q61 were deleted, the construct consisted of INT and STUMOT defined as

Attitude (ATT) was separated into variables INT and STUMOT and the construct consisted of SCON and SEFF defined as Self Related Variables (SRV) was separated into variables SCON and SEFF variables. After these improvement procedures the measurement model showed a good fit to data and the GOF are given in Table 4.13. As seen in table, all values of fit indexes show a good model-data fit. As explained in chapter 3.5 chi-square criterion is not considered as it shows a tendency to indicate a significant probability level when the sample size is large.

Table 4.13 Conventional Global Fit Indices of the Final Measurement Model

Index	Value	Criterion
χ^2 (df, p)*	2756,82 (899, .00)	p>.05
NC (χ^2/ df)	3.06	χ^2/ df < 5
GFI	.92	GFI > .90
AGFI	.91	AGFI > .90
SRMR	.035	SRMR < .05
RMSEA	.039	RMSEA < .05

All t-values of the final measurement model are significant at .05-level (t>1.96), they are presented in Table 4.14.

Table 4.14 T-Values for the Measurement Model

Item	T-Value	Latent Variable
Q5	22.90	INT
Q6	30.58	
Q14	36.91	
Q15	30.91	
INTTOP6	47.36	
Q18	15.07	
Q18	8.39	STUMOT
Q19	36.27	
Q20	37.47	
Q23	22.77	IMP
Q24	33.72	
Q25	25.36	
Q26	25.39	
Q27	31.37	
Q28	23.69	
Q29	38.10	
Q30	39.47	ENJ
Q31	39.08	
Q35	30.84	
Q37	20.49	
Q43	36.16	PTANX
Q44	36.70	
Q45	34.61	
Q46	31.04	
Q49	33.50	PCANX
Q53	22.66	
Q58	32.55	
Q59	37.48	
PCAN1	38.96	

Table 4.14 (Continued)

Q60	32.34	SCON
Q62	35.23	
Q63	28.45	
Q64	30.33	
Q65	34.54	
Q66	33.56	
Q75	36.17	ACHMOT
Q76	36.82	
ACMOT1	35.31	
Q78	39.45	SEFF
Q79	40.44	
Q80	41.34	
Q81	33.10	
ACH1	14.59	ACH
ACH2	15.11	
ACH3	11.21	
ACH4	16.82	

The reliabilities of the final forms of sub-scales of AC Scale were calculated and summarized in Table 4.15. As seen in the table reliabilities are changing between .84 and .92.

Table 4.15 Reliabilities of Final Sub-scales of the AC Scale

Name of the Sub-scale	Alpha Reliability Coefficient of the final
INT	.89
STUMOT	.87
IMP	.87
ENJ	.84
PTANX	.88
PCANX	.88
SCON	.89
SEFF	.92
ACHMOT	.87

4.2.2 The Affective Characteristics and Achievement Model

The two hypothesized models were tested in two steps. In the first step, the first hypothesized model was estimated and in the last step the second hypothesized model was estimated. Hence, there are two separate sections explaining the LISREL solutions of these two models.

4.2.2.1. The LISREL Solution for the First Hypothesized Model

The syntax of the first model is given in Appendix H. The model did not converge because the Covariance Matrix was not positive definite. Thus, the global fit indices for the first model could not be estimated by LISREL. The LISREL solution for this model is given in Appendix I.

4.2.2.2. The LISREL Solution for the Second Hypothesized Model

This model was developed in two basic steps, in the first step the model syntax was constructed and in the second step the relations are added to improve the model. Table 4.16 presents the global fit indices of the LISREL solution of the second hypothesized model. The beginning SIMPLIS syntax for this model is given in Appendix J.

Table 4.16 Conventional Global Fit Indices of Second Hypothesized Model.

Index	Value	Criterion
χ^2 (df, p)*	4008,17 (935, .00)	p>.05
χ^2/ df	4.28	χ^2/ df < 5
GFI*	.88	GFI > .90
AGFI*	.87	AGFI > .90
SRMR*	.051	SRMR < .05
RMSEA	.049	RMSEA < .05

* unacceptable

As seen in the table only RMSEA and the ratio of Chi-square and df indicated an acceptable fit, none of the other indices indicated an acceptable fit. Therefore, the modification suggestions of LISREL were examined. The relationships between PCANX and PTANX; SEFF and SCON; SCON and PTANX; SCON, SEFF and ACHMOT; INT and PCANX; PCANX and ACHMOT; IMP and STUMOT; INT and STUMOT are proposed and global fit indices indicated a fitting model. The indices providing evidence for the reasonable model are summarized in Table 4.14. The final SIMPLIS syntax for this model is also given in Appendix J.

The structural model for the final affective characteristics and achievement model is presented in Figure 4.1. The basic form of final model with estimates and t-values are given in Appendix K.

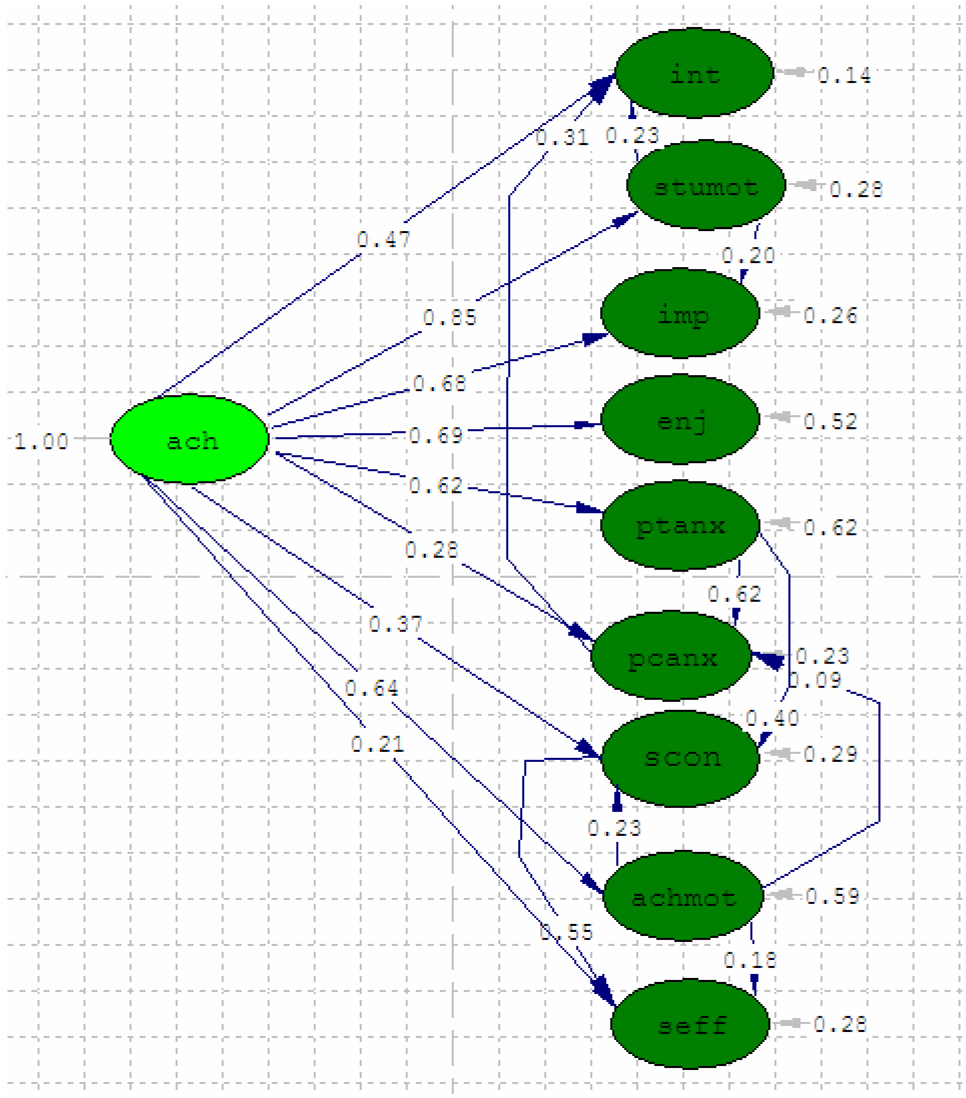

Figure 4.1 Structural Model of Affective Characteristics and Achievement Model

Table 4.17 tabulates t-values, λ_{x}, λ_{y} and measurement errors of the observed variables, ε (lowercase epsilon), and δ (lowercase delta) for the final model. λ_{x} values provide us with the information about the extend to which an item is able to measure the latent independent variable for example 0.039 shows the extent to which the ACH1 measures the ACH variable. On the other side, λ_y values indicate the extend to which an item is able to measure the latent dependent variable, for example 70.81 shows the extent to which the Q5 measures the INT variable. These values are referred as factor loadings (Schumacker & Lomax, 1996)

Table 4.17 T-Values, $\lambda_{x,}$ λ_y and Measurement Errors of the Final Model

Latent Variables	Item	T-Values	λ	Measurement Errors
INT	Q5	17.92	70.81(λ_y)	10014.05 (ε)
	Q6	20.96	90.61(λ_y)	7464.58 (ε)
	Q14	22.71	105.87(λ_y)	5286.21 (ε)
	Q15	21.07	86.66(λ_y)	6592.84 (ε)
	INTTOP6	23.80	110.93(λ_y)	1111.03 (ε)
	Q18	13.53	76.12 (λ_y)	5944.54 (ε)
STUMOT	Q18	8.03	40.98(λ_y)	5944.54 (ε)
	Q19	19.50	107.03(λ_y)	5087.05 (ε)
	Q20	19.59	99.50(λ_y)	3755.36 (ε)
IMP	Q23	18.23	73.95(λ_y)	10312.05 (ε)
	Q25	19.60	78.52(λ_y)	8544.31 (ε)
	Q26	19.76	64.84(λ_y)	5607.80 (ε)
	Q27	21.99	84.54(λ_y)	5099.06 (ε)
	Q28	18.75	67.90(λ_y)	7753.54 (ε)
	Q29	22.89	100.73(λ_y)	4946.52 (ε)
ENJ	Q30	33.61	108.07(λ_y)	3393.14 (ε)
	Q31	33.43	107.51(λ_y)	3551.25 (ε)
	Q35	27.89	95.45(λ_y)	7472.54 (ε)
	Q37	19.46	70.04(λ_y)	12218.35 (ε)
PTANX	Q43	32.40	114.42(λ_y)	6077.71 (ε)
	Q44	32.69	117.24(λ_y)	6074.66 (ε)
	Q45	31.15	100.20(λ_y)	5661.47 (ε)
	Q46	28.49	103.59(λ_y)	8767.92 (ε)
PCANX	Q49	24.78	104.49(λ_y)	7045.65 (ε)
	Q53	19.35	68.92(λ_y)	9344.22 (ε)
	Q58	24.41	101.02(λ_y)	7235.66 (ε)
	Q59	26.19	113.35(λ_y)	5352.10 (ε)
	PCAN1	26.60	112.52(λ_y)	4450.55 (ε)

Table 4.17 (Continued)

SCON	Q60	26.79	91.23(λ_y)	6087.80 (ε)
	Q62	28.44	92.91(λ_y)	4564.00 (ε)
	Q63	24.54	79.42(λ_y)	6759.16 (ε)
	Q64	25.74	88.73(λ_y)	6927.01 (ε)
	Q65	28.04	95.68(λ_y)	5264.23 (ε)
	Q66	27.48	93.82(λ_y)	5661.50 (ε)
ACHMOT	Q75	31.88	95.50(λ_y)	3989.27 (ε)
	Q76	32.36	97.65(λ_y)	3777.67 (ε)
	ACMOT1	31.2	83.62(λ_y)	3426.51 (ε)
SEFF	Q78	31.55	99.78(λ_y)	3361.23 (ε)
	Q79	32.02	103.27(λ_y)	3165.45 (ε)
	Q80	32.38	99.49(λ_y)	2628.26 (ε)
	Q81	28.46	95.08(λ_y)	5769.56 (ε)
ACH	ACH1	10.59	0.39 (λ_x)	1.54 (δ)
	ACH2	12.18	0.43 (λ_x)	1.43 (δ)
	ACH3	8.68	0.17 (λ_x)	0.43 (δ)
	ACH4	15.64	0.61 (λ_x)	1.68 (δ)

Table 4.18 and Table 4.19 summarize the structure coefficients; γ (lowercase gamma) and β (lowercase beta) values of the final model of affective characteristics and achievement, respectively.

Table 4.18 γ (lowercase gamma) Values of the Final Model

Exogenous Variables	γ	Endogenous Variable
ACH	0.47	INT
	0.85	STUMOT
	0.20	IMP
	0.69	ENJ
	0.62	PTANX
	0.62	PCANX
	0.37	SCON
	0.64	ACHMOT
	0.21	SEFF

Table 4.19 β (lowercase beta) Values of the Final Model

Endogenous Variable	β	Endogenous Variable
STUMOT	0.23	INT
	0.20	IMP
PTANX	0.62	PCANX
	0.40	SCON
PCANX	0.31	INT
SCON	0.55	SEFF
ACHMOT	0.09	PCANX
	0.23	SCON
	0.18	SEFF

Table 4.20 shows the global fit indices for the final form of the second hypothesized model of the affective characteristics and achievement. As can be seen given indices reflects a good model-data fit.

Table 4.20 Conventional Global Fit Indices of Second Hypothesized Model

Index	Value	Criterion
χ^2 (df, p)	2750,15 (883,.00)	p>.05
χ^2/ df	3.11	χ^2/ df < 5
GFI	.92	GFI > .90
AGFI	.91	AGFI > .90
SRMR	.036	SRMR < .05
RMSEA	.039	RMSEA < .05

In addition, the squared multiple correlation (R^2), which is calculated for observed and latent variables are given in Table 4.21 and Table 4.22. Squared multiple correlation R^2 equals the proportion of explained variance. Values of R^2 less than .50, mean that more than half of an indicators' variance is unique and so unexplained by the factor(s) that is specified to measure (Kline, as cited in Yayan, 2003).

Table 4.21 Squared Multiple Correlation for the items in the Final Model

Variable	R^2	Variable	R^2	Variable	R^2
Q5	0.33	Q31	0.76	Q64	0.53
Q6	0.52	Q35	0.55	Q65	0.63
Q14	0.68	Q37	0.29	Q66	0.61
Q15	0.53	Q43	0.68	Q75	0.70
INTTOP6	0.92	Q44	0.69	Q76	0.72
Q18	0.67	Q45	0.64	ACMOT1	0.67
Q19	0.69	Q46	0.55	Q78	0.75
Q20	0.73	Q49	0.61	Q79	0.77
Q23	0.35	Q53	0.34	Q80	0.79
Q25	0.42	Q58	0.59	Q81	0.61
Q26	0.43	Q59	0.71	ACH1	0.089
Q27	0.58	PCAN1	0.74	ACH2	0.12
Q28	0.37	Q60	0.58	ACH3	0.060
Q29	0.67	Q62	0.65	ACH4	0.18
Q30	0.77	Q63	0.48		

Table 4.22 Squared Multiple Correlation for the Latent Variables in the Final Model

INT	0.86
STUMOT	0.72
IMP	0.74
ENJ	0.48
PTANX	0.38
PCANX	0.77
SCON	0.71
ACHMOT	0.41
SEFF	0.72

The effect size is an indicator of the association that exists between two or more variables (Denis, 2003; cited in Yayan, 2003) and the measure is roughly equivalent to the squared multiple correlation (R^2). Cohen (Cohen & Cohen, 1983) suggested a standard classification scheme for effect sizes measured through R^2. According to this classification, 0.01 is small, 0.09 is medium and 0.25 and greater values are large effect sizes. In this case, most of the reported effect sizes are large effect sizes, except two, and these are approximately medium.

4.3 Summary of the Results

At the beginning, bivariate correlations between the items were examined and some of them were combined as they have linear dependency. The descriptive statistics of all variables were analyzed in order to check the normalities of these variables, which is the necessary condition for structural equation modeling. Later, the confirmatory factor analysis was conducted and measurement model was constructed. After all, the two hypothesized models explaining the relationship between affective characteristics related to physics and physics achievement of high school students were tested. The first hypothesized model did not indicate a good model-data fit, but the second model showed a better fit and after making some improvements following suggestions and deleting some items, a good model-data fit was reached. The final model providing the good fit was attained in several successive computer runs. In each computer run a modification index was added to the beginning SIMPLIS syntax. The beginning and final syntaxes, the structural model for the final model, t-values, estimates, goodness-of-fit indices and squared multiple correlation coefficients were given in tables, figures and appendixes.

The final model was consisted of the ACH, the INT, the IMP, the STUMOT, the ENJ, the PTANX, the PCANX, the SCON, the SEFF, and the ACHMOT variables and the AC scale items which constitute those variables. ACH variable was consisted of four latent variables representing the sub-dimensions formed by factor-analysis. The achievement scores were calculated for electricity concept in physics. All of the affective variables were related to this achievement variable significantly and path coefficients were given. Some of the affective characteristics were correlated with each other. Physics test anxiety and physics course anxiety, self-concept and self-efficacy were related to each other. Student motivation was found to be related to interest in physics and importance of physics. Physics test anxiety and self-concept and physics course anxiety and interest in physics were other related variables. Also achievement motivation in physics was related to self-concept, self-efficacy and interest in physics. The magnitude of squared multiple correlations indicated the explained variances interpreted according to Cohen's (Cohen & Cohen, 1983) guidelines for effect sizes were generally large in size.

CHAPTER 5

DISCUSSION, CONCLUSIONS, AND IMPLICATIONS

The purpose of this study was to explain the relationship of high school students affective characteristics related to physics and their physics achievement by using the structural equation modeling. The results of this study was supported some of the conclusions reported in earlier studies while contradicted some of the findings of prior research in the literature.

This chapter begins with the discussion of these results, next conclusions are made, then the limitations and implications were given. In he last section, suggestions for further research were made.

5.1 Discussion

Most of the relevant research studies which reviewed the causal relationships between affective characteristics and achievement generally had been conducted using only a form of subject-specific students' self-concept of ability as the attitude construct (Mattern & Schau, 2002). Yet, there was not any consensus in their conclusions. Some of the studies concluded that the causal relationship was a reciprocal relationship (Marsh & Yeung, 1987); some supported the achievement predominant models (Helmke & van Aken, 1995; Newman, 1984; Reynolds & Walberg, 1992; Schibeci, 1989); and some supported the opposite direction for this direction (Oliver & Simpson, 1988).

Interest, motivation, importance, enjoyment, test and course anxiety, self-concept, self-efficacy, and achievement motivation variables were included in the present study. In most studies, attitude is included with different kinds of sub-constructs; however, none of these studies included all the constructs included in this study. Because of that, it is difficult to compare the results of this study with others. Only one study (Abak, 2003) resembled to this study from this point of view, but it was conducted for university students. Physics achievement variable used in this study contains only the achievement in electricity concept that student scores taken form the NGET were used as achievement variable.

There were two hypothesized models in this study. In the first one achievement was included as endogenous variable and affective characteristics were as exogenous variables, but this model did not fit the data. With the second hypothesized model a good model-data fit was attained. This pattern suggested that achievement in physics affects interest in physics, importance of physics, student motivation in physics, enjoyment in extracurricular activities related to physics, physics test anxiety, physics course anxiety, self-concept, self-efficacy and achievement motivation in physics. Apparently, this model is close in spirit to the achievement predominant model.

The final model found by this study imply that high school students who did well in physics are more interested in physics, are motivated to learn physics, give more importance to physics, enjoy more in activities related to physics, feel less anxious about taking a physics exam, or about physics courses, fell more efficacious about physics and are more motivated to be successful in physics lesson. However being more interested in physics, more motivated to learn physics, giving more importance to physics, enjoying more in activities related to physics, feeling less anxious about taking a physics exam, or about physics courses, felling more efficacious about physics and being more motivated to be successful in physics lesson do not necessarily lead to greater achievement in physics. In summary, being successful in physics lesson influence students' affective characteristics. There relations between interest, motivation, importance, enjoyment, self-concept and self efficacy and achievement were positive and the relation between students' test and course anxiety and achievement were negative.

The achievement predominant model was supported by the findings of some researchers (Helmke & van Aken, 1995; Newman, 1984; Reynolds & Walberg, 1992; Schibeci, 1980 Skaalvik & Hagtvet, 1990). In addition to them, Mattern and Schau (2002) found evidence supporting the achievement predominant model only for boys and no cross-effects model for girls, but they only used value, affect and cognitive competence variables as measures of attitude.

Skaalvik and Hagtvet (1990) also supported this kind of causal direction. They used different age groups and suggested achievement predominant model for younger ages and reciprocal relations in higher grades. There are other studies supporting the achievement predominant model at younger ages (Calsyn & Kenny, 1977; Helmke & van Aken, 1995; Maruyama, Rubin & Kingsbury, 1981; Newman, 1984).

Obviously, the patterns of results with regard to causal predominance are quite heterogeneous. There are studies supporting reciprocal effects, achievement predominant models or reverse direction of causation. The reasons of this may be different kinds of designs or different sample characteristics. For example, number of points of data collection are quite varies from two to four or five (longitudinal studies) for studies and grade levels of the students vary from 2nd grade to 12th grades or university level. Secondly, the variables used in studies that some include only the self-concept of ability, some includes different sub-construct of attitude or motivation. Third this may be due to different instruments to assess variables used in studies. Another reason may be the difference in determination of academic achievement that is sometimes represented by teacher ratings, objective achievement test, or both. Finally, the difference is related to the domain under consideration, as studies generally focus on mathematics and reading.

On the other side, the relationships among the affective variables were also examined in the present study. Students' test anxiety and course anxiety seemed to have strongest relationship (.62). This is an acceptable result because they can be thought to be sub-constructs of the latent variable anxiety. This relationship implies that students who feel anxious about physics courses are also anxious about having physics exams. Self-concept and self-efficacy were also highly related concepts (.55), which is not interesting that they are very close variables. This relation means that students who feel good at physics also feel that they are able to de well in physics. These high relationships were supported previously in the study of Abak (2003).

Physics course anxiety and interest in physics are other related constructs (.31) and this strong relation indicates that students who feel anxious about physics are not interested in physics lessons. The relationship found between interest in physics and student motivation (.23) carry the meaning that students who are motivated to learn physics are also interested in physics.

Self-concept in physics and achievement motivation in physics are also related variables (.23). This relation simply means that students who feel that they are good at physics are motivated to be successful in physics and this result was also found in Abak’s study (2003).

Another supported relationship by Abak (2003) was between student motivation in physics and importance given to physics. It can be explained as students who give importance to physics are also motivated to learn physics.

The relationship of achievement motivation in physics with self-efficacy (.18) can be expressed as students who feel that they can be good at physics are also motivated to achieve in physics. Its relationship with physics course anxiety can be expressed as students who are motivated to learn physics are less anxious about physics courses. The last relationship between physics test anxiety and self-concept (.40) shows that students who are anxious about physics exams think that they are not good at physics.

5.2 Conclusions

as a result of the data analysis procedures a significant model explaining the pattern of the relationship between affective characteristics related to physics and physics achievement in electricity concept of physics was found. The following conclusions can be drawn from the final model found in this study.

- The final best-fitting structural model evidenced that the direction of the relationship was from achievement to the affective characteristics of high school students related to physics which was identified as the achievement predominant model in previous chapters.
- Achievement most strongly affected student motivation, next enjoyment, importance and physics test anxiety, respectively. These relations imply that students who are more successful are more motivated to learn physics, are more enjoying in extracurricular activities related to physics, give more importance to physics lesson and less worried about physics exams.
- There are also relationships among the affective characteristics.

1. The strongest of these relations are between physics test anxiety and course anxiety. This relationship implies that students who are worried about physics courses are also worried about physics exams.
2. Self-concept and self-efficacy are also related variables meaning that students who feel that they are good at physics also feel that they can be good at physics.

3. Other related variables are physics course anxiety and interest in physics that shows students who are worried about physics courses are not interested in physics courses.
4. Another relationship found was between motivation and interest. That means students who are motivated to learn physics are interested in physics.
5. Self-concept and physics test anxiety were found to be related that evidences students who feel that they are good at physics are less worried about physics exams or tests.
6. Self-concept and achievement motivation were shown to be related that implies that students who feel that they are good in physics are more motivated to be successful in physics.
7. Self-efficacy and achievement motivation are also found to be related that students who feel that they are able to do well in physics are more motivated to be successful in physics.
8. The last relationship found between physics course anxiety and achievement motivation. This relationship indicates that students who are less worried about physics courses are more motivated to be successful in physics.

5.3 Limitations

There were several limitations to this study which may be impacted the outcomes. These limitations may be grouped as the limitations related to population generalizability, ecological generalizability, task generalizability, and the limitations of methodology (Ağazade, as cited in Abak 2003).

- The sample of this study included tenth grade students in super lyces in Ankara. Thus the results can be generalized to students who took electricity in the physics courses in high schools of Ankara. Because of the limitation on population generalizability, the results can not be generalized to student attending to different types of high schools, such as regular high schools, private high schools, or occupational high schools. The results also can not be generalized to other populations like university students taking physics courses or to students from different age groups.
- Since all students in the sample were living in Ankara, because of the limitations on the ecological generalizability the results can be generalized to only the students in super lyce students in Ankara or other cities that are similar culturally to Ankara.
- The scores obtained by the NGET were used as the physics achievement scores of students. The examination results or course grades given by teachers to students were not included in the study. Hence the results

about achievement can only be generalized to this kind of achievement scores.

- Some items of the affective characteristics scale were not included in the study. These aspects limit the task generalizability of this study.
- Finally, there were several methodological limitations in this study. The main limitation was that the instruments were planned to be administered at the end of the ninth grade and they could be administered at the beginning of tenth grade with a four months delay. In addition to this, there were no time interval in applications of achievement test and affective characteristics scale; they were applied at the same time. The pilot study were not conducted previously, it is conducted within the main study. Furthermore, a large number of items that were problematic in the questionnaire were deleted from the data. Another limitation was that, there were a lot of classes and it was difficult to equate the conditions of administration of instruments. Although in most classes, researchers gave the directions in some classes the directions were given through a teacher, or in some classes teachers themselves administered the scale and the test. Additionally, there might be alternative models to the hypothesized models. The models tested and evaluated in this study were not the only possible models that fit the data well. Finally the cross validation studies were not conducted, which is another limitation to this study.

5.4 Internal Validity

The threats to internal validity in a correlational study can be grouped in as (Fraenkel & Wallen, 1996);

1. Subject Characteristics: This threat is always possible in a correlational study that other characteristics of the individuals may explain any relationship that is found. However these are not controlled.
2. Location: The location where the instruments were administered may always be a threat for internal validity. The effect of location was no controlled.
3. Instrumentation:
    - Instrument Decay: In the present study is does not seem to be a threat for the AC Scale and the NGET.
    - Data Collector Characteristics: The researcher was the data collector, so it is not a threat for the present study.
    - Data Collector Bias: The researcher was the data collector, and had no any preconceptions about the students included in the study. The AC Scale is a likert type questionnaire and the NGET is an objective test, so this is also not a threat for the present study.
4. Testing: When more than one variable are measured at the same time and when students guess the relationship between these variables they may

study, they may response accordingly, this causes a testing threat, but no such factor was controlled.

5. Mortality: The AC Scale and the NGET were administered at the same time, so there was no subject loss. The missing data analysis also did not show a significant loss.

5.5. Implications

At late high school years and at university years researches show that students' achievement is dependent on the affective characteristics of students. Thus, in earlier years affective characteristics of students should be firmly established. In early years students' affective characteristics are affected by the level of students' achievement. Thus in order to improve affective characteristics of students, achievement of students should be increased.

On the other side, increasing interest, motivation, and enjoyment, decreasing anxiety of students and increasing the feeling of efficacy may be important outcomes themselves whether or not have an effect on later achievement. Positive attitude were shown to be effective on persistence in the form of intended course selection (Meece et al., 1990). Thus, trying to improve students' affective characteristics relate to a subject may not give the expected influence on later students achievement but it may be justified through the influence of persistence alone.

All affective characteristics were related to achievement in physics, so teachers, parents, curriculum developers and textbook authors should be sensitive about the issue of affective characteristics.

Teachers should

- Emphasize the success stories and neglect the failures of students
- Not give very difficult tasks that probably will end with a failure of student, and will probably give the sence of incompetency
- Spend more time and effort to persuade students that they are doing well

- Not demotivate students
- Consider improving self-concept of students by changing their perceived evaluations of themselves relative to others
- Try to make students believe that they are efficient in physics
- Try to decrease anxiety
- Arouse interest
- Increase achievement motivation.

Parents should

- Emphasize their children's successful performances and try to make to believe them that they are capable
- Not force their children to perform very heavy duties that may give the sense of incapability
- Consider arousing interest in physics, science and technology from early ages of their children.

Curriculum developers should

- Not load the curriculum with the information above students' level
- Should emphasize students' needs, and interests.

Text book authors should

- Avoid information, explanations and examples above students' level

5.6 Suggestions for Further Research

The final model found in this study should be examined with other samples of the same population to confirm the findings. In addition it is important to continue this research with other samples of students from different kinds of high schools in order to see differences or students from different age groups in order to see developmental pattern of the model by the time. Moreover, investigating the best-fitting model for different populations for example other ethnic groups or culturally different groups would be an important addition to the literature. The final model may also be tested across gender groups to compare the results and see the difference. Another source of distinction may be different subject areas, so further studies should be designed to include other subject areas. Besides, some other affective characteristics may also be added to have a more complex structure of relations. The last suggestion may be replication studies with students from different cities or even countries as a cross validation analysis across cultures or nations.

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APPENDIX A

LIST OF SCHOOLS

1. ALTINDAĞ AHMET YESEVİ LİSESİ (Y.D.A.)
2. ANKARA BAŞKENT LİSESİ (Y.D.A.)
3. ANKARA DİKMEN LİSESİ (Y.D.A.)
4. ANKARA GAZİ LİSESİ (Y.D.A.)
5. ANKARA KURTULUŞ LİSESİ (Y.D.A.)
6. ANKARA YILDIRIM BEYAZIT LİSESİ (Y.D.A.)
7. ÇANKAYA 50.YIL LİSESİ (Y.D.A.)
8. ÇANKAYA LİSESİ (Y.D.A.)
9. ÇANKAYA S.MEHMET PAŞA LİSESİ (Y.D.A.)
10. ETİMESGUT ERYAMAN LİSESİ (Y.D.A.)
11. GÖLBAŞI DR.Ş.TOMBULOĞLU LİSESİ (Y.D.A.)
12. KEÇİÖREN FATİH SULTAN MEHMET LİSESİ (Y.D.A.)
13. KEÇİÖREN İNCİRLİ LİSESİ (Y.D.A.)
14. KEÇİÖREN LİSESİ (Y.D.A.)
15. KEÇİÖREN KALABA LİSESİ (Y.D.A.)
16. MAMAK NAHİT MENTEŞE LİSESİ (Y.D.A.)
17. SİNCAN İBNİ SİNA LİSESİ (Y.D.A.)
18. YENİMAHALLE HALİDE EDİP LİSESİ (Y.D.A.)
19. YENİMAHALLE MEHMET AKİF ERSOY LİSESİ (Y.D.A.)
20. YENİMAHALLE MOBİL LİSESİ (Y.D.A.)
21. YENİMAHALLE PROF.DR.Ş.R.HATİPOĞLU LİSESİ (YDA)
22. YENİMAHALLE ŞENTEPE LİSESİ (Y.D.A.)

APPENDIX B

DUYUŞSAL KARAKTERİSTİKLER ANKETİ

Bu anket sizin fizik ve fizik dersleri hakkındaki görüşlerinizi öğrenmek için geliştirilmiştir. İçeriğinde fiziğe ve fizik dersine yönelik tutum soruları bulunmaktadır. Cevaplarınız önümüzdeki yıllarda fizik derslerinin sizin görüşleriniz doğrultusunda şekillenmesine katkıda bulunabileceğinden dolayı önem taşımaktadır. Lütfen bütün soruları yanıtlayınız. İsimleriniz verileri eşlemekte kullanılacağından yazılması gereklidir. Araştırmada toplanılan tüm bilgiler ve katılımcıların isimleri kesinlikle gizli tutulacaktır ve ders notlarına etki etmeyecektir.

Adınız Soyadınız		
Cinsiyetiniz	Bay ☐	Bayan ☐
Doğum Yılınız		

Teşekkürler...

Özlem Doğan TEKİROĞLU

Her bir cümleyi dikkatlice okuduktan sonra, cümleye ne derece katıldığınızı veya katılmadığınızı belirtmek için yanındaki seçeneklerden size en uygun olanına ait kutu içine "X" işareti koyunuz.

#	Cümleler	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1	Fizik dersi eğlencelidir.					
2	Fizik dersini ilgi çekici buluyorum.					
3	Fizik dersine girmek için can atıyorum.					
4	Fizik dersinin gereksiz olduğunu düşünüyorum.					
5	Aldığımız diğer dersler fizik dersinden daha ilgi çekicidir.					
6	Fizik dersi sıkıcıdır.					
7	Fizik dersinde öğrendiklerimin günlük hayatta işime yaramayacağını düşünüyorum.					
8	Fizik problemlerinin gerçek hayatla daha fazla ilgisi olsa, fizik dersinin daha iyi olacağını düşünüyorum.					
9	Fizik dersinde öğrendiğimiz şeylerin gerçek hayatta kullanılmayacağını düşünüyorum.					
10	Fizik dersinde öğrendiğim şeyleri bir daha kullanmayacağım için bu derse ihtiyacım olmadığını düşünüyorum.					
11	Fizik derslerini severim.					
12	Fizik derslerine karşı olumlu hislerim vardır.					
13	Benim için fizik dersleri eğlencelidir.					
14	(Okulda) fizik çalışmaktan hoşlanırım.					
15	Diğer derslere göre fizik daha ilgi çekicidir.					
16	Bugüne kadar aldığım bütün fizik dersleri sıkıcıdır.					
17	Fizik becerilerimi geliştirmek istiyorum.					
18	Fizikle ilgili daha çok şey öğrenmek istiyorum.					
19	Zorunlu fizik dersi dışında seçmeli fizik dersleri de almak istiyorum.					
20	Eğitim hayatım boyunca alabildiğim kadar çok fizik dersi almak istiyorum.					
21	Fizik derslerinde çok çalışmak için yeterli motivasyonum var.					
22	Fizik derslerine devam etmek için yeterli motivasyonum var.					
23	Herkesin fizik öğrenmesi gerektiğini düşünüyorum.					

#	Cümleler	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
24	Fiziğin ilerdeki meslek hayatımda önemli bir yeri olacağını düşünüyorum.					
25	Fizik dersinde öğrendiklerimin gündelik hayatta işime yarayacağını düşünüyorum.					
26	Fizik derslerinin zekayı geliştirmeye yararı olacağını düşünüyorum.					
27	Fizik dersinde öğrendiklerimin hayatımı kolaylaştıracağını düşünüyorum.					
28	Fiziğin, gelecekte gittikçe önemi artan bir alan olacağını düşünüyorum.					
29	Fizik derslerinin, ilerdeki çalışmalarımda bana yararlı olacağını düşünüyorum.					
30	Güncel hayattaki fizik veya teknoloji ile ilgili konuları okumaktan hoşlanırım.					
31	Fizik veya teknoloji ile ilgili kitaplar okumaktan hoşlanırım.					
32	Bana hediye olarak bir fizik kitabı veya fizikle ilgili aletler verilmesinden hoşlanırım.					
33	Fizik veya teknoloji ile ilgili bir sorun ortaya çıkarsa; bir ders kitabı, ansiklopedi, vb' ye başvurmaktan hoşlanırım.					
34	Okulumuzda fizik topluluğu olsaydı üye olmak isterdim.					
35	Fizik veya teknoloji ile ilgili televizyon programlarını izlemekten hoşlanırım.					
36	Fizik laboratuarlarında deney yapmaktan hoşlanırım.					
37	Teknik aletlerle çalışmaktan hoşlanırım. (Zil veya model uçak gibi.)					
38	Arkadaşlarla fizik veya teknoloji ile ilgili meseleleri konuşmaktan hoşlanırım.					
39	Okuldan sonra arkadaşlarla fizik hakkında konuşmak eğlencelidir.					
40	Yakın bir zamanda olacağım bir fizik sınavını düşünmek beni kaygılandırır.					
41	Fizik dersinde sınav olmak beni kaygılandırır.					
42	Fizik sınavları beni korkutur.					
43	Fizik sınavına çalışmak beni kaygılandırır.					
44	Fizik sınavları kendimi sinirli hissetmeme sebep olur.					
45	Fizik sınavlarında rahatımdır.					
46	Fizik sınavlarında elim ayağıma dolaşır.					
47	Diğer derslere göre fizik çalışırken daha rahatımdır.					
48	Fizik problemleri çözememek beni endişelendirir.					
49	Fizik kitabını açmak yada problemlerle dolu bir sayfa görmek beni kaygılandırır.					

#	Cümleler	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
50	Fizik dersinde kendimi gergin hissederim.					
51	Fizik dersine girmek beni kaygılandırır.					
52	Daha fazla fizik dersi almak canımı sıkmaz.					
53	Belli bir sayıda fizik dersi almak zorunluluğum olması beni kaygılandırır					
54	Fizik derslerinde rahatımdır.					
55	Diğer derslere göre fizikte başarısız olmak beni daha çok endişelendirir.					
56	Fizik dersi, kendimi tedirgin ve şaşkın hissetmeme neden olur.					
57	Fizik dersinde başarısız olmak beni endişelendirir.					
58	Fizik çalışmak, kendimi ormanda kaybolmuş gibi hissetmeme neden olur.					
59	Fizik dersiyle uğraşmak zorunda olmak beni dehşete düşürür.					
60	Fizik dersinde iyi notlar alma yeteneğine sahibim.					
61	Fizik dersiyle başa çıkabilecek kadar zekiyim.					
62	Fizik dersindeki yeteneğimle gurur duyarım.					
63	Fizik dersindeki çalışmalarım beni tatmin eder.					
64	Fizik dersindeki başarılarımla gurur duyarım.					
65	Fizik dersinde, kendimi sınıfımdaki diğer kişiler kadar başarılı hissederim.					
66	Fizik dersinde sınıfın bir parçası olduğumu hissederim.					
67	Fizik dersinde iyi bir not aldığımda sebebini anlayamam.					
68	Fizik dersini veren öğretmenimizle aramızda güçlü bir iletişim olduğunu hissederim.					
69	Fizik dersinde kötü bir not aldığımda sebebini anlayamam.					
70	Dersi veren iyi bir öğretmen değilse, fizikte başarılı olamam.					
71	Fizik dersinde başarısız olursam, bu kendimin suçudur.					
72	Fizik dersinde başarılı olmak benim elimdedir.					
73	Fizik dersinde başarılı olmak için elimden geleni yaparım.					
74	Fizik dersinde elimden gelenin en iyisini yapmaya çalışırım.					
75	Fizik dersinde başarısız olduğumda daha çok çabalarım.					
76	Fizik dersinde yapılacak iş ne kadar zor olursa olsun, elimden geleni yaparım.					

#	Cümleler	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
77	Fizik öğrenebileceğimden eminim.					
78	Daha zor fizik problemleri ile başa çıkabileceğimden eminim.					
79	Fizik dersinde başarılı olabileceğimden eminim.					
80	Fizik dersinde zor işleri yapabileceğimden eminim.					
81	Yeterince vaktim olursa en zor fizik problemlerini bile çözebileceğimden eminim.					

APPENDIX C

THE NINTH GRADE ELECTRICITY TEST

ELEKTRİK TESTİ

YÖNERGE: Bu test, Orta Doğu Teknik Üniversitesi, Eğitim Fakültesinde yapılmakta olan bir yüksek lisans tezi için hazırlanmış olup fizik dersinin elektrik konusundaki durumunuzu ölçmek amacı ile kullanılacaktır. Testin içeriğinde ÖSS sınavında çıkan sorular paralelinde sorular bulunmaktadır. Cevaplarınız önümüzdeki yıllarda fizik derslerinin sizin görüşleriniz doğrultusunda şekillenmesine katkıda bulunabileceğinden dolayı önem taşımaktadır. Testten alınan puanlar ve çalışmaya katılan kişilerin isimleri kesinlikle gizli tutulacak, okul veya öğretmen değerlendirmelerinde kullanılmayacaktır. Her soruyu okuduktan sonra size göre en uygun seçeneği sadece cevap kağıdına işaretleyiniz. Soru kitapcığıda herhangi bir işaretleme yapmayınız. *Bilmediğiniz sorularda, cevap kağıdında seçeneklerin yanına eklenmiş olan içinde soru işareti bulunan daireyi işaretleyiniz. Yanlış cevaplar doğruları götürmeyecektir.*

Sonuçlar isimsiz olarak sınıfınızda asılacaktır.

Başarılar...

Özlem Doğan Tekiroğlu

ODTÜ

1. Aşağıda sırasıyla yazılmış olan cümlelerin numaraları cevap anahtarında verilmiştir. Bu cümlelerden *doğru* olanların harfinin yanındaki 'D' harfinin, *yanlış* olanların ise yanındaki 'Y' harfinin bulunduğu daireyi işaretleyiniz. Bu alanda herhangi bir işaretleme yapmayınız.

1.1. Negatif yük alındığında negatif, pozitif yük alındığında pozitif yüklenme olur.

1.2. Aynı cins yüklü cisimler birbirini iter, zıt cins yüklü cisimler birbirini çeker.

1.3. Elektroskop, yalnızca bir cismin yüklü olup olmadığını anlamaya yarar.

1.4. Yüklü bir cisim yüksüz bir cisme dokundurulduğunda aralarında yük paylaşımı olur.

1.5. Birim zamanda devreden geçen yük miktarına 'Akım' denir.

2. Aşağıda verilmiş olan sütunlardan birincisinde elektrik devresinde kullanılan devre elemanlarının görevleri, ikincisinde ise elemanların isimleri verilmiştir. Cevap anahtarında harfleri ile verilen görevlerin yanına ikinci sütunda sayıları ile verilmiş olan elemanlardan uygun olanının sayısını yazınız. Eşlenmeyen eleman kalabilir.

Sütun 1	**Sütun 2**
a. Devredeki akımı keser/açar.	**1.** Reosta
b. Devredeki akımın şiddetini ölçer.	**2.** Üreteç
c. Devreye akım sağlar.	**3.** Voltmetre
d. Devrenin potansiyel farkını ölçer.	**4.** Anahtar
e. Devrenin eşdeğer direncini artırır/azaltır.	**5.** Direnç
	6. Lamba
	7. Ampermetre

3. Aşağıdakilerden hangisi yalıtkan maddedir ?

A) Demir B) Gümüş

C) Bakır D) Cam

4. Bir sıvının elektrik akımını iletmesi için aşağıdakilerden hangisi gereklidir?

A) İyonlar içermesi

B) Homojen olması

C) Heterojen olması

D) Moleküler yapıda olması

5. Katı metallerin elektriği iletmesinin sebebi aşağıdakilerden hangisidir?

A) Katı olmaları

B) Homojen olmaları

C) Serbest elektronlar içermeleri

D) Element halinde olmaları

6. Aşağıdaki akım kaynaklarından hangisi doğru akım kaynağı değildir?

A) Dinamo B) Pil

C) Akümülatör D) Jeneratör

7. Bir telin direnci hesaplanırken

aşağıdakilerden hangisi kullanılmaz?

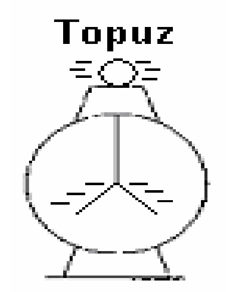
A) Özdirenci B) Uzunluğu

C) Öz kütlesi D) Kesiti

8. Yalıtkan katı maddelerin elektriği iletmemesinin nedeni aşağıdakilerden hangisidir?

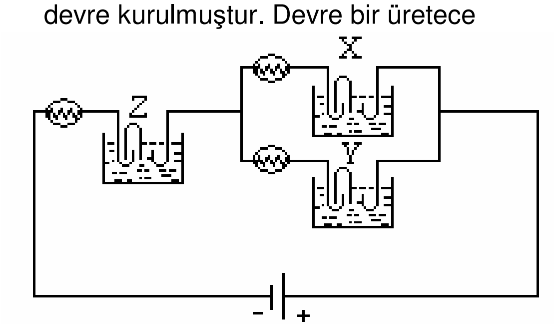
A) Dirençlerinin çok büyük olması
B) Yapılarında iyon bulunması
C) Serbest elektronlarının fazla olması
D) Sürtünme ile elektriklenmesi

9. Şekildeki elektroskopa elektrik yüklü bir çubuk <u>yaklaştırıldığında</u>, aşağıdakilerden hangisi gerçekleşir?



A) Elektroskoptaki yük cinsi değişir.
B) Yapraklar zıt yükle yüklenir.
C) Elektroskoptaki yük boşalır.
D) Yapraklar arasındaki açı değişir.

10.Özdeş lambalar ve özdeş X, Y ve Z kapları şekilde görüldüğü gibi bağlanarak bir devre kurulmuştur. Devre bir üretece



bağlanarak üzerinden elektrik yükü geçmesi sağlanmış ve 2 dakika boyunca gözlem yapılmıştır. Gözlem sonuçlarına göre:

1. X ve Y kaplarında biriken gaz miktarları eşit ve herhangi birinde biriken gaz miktarı, Z de birikenin yarısı kadardır.
2. İki dakikada biriken toplam gaz miktarı, 1 dakikada biriken miktarın 2 katıdır.

Buna göre aşağıdaki yargılardan hangilerine varılabilir?

I. Koldan geçen yük ile o koldaki elektroliz kabında biriken gaz miktarı doğru orantılıdır.
II. Ana koldan geçen yük miktarı paralel kollardan geçenlerin toplamına eşittir.
III. Ana koldan geçen akım arttıkça kaplarda biriken gaz miktarı da artar.

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

11. Kuru saç taranırken tarağın saçı çekmesi aşağıdaki olaylardan hangisi için bir örnektir?

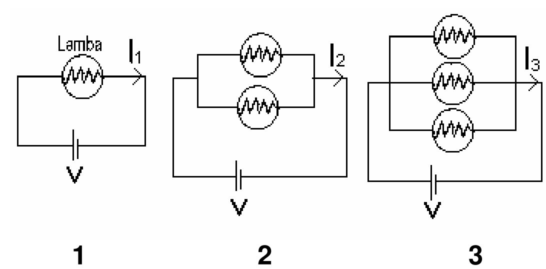
A) Sürtünme ile elektriklenme

B) Dokunma ile elektriklenme

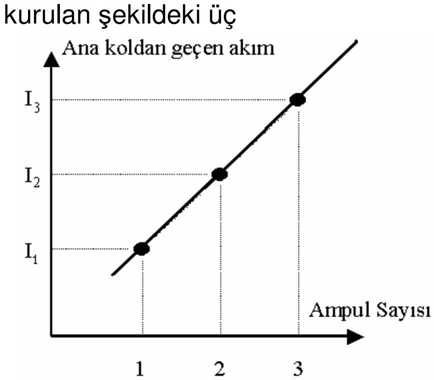
C) Etki ile elektriklenme

D) Topraklama

12.



Özdeş ampullerle kurulan şekildeki üç devrede, ana koldan geçen akımlar verilmiştir. Ana koldan geçen bu akımların ampul sayısına göre değişimi yandaki grafikteki gibidir.



Bu bulgulardan aşağıdaki hangi sonuca ulaşılır?

A) Ampul sayısı arttıkça ana koldan geçen akım azalmaktadır.

B) Eşdeğer direnç ampul sayısına bağlı olarak azalmaktadır.

C) Paralel kollardaki potansiyel farkı ampul sayısına bağlı olarak artmaktadır.

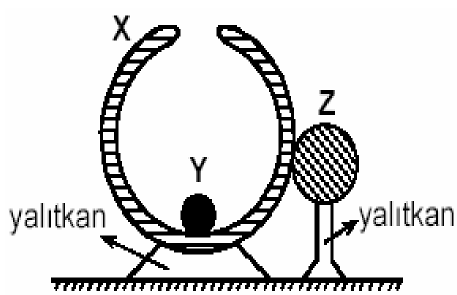
D) Paralel kollardaki potansiyel farkı ampul sayısına bağlı olarak azalmaktadır.

13. Sırasıyla yükleri –q, +7q ve +q olan A, B, ve C kürelerinin yarıçapları r, 2r ve 3r dir. B küresi önce A' ya sonra C' ye dokundurulup ayrılıyor. Buna göre C küresinin son yükü ne olur?

A) -q B) +q

C) +2q D) +3q

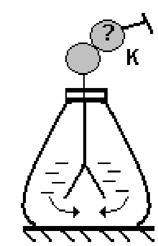
14.

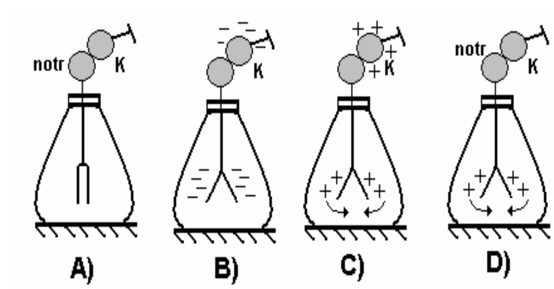


Yüksüz X, Y, Z metal küreleri şekildeki gibi birbirine değmektedir. + elektrik yüklü başka bir cisim X küresinin iç yüzüne dokundurulup uzaklaştırılıyor. Bu işlemden sonra, Y ve Z kürelerinin elektrik yükleri için ne söylenebilir?

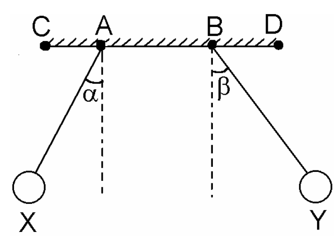
	Y	Z
A)	+ yüklüdür	yüksüzdür
B)	yüksüzdür	- yüklüdür
C)	yüksüzdür	+ yüklüdür
D)	+ yüklüdür	+yüklüdür

15. Şekildeki (–) yüklü elektroskopa, yükü bilinmeyen K cismi yalıtkan sapından tutularak dokundurulduğunda, yaprakların biraz kapandığı gözleniyor. Bundan sonra K cismi nötr bir elektroskopa, dokundurulduğunda aşağıdaki durumlardan hangisi gözlenir?





16. Yüklü X ve Y küreleri şekildeki gibi asılarak bir deney düzeneği oluşturuluyor. Deneyde;



1. X ve Y'nin yükleri artırılınca, α ve β açılarının arttığı,
2. X ve Y'nin arasına kağıt yada başka bir plastik koyulunca α ve β açılarının azaldığı ,
3. Kürelerin asılma noktaları A ve B'den sırasıyla C ve D'ye alındığında α ve β açılarının azaldığı, gözleniyor.

Yukarıda verilen gözlemlerin sonuçlarına göre X ve Y kürelerinin aralarındaki itme kuvvetinin büyüklüğü aşağıdakilerden hangilerine bağlıdır?

1. X ve Y'nin yük miktarına,
2. X ve Y'nin arasındaki uzaklığa,
3. X ve Y' nin öz kütlesine,
4. X ve Y' nin bulundukları ortama,
5. X ve Y' nin yükünün cinsine,

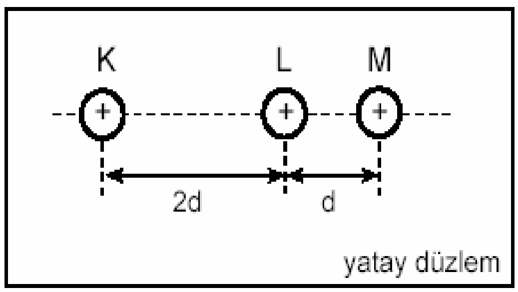
A) 1, 3, 4 B) 1, 2, 4
C) 2, 4, 5 D) 2, 3, 4

17. Yükleri sırasıyla $4x10^{-9}$ C ve $2x\ 10^{-9}$ C olan K ve L küreleri arasındaki uzaklık 3 cm dir. Buna göre K ve L kürelerinin birbirlerine uyguladıkları elektrik kuvvetinin büyüklüğü kaç Newton dur? (k = $9x10^{9}$ Nm^2/C^2)

A) $8x10^{-5}$ N B) $8x10^{-7}$ N

C) $24x10^{-7}$ N D) $24x10^{-5}$ N

18.



Sürtünmesiz yatay düzlemde, artı (+) elektrik yüklü, iletken K,L,M küreleri şekildeki konumda tutulmaktadır.

L küresi serbest bırakıldığında hareket etmediğine göre,

I. K'nın elektrik yükü L'ninkinden büyüktür.
II. K' nın elektrik yükü M'ninkinden büyüktür.
III. L' nin elektrik yükü M'ninkinden büyüktür.

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

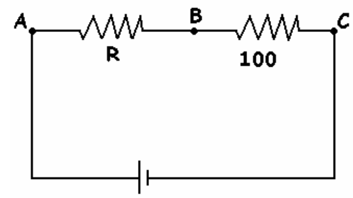
A) Yalnız I B) Yalnız II

C) I ve II D) II ve III

9. Suyun elektrolizinde, anotta toplanan gazın hacmi 5 cm^3 olduğuna göre katotta toplanan gazın cinsi ve hacmi hangisinde belirtilmiştir?

A) Hidrojen – 2.5 cm^3
B) Oksijen – 2.5 cm^3
C) Hidrojen – 10 cm^3
D) Oksijen – 10 cm^3

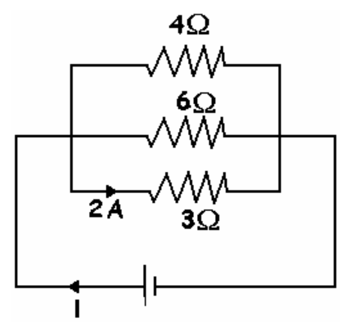
20. Şekildeki devrede V_{AC} = 24 V, V_{BC} = 6 V olduğuna göre R direnci kaç Ohm dur?



A) 300 Ω B) 150 Ω

C) 100 Ω C) 75 Ω

21. Şekildeki devrede 3 Ohmluk dirençten 2 Amperlik akım geçtiğine göre ana koldan geçen akım şiddeti kaç Amperdir?



A) 6 A B) 4 A

C) 4.5 A D) 3.5 A

APPENDIX D

OBJECTIVE LIST

Go1. İletken ve yalıtkan cisimlerin kavranması, (Kavrama)

1. İletken ve yalıtkan cisimlerin örneklerini benzerleri arasından seçer. (Kavrama)
2. İletken ve yalıtkan cisimler arasındaki temel farkı ortaya koyar. (Kavrama)

Go2. Yüklenme ve yüklenme türlerinin analiz edilmesi, (Analiz)

1. Cam, ebonit, gibi cisimlerin yünlü kumaşa sürtüldüğünde aralarında yük geçişi olacağını hatırlar. (Bilgi)
2. Sürtünme ile elektriklenmeye günlük hayattan örnek verildiğinde hangi tür yüklenme örneği olduğunu benzerlerinden ayırt eder. (Kavrama)
3. Negatif yada pozitif yüklenme olması için negatif yükün hareket etmesi gerektiğini hatırlarlar. (Bilgi)
4. Aynı cins yüklü cisimlerin birbirini ittiğini ve zıt yüklü cisimlerin birbirini çektiğini hatırlar. (Bilgi)
5. Yüklü bir cisim yüksüz bir cisme dokundurulduğunda aralarında yük paylaşımı olacağını hatırlar. (Bilgi)
6. Yük miktarları ve yarıçapları verilen kürelerin birbirine dokundurulduktan sonraki yüklerini hesaplar. (Uygulama)
7. Dokunma ile elektriklendikten sonraki yükleri verilen kürelerin ilk yüklerini bulur. (Uygulama)
8. Küre veya silindir gibi kapalı cisimlerin yüklenmesini içeren problemlerde bütün yükün kürenin yada silindirin dışında toplanacağı bilgisini kullanır. (Uygulama)
9. Etki ile elektriklenme esnasında nötr bir cismin pozitif ve negatif yüklenmiş uçlar oluşturduğu bilgisini soru çözerken kullanır. (Uygulama)
10. Etki ile elektriklenme esnasında topraklanması ile herhangi bir cismin kazanacağı elektrik yükünü belirler. (Uygulama)

Go3. Elektroskop kullanarak cisimlerin yük durumunun incelenmesi, (Analiz)

1. Bir cismin yüklü olup olmadığını anlamak ve ve yüklü bir cismin yükünü miktarını ve cinsini belirlemek amacı ile kullanılan aleti 'elektroskop' olarak adlandırır. (Bilgi)
2. Yüksüz bir elektroskopa yüklü bir cisim dokundurulduğunda elektroskopun yükünü belirler. (Uygulama)
3. Yüksüz bir elektroskopa yüklü bir cisim yaklaştırıldığında elektroskopun yükünü bulur. (Uygulama)
4. Elektroskopun yüklü bir cismin yaklaştırılması ve dokundurulması ile yüklenmesi arasındaki yüklenme türü farkını ayırt eder. (Kavrama)
5. Yüklü bir elektroskop kullanarak yüklü bir cismin yükünün cinsini tayin eder. (Uygulama)

Go4. Coulomb kanunun elde edilmesi, (Sentez)

1. Aynı cins yüklü cisimlerin birbirini ittiğini, zıt yüklü cisimlerin birbirini ittiğini hatırlar. (Bilgi)
2. Yüklü cisimlerin arasındaki kuvvetin yönüne göre yük durumlarını yorumlar. (Kavrama)
3. Gözlem sonuçlarını yorumlayarak yüklü parçacıklar arasındaki itme/çekme kuvvetinin bağlı olduğu faktörleri belirler. (Sentez)
4. Coulomb yasasını kullanarak iki yüklü parçacık arasındaki etkileşim kuvvetinin büyüklüğünü bulur. (Uygulama)
5. Birden fazla yüklü parçacığın etkilediği yükün üzerindeki bileşke kuvveti bileşenlerine ayırarak kuvveti oluşturan parçacıkların yüklerini bulur. (Uygulama)
6. Birden fazla yüklü parçacığın etkisinde hareketsiz kalan yüke etkiyen kuvvetlere dayanarak diğer parçacıkların yükünü bulur. (Uygulama)

Go5. Elektroliz deneyinde ortaya çıkan gaz ile devreden geçen akım arasındaki ilişkinin ortaya konulması, (Sentez)

1. Elektroliz deneyinde saf su içinden akım geçmesi için, suda iyon oluşturacak bir maddeyi, oluşturmayacak diğer maddeler arasından seçer. (Kavrama)
2. Sıvılarda elektrik akımın iletilmesinin sebebini verilen açıklamalar arasından ayıklar. (Kavrama)
3. Sülfürik asitli suyla yapılan elektroliz deneyinde meydana gelen kimyasal tepkime sonunda ortaya çıkan gazları listeler. (Bilgi)
4. Elektroliz kabında biriken gaz miktarı ile devreden geçen yük miktarı arasında ilişki kurar. (Kavrama)
5. Seri bağlı elektroliz düzeneklerinin her birindeki kaplarda biriken gaz miktarının da eşit olduğunu sonucuna dayanarak seri bir devreden eşit yük geçtiği kararını verir. (Kavrama)
6. Paralel bağlı elektroliz düzeneğinde, her bir düzenekteki kaplarda biriken gaz miktarının toplamının seri bağlandığında birikene eşit olduğu sonucuna dayanarak paralel devrede yükün paralel kollara ayrılarak dolaştığı kararını verir. (Kavrama)
7. Seri ve paralel elektroliz devrelerde herhangi bir kaptaki gaz miktarını kullanarak diğer kaplardaki gaz miktarlarını hesaplar. (Uygulama)
8. Birim zamanda devreden geçen yük miktarını ‘Akım’ olarak adlandırır.(Bilgi)
9. Elektroliz devresinden geçen akım ile kaplarda toplanan gaz miktarı arasında ilişki kurar. (Kavrama)

Go6. Elektrik iletkenliğinin kavranması, (Kavrama)

1. Katı iletkenlerin elektriği iletilmesini sağlayan özeliğini verilen özellikleri arasından seçer. (Kavrama)
2. Sıvılarda elektrik yükünün iletilmesinden sorumlu olan elektronları veya sıvıda çözünmüş olan iyonları verilen seçenekler arasından bulur. (Kavrama)

Go7. Elektrik akım kaynaklarının anlaşılması, (Kavrama)

1. Alternatif akım üreten kaynakları doğru akım üreten kaynaklardan ayırır. (Kavrama)

Go8. Ohm yasası ve eşdeğer direnç formüllerinin çıkarılası, (Sentez)

1. Adları verilen devre elemanları (reosta, anahtar ve üreteç) ile devredeki görevlerini eşleştirir. (Kavrama)
2. Ampermetre ve voltmetre ile devredeki görevlerini eşler. (Kavrama)
3. Bir telin direncini etkileyen faktörleri seçenekler arasından tanır. (Kavrama)
4. Boyu, kesiti, ve özdirenci verilen telin direncini hesaplar.(Uygulama)
5. Sabit bir direnci uçları arasına değişen potansiyel fark uygulandığında devreden geçen akımın değerini hesaplar. (Uygulama)
6. Basit bir devrede Ohm yasasını kullanarak bilinmeyen değerleri bulur. (Uygulama)
7. Seri veya paralel devrelerde devreye eklenen ampulün eşdeğer direnci nasıl değiştireceğine ilişkin açıklamayı seçeneklerden bulur. (Kavrama)
8. Dirençlerin seri veya paralel bağlanması ile kurulan devrelerin tamamı veya herhangi bir bölümünde Ohm yasasını kullanarak bilinmeyen değerleri hesaplar. (Uygulama)

APPENDIX E

TABLE OF SPECIFICATIONS

	Bilgi	Kavrama	Uygulama	Analiz	Sentez
Elektrik ve Elektrik Yükü		GO1-1 (Q3) GO1-2 (Q8)			
	GO2-1 GO2-3 (Q1-a) GO2-4 (Q1-b) GO2-5 (Q1-d)	GO2-2 (Q9)	GO2-6 (Q13) GO2-7 GO2-8 (Q14) GO2-9 GO2-10		
	GO3-1 (Q1-c)	GO3-4 (Q10)	GO3-2 (Q15) GO3-3 GO3-5 (Q15)		
Yüklü Cisimler Arasındaki Etkileşme Kuvvetleri	GO4-1 (Q1-b)	GO4-2	GO4-4 (Q17) GO4-5 (Q18) GO4-6 (Q18)		GO4-3 (Q16)
Elektrik Yükünün Ölçülmesi ve Elektrik Akımı	GO5-3 GO5-8 (Q1-e)	GO5-1 GO5-2 (Q4) GO5-4 (Q11) GO5-5 (Q11) GO5-6 (Q11) GO5-9 (Q11)	GO5-7 (Q19)		
Maddelerin Elektrik İletkenliği		GO6-1 (Q5) GO6-2			
Elektrik Akım Kaynakları		GO7-1 (Q6)			
Elektrik Devreleri		GO8-1 (Q2) GO8-2 (Q2) GO8-3 (Q7) GO8-7 (Q12)	GO8-4 GO8-5 GO8-6 (Q20) GO8-8 (Q20) (Q21)		

APPENDIX F

UNIVARIATE DISTRIBUTIONS FOR ORDINAL VARIABLES AND HISTOGRAMS FOR CONTINUOUS VARIABLES OF ITEMS AND ACHIEVEMENT SCORES

1. Q5

	Frequency	Percentage	Bar Chart
100	237	17.3	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
140	1	0.1	
200	340	24.9	□□□
230	1	0.1	
260	1	0.1	
280	1	0.1	
300	334	24.5	□□
309	1	0.1	
320	1	0.1	
322	1	0.1	
330	1	0.1	
370	1	0.1	
380	1	0.1	
400	325	23.8	□□□
500	120	8.8	□□□□□□□□□□□□□□□□□

2. Q14

	Frequency	Percentage	Bar Chart
100	248	18.2	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
200	352	25.8	□□□
300	244	17.9	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
309	1	0.1	
350	1	0.1	
400	381	27.9	□□□
440	1	0.1	
500	138	10.1	□□□□□□□□□□□□□□□□□

3. Q15

	Frequency	Percentage	Bar Chart
100	260	19.0	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
200	412	30.2	□□□
270	1	0.1	
300	344	25.2	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
309	1	0.1	
322	1	0.1	
370	1	0.1	
390	1	0.1	
400	245	17.9	□□□□□□□□□□□□□□□□□□□□□□□□□□□□
500	100	7.3	□□□□□□□□□□□

4. Q18

Frequency	Percentage		Bar Chart
100	161	11.8	
120	1	0.1	
180	1	0.1	
200	241	17.6	
240	1	0.1	
260	1	0.1	
280	1	0.1	
297	1	0.1	
300	227	16.6	
360	1	0.1	
380	1	0.1	
400	371	27.2	
420	1	0.1	
500	357	26.1	

5. Q19

Frequency	Percentage		Bar Chart
100	290	21.2	
200	358	26.2	
297	1	0.1	
300	323	23.6	
340	1	0.1	
350	1	0.1	
400	237	17.3	
420	2	0.1	
500	153	11.2	

6. Q20

Frequency	Percentage		Bar Chart
100	384	28.1	
200	375	27.5	
297	1	0.1	
300	373	27.3	
340	1	0.1	
350	1	0.1	
400	154	11.3	
500	77	5.6	

7. Q30

Frequency	Percentage		Bar Chart
100	117	8.6	
200	237	17.3	
300	215	15.7	
312	1	0.1	
340	23	1.7	
400	496	36.3	
422	1	0.1	
500	276	20.2	

8. Q35

Frequency	Percentage		Bar Chart
100	166	12.2	
200	232	17.0	
271	1	0.1	
300	215	15.7	
340	23	1.7	
378	1	0.1	
400	471	34.5	
500	257	18.8	

9. Q37

	Frequency	Percentage	Bar Chart
100	127	9.3	□□□□□□□□□□□□□□□
156	1	0.1	
200	210	15.4	□□□□□□□□□□□□□□□□□□□□□□□□
256	1	0.1	
271	1	0.1	
300	194	14.2	□□□□□□□□□□□□□□□□□□□□□□
311	1	0.1	
322	1	0.1	
340	23	1.7	□□□
344	2	0.1	
400	395	28.9	□□□
500	410	30.0	□□□

10. Q43

	Frequency	Percentage	Bar Chart
100	386	28.3	□□□
200	301	22.0	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
233	2	0.1	
241	24	1.8	□□□
300	174	12.7	□□□□□□□□□□□□□□□□□□□□□
350	1	0.1	
400	331	24.2	□□
500	147	10.8	□□□□□□□□□□□□□□□□□□

11. Q44

	Frequency	Percentage	Bar Chart
100	378	27.7	□□□
180	1	0.1	
200	264	19.3	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
233	1	0.1	
241	24	1.8	□□□
300	191	14.0	□□□□□□□□□□□□□□□□□□□□□□□□
400	338	24.7	□□
500	169	12.4	□□□□□□□□□□□□□□□□□□□□□

12. Q45

	Frequency	Percentage	Bar Chart
100	462	33.8	□□□
117	1	0.1	
200	321	23.5	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
241	24	1.8	□□
267	1	0.1	
300	241	17.6	□□□□□□□□□□□□□□□□□□□□□□□□□
317	1	0.1	
383	1	0.1	
400	244	17.9	□□□□□□□□□□□□□□□□□□□□□□□□□
500	70	5.1	□□□□□□□

13. Q46

	Frequency	Percentage	Bar Chart
100	353	25.8	□□□
180	1	0.1	
200	285	20.9	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
217	1	0.1	
241	24	1.8	□□□
300	179	13.1	□□□□□□□□□□□□□□□□□□□□□□□□
350	1	0.1	
400	352	25.8	□□□

417	1	0.1	
433	1	0.1	
500	168	12.3	□□□□□□□□□□□□□□□□□□□□□□

14. Q56

Frequency Percentage Bar Chart

100	214	15.7	□□□□□□□□□□□□□□□□□□□□□□
150	1	0.1	
200	289	21.2	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
275	1	0.1	
300	258	18.9	□□□□□□□□□□□□□□□□□□□□□□□□□□
367	1	0.1	
400	459	33.6	□□□
500	143	10.5	□□□□□□□□□□□□□□□

15. Q58

Frequency Percentage Bar Chart

100	201	14.7	□□□□□□□□□□□□□□□□□□□□
200	205	15.0	□□□□□□□□□□□□□□□□□□□□□
233	1	0.1	
242	1	0.1	
300	241	17.6	□□□□□□□□□□□□□□□□□□□□□□□□
333	1	0.1	
350	1	0.1	
367	1	0.1	
400	466	34.1	□□□
500	248	18.2	□□□□□□□□□□□□□□□□□□□□□□□□□

16. Q59

Frequency Percentage Bar Chart

100	224	16.4	□□□□□□□□□□□□□□□□□□□□□□
183	1	0.1	
190	1	0.1	
200	216	15.8	□□□□□□□□□□□□□□□□□□□□□
250	1	0.1	
286	1	0.1	
291	1	0.1	
300	206	15.1	□□□□□□□□□□□□□□□□□□□□
400	479	35.1	□□□
500	236	17.3	□□□□□□□□□□□□□□□□□□□□□□□

17. Q60

Frequency Percentage Bar Chart

100	171	12.5	□□□□□□□□□□□□□□□□□□
200	228	16.7	□□□□□□□□□□□□□□□□□□□□□□□□
300	356	26.1	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
343	1	0.1	
371	1	0.1	
400	453	33.2	□□□
500	156	11.4	□□□□□□□□□□□□□□□□

18. Q62

Frequency Percentage Bar Chart

100	187	13.7	□□□□□□□□□□□□□□□□□□□□
171	1	0.1	
200	339	24.8	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
300	450	32.9	□□□
343	1	0.1	
371	1	0.1	
400	270	19.8	□□□□□□□□□□□□□□□□□□□□□□□□□□□□
500	117	8.6	□□□□□□□□□□□□

19. Q63

Frequency Percentage Bar Chart

100	179	13.1
200	372	27.2
300	360	26.4
317	1	0.1
367	1	0.1
386	1	0.1
400	364	26.6
500	88	6.4

20. Q65

Frequency Percentage Bar Chart

100	196	14.3
183	1	0.1
200	315	23.1
300	375	27.5
386	1	0.1
400	348	25.5
500	130	9.5

21. Q75

Frequency Percentage Bar Chart

100	82	6.0
167	1	0.1
200	112	8.2
300	211	15.4
383	1	0.1
400	526	38.5
500	433	31.7

22. Q76

Frequency Percentage Bar Chart

100	83	6.1
200	135	9.9
300	230	16.8
383	1	0.1
400	524	38.4
500	393	28.8

23. ACMOT1

Frequency Percentage Bar Chart

100	42	3.1
150	18	1.3
200	59	4.3
250	41	3.0
300	157	11.5
****	1	0.1
350	86	6.3
383	1	0.1
400	464	34.0
****	2	0.1
450	85	6.2
500	410	30.0

24. Q78

Frequency Percentage Bar Chart

100	195	14.3
200	242	17.7
250	1	0.1
300	529	38.7
316	1	0.1
325	2	0.1

400	262	19.2	
500	134	9.8	

25. Q79

Frequency	Percentage	Bar Chart	
100	133	9.7	
200	164	12.0	
300	397	29.1	
316	1	0.1	
350	1	0.1	
400	445	32.6	
500	225	16.5	

26. Q80

Frequency	Percentage	Bar Chart	
100	147	10.8	
200	225	16.5	
275	1	0.1	
300	535	39.2	
316	1	0.1	
325	1	0.1	
400	309	22.6	
500	147	10.8	

27. Q81

Frequency	Percentage	Bar Chart	
100	235	17.2	
200	220	16.1	
225	1	0.1	
275	1	0.1	
300	502	36.7	
316	1	0.1	
325	2	0.1	
400	249	18.2	
500	155	11.3	

28. ACH3

Frequency	Percentage	Bar Chart	
0	3	0.2	
1	6	0.4	
2	12	0.9	
3.0	1	0.1	
3	58	4.2	
3.9	1	0.1	
3.9	2	0.1	
4.0	4	0.3	
4	253	18.5	
4.9	1	0.1	
4.9	1	0.1	
4.9	7	0.5	
4.9	1	0.1	
5.0	3	0.2	
5	1013	74.2	

Univariate Summary Statistics for Continuous Variables

1. Q6

Frequency	Percentage	Lower Class Limit	
135	9.9	100.000	
1	0.1	140.000	
202	14.8	180.000	
3	0.2	220.000	
233	17.1	260.000	
4	0.3	300.000	
2	0.1	340.000	

493	36.1	380.000
1	0.1	420.000
292	21.4	460.000

2. INTTOP6

Frequency	Percentage	Lower Class Limit
140	10.2	100.000
72	5.3	140.000
150	11.0	180.000
94	6.9	220.000
87	6.4	260.000
163	11.9	300.000
132	9.7	340.000
302	22.1	380.000
87	6.4	420.000
139	10.2	460.000

3. Q26

Frequency	Percentage	Lower Class Limit
46	3.4	100.000
2	0.1	140.000
62	4.5	180.000
6	0.4	220.000
2	0.1	260.000
163	11.9	300.000
6	0.4	340.000
592	43.3	380.000
0	0.0	420.000
487	35.7	460.000

4. Q27

Frequency	Percentage	Lower Class Limit
120	8.8	100.000
2	0.1	140.000
313	22.9	180.000
6	0.4	220.000
2	0.1	260.000
400	29.3	300.000
6	0.4	340.000
397	29.1	380.000
0	0.0	420.000
120	8.8	460.000

5. Q28

Frequency	Percentage	Lower Class Limit
66	4.8	100.000
2	0.1	140.000
176	12.9	180.000
6	0.4	220.000
2	0.1	260.000
366	26.8	300.000
6	0.4	340.000
447	32.7	380.000
0	0.0	420.000
295	21.6	460.000

6. Q29

Frequency	Percentage	Lower Class Limit
165	12.1	100.000
2	0.1	140.000
311	22.8	180.000
6	0.4	220.000
315	23.1	260.000
0	0.0	300.000
6	0.4	340.000

385	28.2	380.000
0	0.0	420.000
176	12.9	460.000

7. Q31

Frequency	Percentage	Lower Class Limit
138	10.1	100.000
1	0.1	140.000
300	22.0	180.000
0	0.0	220.000
244	17.9	260.000
26	1.9	300.000
3	0.2	340.000
449	32.9	380.000
1	0.1	420.000
204	14.9	460.000

8. PTAN2

Frequency	Percentage	Lower Class Limit
503	36.8	100.000
79	5.8	140.000
197	14.4	180.000
113	8.3	220.000
168	12.3	260.000
50	3.7	300.000
48	3.5	340.000
101	7.4	380.000
40	2.9	420.000
67	4.9	460.000

9. Q49

Frequency	Percentage	Lower Class Limit
278	20.4	100.000
1	0.1	140.000
289	21.2	180.000
6	0.4	220.000
240	17.6	260.000
2	0.1	300.000
7	0.5	340.000
373	27.3	380.000
0	0.0	420.000
170	12.4	460.000

10. PCAN1

Frequency	Percentage	Lower Class Limit
217	15.9	100.000
36	2.6	140.000
169	12.4	180.000
81	5.9	220.000
5	0.4	260.000
159	11.6	300.000
112	8.2	340.000
358	26.2	380.000
55	4.0	420.000
174	12.7	460.000

11. ACH1

Frequency	Percentage	Lower Class Limit
116	8.5	0.000
2	0.1	0.400
199	14.6	0.800
5	0.4	1.200

1	0.1	1.600
292	21.4	2.000
5	0.4	2.400
310	22.7	2.800
6	0.4	3.200
430	31.5	3.600

12. ACH2

Frequency	Percentage	Lower Class Limit
43	3.1	0.000
141	10.3	0.500
0	0.0	1.000
236	17.3	1.500
2	0.1	2.000
407	29.8	2.500
7	0.5	3.000
366	26.8	3.500
1	0.1	4.000
163	11.9	4.500

13. ACH4

Frequency	Percentage	Lower Class Limit
247	18.1	0.000
334	24.5	0.600
14	1.0	1.200
313	22.9	1.800
241	17.6	2.400
16	1.2	3.000
135	9.9	3.600
3	0.2	4.200
48	3.5	4.800
15	1.1	5.400

APPENDIX G

SYNTAX OF THE MEASUREMENT MODEL

Syntax of the Beginning Model

```
Observed Variables
Q5 Q6 Q14 Q15 INTTOP6 Q18 Q19 Q20 SM2122 Q23
Q24 Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32
Q33 Q35 Q36 Q37 Q38 Q43 Q44 Q45 Q46
PTAN2 Q49 Q53 Q56 Q58 Q59 PCAN1 Q60 Q61
Q62 Q63 Q64 Q65 Q66 Q75 Q76 ACMOT1 Q77
Q78 Q79 Q80 Q81 ACH1 ACH2 ACH3 ACH4
Raw Data From File
C:\DOCUME~1\OZLEMT~1\DESKTOP\TEZDEN~1\TEZDEN.TXT
Sample Size = 1366
Latent Variables  att imp enj ptanx pcanx scon achmot seff ach
Relationships
Q5 Q6 Q14 Q15 INTTOP6 Q18 Q19 Q20 SM2122 = att
Q23 Q24 Q25 Q26 Q27 Q28 Q29 = imp
Q30 Q31 Q32 Q33 Q35 Q36 Q37 Q38 = enj
Q43 Q44 Q45 Q46 PTAN2 = ptanx
Q49 Q53 Q56 Q58 Q59 PCAN1 = pcanx
Q60 Q61 Q62 Q63 Q64 Q65 Q66 Q77 Q78 Q79 Q80 Q81 = srv
Q75 Q76 ACMOT1 = achmot
ACH1 ACH2 ACH3 ACH4 = ach
Path Diagram
Iterations = 250
Method of Estimation: Maximum Likelihood
End of Problem
```

Syntax of the Final Form of Measurement Model

```
Observed Variables
Q5 Q6 Q14 Q15 INTTOP6 Q18 Q19 Q20 SM2122 Q23
Q24 Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32
Q33 Q35 Q36 Q37 Q38 Q43 Q44 Q45 Q46
PTAN2 Q49 Q53 Q56 Q58 Q59 PCAN1 Q60 Q61
Q62 Q63 Q64 Q65 Q66 Q75 Q76 ACMOT1 Q77
Q78 Q79 Q80 Q81 ACH1 ACH2 ACH3 ACH4
Raw Data From File
C:\DOCUME~1\OZLEMT~1\DESKTOP\TEZDEN~1\TEZDEN.TXT
Sample Size = 1366
Latent Variables  int stumot imp enj ptanx pcanx scon achmot seff ach
Relationships
Q5 Q6 Q14 Q15 INTTOP6 = int
Q18 Q19 Q20 = stumot
Q18 Q23 Q24 Q25 Q26 Q27 Q28 Q29 = imp
Q30 Q31 Q35 Q37 = enj
Q43 Q44 Q45 Q46 = ptanx
Q49 Q53 Q58 Q59 PCAN1 = pcanx
Q60 Q62 Q63 Q64 Q65 Q66 = scon
Q75 Q76 ACMOT1 = achmot
Q78 Q79 Q80 Q81 = seff
ACH1 ACH2 ACH3 ACH4 = ach
Path Diagram
Iterations = 250
Method of Estimation: Maximum Likelihood
End of Problem
```

APPENDIX H

SYNTAX OF THE FIRST HYPOTESIZED MODEL

```
Observed Variables
Q5 Q6 Q14 Q15 INTTOP6 Q18 Q19 Q20 SM2122 Q23
Q24 Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32
Q33 Q35 Q36 Q37 Q38 Q43 Q44 Q45 Q46
PTAN2 Q49 Q53 Q56 Q58 Q59 PCAN1 Q60 Q61
Q62 Q63 Q64 Q65 Q66 Q75 Q76 ACMOT1 Q77
Q78 Q79 Q80 Q81 ACH1 ACH2 ACH3 ACH4
Raw Data From File
C:\DOCUME~1\OZLEMT~1\DESKTOP\TEZDEN~1\TEZDEN.TXT
Sample Size = 1366
Latent Variables  int stumot imp enj ptanx pcanx scon achmot seff ach
Relationships
Q5 Q6 Q14 Q15 INTTOP6 = int
Q18 Q19 Q20 = stumot
Q18 Q23 Q24 Q25 Q26 Q27 Q28 Q29 = imp
Q30 Q31 Q35 Q37 = enj
Q43 Q44 Q45 Q46 = ptanx
Q49 Q53 Q58 Q59 PCAN1 = pcanx
Q60 Q62 Q63 Q64 Q65 Q66 = scon
Q75 Q76 ACMOT1 = achmot
Q78 Q79 Q80 Q81 = seff
ACH1 ACH2 ACH3 ACH4 = ach
ach = int stumot imp enj ptanx pcanx scon achmot seff
Path Diagram
Iterations = 250
Method of Estimation: Maximum Likelihood
End of Problem
```

APPENDIX I

LISREL SOLUTION OF THE FIRST HYPOTESIZED MODEL

DATE: 5/24/2005
TIME: 14:44

L I S R E L 8.30

BY

Karl G. Jöreskog & Dag Sörbom

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Website: www.ssicentral.com

The following lines were read from file
C:\DOCUME~1\OZLEMT~1\DESKTOP\TEZDEN~1\TEZDEN2.SPJ:

```
 Observed Variables
 Q5 Q6 Q14 Q15 INTTOP6 Q18 Q19 Q20 SM2122 Q23
 Q24 Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32
 Q33 Q35 Q36 Q37 Q38 Q43 Q44 Q45 Q46
 PTAN2 Q49 Q53 Q56 Q58 Q59 PCAN1 Q60 Q61
 Q62 Q63 Q64 Q65 Q66 Q75 Q76 ACMOT1 Q77
 Q78 Q79 Q80 Q81 ACH1 ACH2 ACH3 ACH4
 Raw Data From File
C:\DOCUME~1\OZLEMT~1\DESKTOP\TEZDEN~1\TEZDEN.TXT
```

400.000000 500.000000 500.000000 300.000000 500.000000 400.000000
400.000000 300.000000
Sample Size = 1366
Latent Variables int stumot imp enj ptanx pcanx scon achmot seff ach
Relationships
Q5 Q6 Q14 Q15 INTTOP6 = int
Q18 Q19 Q20 = stumot
Q18 Q23 Q24 Q25 Q26 Q27 Q28 Q29 = imp
Q30 Q31 Q35 Q37 = enj
Q43 Q44 Q45 Q46 = ptanx
Q49 Q53 Q58 Q59 PCAN1 = pcanx
Q60 Q62 Q63 Q64 Q65 Q66 = scon
Q75 Q76 ACMOT1 = achmot
Q78 Q79 Q80 Q81 = seff
ACH1 ACH2 ACH3 ACH4 = ach
ach = int stumot imp enj ptanx pcanx scon achmot seff
Path Diagram
Iterations = 250
Method of Estimation: Maximum Likelihood
End of Problem

Sample Size = 1366

Covariance Matrix to be Analyzed

	ACH1	ACH2	ACH3	ACH4	Q5	Q6
ACH1	1.69					
ACH2	0.45	1.62				
ACH3	0.23	0.17	0.46			
ACH4	0.43	0.44	0.16	2.06		
Q5	18.72	22.69	9.41	36.24	15032.69	
Q6	25.10	31.59	6.61	47.94	7317.16	15683.56
Q14	36.87	37.64	17.14	57.34	7481.71	9360.13
Q15	31.66	31.14	14.33	51.08	6980.72	7389.73
INTTOP6	37.44	40.89	14.37	59.53	7692.01	10145.12
Q18	36.41	40.81	20.10	65.14	6616.54	8406.22
Q19	33.23	30.68	13.31	56.32	6213.20	6993.25
Q20	28.47	30.59	12.94	55.61	6154.35	7110.16
Q23	16.30	22.33	11.77	34.62	4372.20	5698.51
Q24	31.10	38.26	15.09	56.48	5981.24	7298.81
Q25	12.89	20.46	11.37	36.46	4377.16	5680.96
Q26	18.59	22.65	8.69	28.89	3745.39	5505.71

Q27	18.06	24.42	7.89	37.09	4422.78	6330.20
Q28	15.98	21.91	9.04	27.51	3230.48	4721.13
Q29	27.62	33.73	14.53	53.37	5628.11	7165.51
Q30	27.63	28.38	12.52	40.95	3666.10	5410.13
Q31	27.22	29.21	13.15	39.38	3813.13	5450.32
Q35	27.83	35.05	14.77	45.53	4701.86	5807.07
Q37	18.28	28.57	12.87	31.68	3660.99	4329.11
Q43	28.60	32.52	8.90	46.87	5638.41	7461.74
Q44	29.85	28.63	11.34	47.67	5545.32	7328.63
Q45	27.05	31.04	8.91	43.11	5136.79	5816.09
Q46	16.51	26.69	7.45	41.20	4541.22	6155.67
Q49	24.80	34.32	7.42	51.68	5945.00	7611.80
Q53	15.02	22.47	6.66	30.43	4388.46	5686.18
Q58	23.99	28.25	4.68	40.58	5513.04	7542.88
Q59	32.57	39.06	10.44	51.95	6666.60	9017.15
PCAN1	34.22	36.18	12.20	48.75	6563.79	8447.77
Q60	31.01	35.32	8.64	45.90	4522.18	6298.55
Q62	29.09	32.38	9.38	47.43	4361.57	5830.43
Q63	21.43	27.63	9.62	42.51	3862.67	5252.63
Q64	27.04	32.12	8.78	41.40	3708.45	5577.23
Q65	28.74	35.16	8.09	46.23	4436.44	5670.96
Q66	32.26	36.15	7.86	46.95	5094.39	6495.92
Q75	19.57	28.51	10.73	28.33	3213.70	5080.72
Q76	21.55	33.61	9.71	33.92	3375.99	5287.44
ACMOT1	17.88	25.16	8.33	26.60	2780.80	4355.67
Q78	31.02	35.79	11.20	42.57	4466.39	6098.82
Q79	32.94	38.59	11.06	47.42	5114.02	7066.24
Q80	27.75	32.40	9.22	42.16	4510.31	5867.29
Q81	24.28	26.67	6.89	45.46	4562.29	6118.94

Covariance Matrix to be Analyzed

	Q14	Q15	INTTOP6	Q18	Q19	Q20
Q14	16505.97					
Q15	9430.96	14109.67				
INTTOP6	11783.68	9531.48	13428.55			
Q18	10378.75	8304.64	10794.32	18267.02		
Q19	9534.76	7618.18	9565.11	11666.14	16541.79	
Q20	9051.14	8073.85	9091.99	10393.83	10813.52	13656.12
Q23	5716.99	5533.83	6395.86	7324.50	6201.06	6442.20
Q24	8707.08	7514.05	9007.22	10682.57	8963.88	8812.30
Q25	6572.21	5323.54	6682.59	7482.44	6108.38	6061.43

Q26	5551.99	4778.09	6121.76	6505.23	4988.22	4768.16
Q27	6646.92	5927.71	7283.37	7606.51	6431.43	6421.67
Q28	5093.42	4802.37	5540.07	6688.49	5174.05	5024.31
Q29	8365.81	7262.85	8812.78	10727.92	8840.11	8418.55
Q30	6174.70	5032.12	6847.32	7732.09	6166.74	5781.56
Q31	6287.36	5243.20	6864.61	7836.83	6050.05	6011.79
Q35	7031.38	5811.36	7630.51	8712.54	6990.33	6768.24
Q37	5479.15	4544.29	5920.39	7550.42	5632.74	5236.19
Q43	8118.36	7147.91	8861.35	7112.65	7289.63	6652.86
Q44	8218.85	6443.65	8549.16	6996.49	6656.14	6328.66
Q45	7118.43	6364.84	7639.37	6068.79	6417.04	6276.17
Q46	5815.24	5342.61	6614.23	5112.53	5315.65	5213.94
Q49	8532.52	7038.09	8834.06	7178.33	6702.95	6654.75
Q53	5881.13	4415.46	6006.54	5549.46	4504.14	4657.46
Q58	8077.47	6343.39	8812.59	7045.78	6219.16	5730.47
Q59	9926.49	8040.04	10620.99	9000.38	8211.45	7567.63
PCAN1	9321.15	7564.15	9896.36	8407.90	7323.87	7044.21
Q60	7202.71	5831.69	8124.39	7213.13	6157.49	5700.81
Q62	6692.82	5670.93	7364.32	6971.53	6346.75	6219.97
Q63	6099.09	5391.36	6881.91	6137.16	5202.35	5240.27
Q64	6425.87	5310.89	7063.52	6657.55	5905.45	5262.59
Q65	6809.51	5955.25	7574.90	6408.88	5879.49	5930.83
Q66	7758.74	6505.08	8553.93	7535.12	6632.14	6160.18
Q75	5819.04	4382.04	6528.37	6707.30	5671.68	4924.73
Q76	5771.56	4477.95	6640.29	6896.27	5715.90	4762.19
ACMOT1	5279.47	3872.77	5942.13	5924.87	4818.05	4349.94
Q78	7031.20	6038.33	7780.01	7480.33	6668.24	6133.87
Q79	7507.64	6209.13	8626.17	8450.62	7442.77	6440.21
Q80	6271.83	5585.97	7305.98	7590.40	6601.35	5966.16
Q81	6795.14	5761.39	7524.08	7852.62	6877.55	6595.52

Covariance Matrix to be Analyzed

	Q23	Q24	Q25	Q26	Q27	Q28
Q23	15780.74					
Q24	7779.11	18558.63				
Q25	6450.28	8004.12	14710.28			
Q26	4613.60	6127.18	4883.00	9811.62		
Q27	6141.79	8139.42	7987.59	5508.61	12245.47	
Q28	5495.66	6786.52	4751.13	5360.45	5438.39	12363.49
Q29	7096.20	12295.63	7373.17	6070.02	8682.89	6877.09
Q30	4813.62	5923.89	4928.20	4398.90	4959.31	4796.63

Q31	4897.60	6194.19	4638.90	4186.58	5010.82	4812.74
Q35	5090.76	6943.94	5286.72	5044.09	5344.59	5274.89
Q37	4326.44	6651.49	4240.32	4430.60	4355.50	4345.91
Q43	4679.51	6791.95	5135.84	3639.10	5273.83	3525.04
Q44	4283.50	6273.54	5422.04	3388.12	4911.75	3384.06
Q45	4088.28	5309.26	4987.56	3323.79	4842.52	3473.53
Q46	3255.78	4663.65	4287.05	2823.69	3958.68	2622.41
Q49	4558.58	6814.13	4686.81	3937.55	4458.25	3162.46
Q53	3697.66	5167.39	3706.20	3103.62	3739.07	2724.69
Q58	4267.07	5713.45	4580.00	3897.01	4999.77	3267.89
Q59	5874.10	7718.60	5997.05	5078.57	6332.27	4540.55
PCAN1	5231.21	7157.31	5213.22	4642.56	5311.48	4206.79
Q60	3947.06	5297.17	3985.36	3802.86	4176.29	3275.90
Q62	4497.69	6103.67	3872.93	3551.78	4406.56	3089.10
Q63	4445.71	5827.37	3878.48	3712.26	4412.69	3530.29
Q64	4484.73	5794.30	4424.69	4080.24	4933.22	3767.79
Q65	4407.15	5687.92	4242.72	3597.46	4821.66	3514.57
Q66	4949.69	6387.35	4846.86	4453.84	5224.37	3971.90
Q75	3580.53	5253.23	3138.95	3680.32	3887.71	3776.22
Q76	3686.24	5452.81	3614.84	3699.83	4102.09	3862.88
ACMOT1	2870.75	4906.75	2915.09	3101.23	3557.13	3096.96
Q78	4579.12	6104.56	4478.22	4166.76	5141.73	4069.77
Q79	4857.66	6662.31	4937.38	4462.19	5308.69	4260.80
Q80	4419.83	5843.18	4140.56	3746.82	4777.29	3930.05
Q81	4502.52	6226.74	4763.36	4044.67	5016.50	4085.04

Covariance Matrix to be Analyzed

	Q29	Q30	Q31	Q35	Q37	Q43
Q29	15092.54					
Q30	6014.90	15073.05				
Q31	6317.70	11989.86	15109.35			
Q35	6715.37	9943.32	9967.45	16583.00		
Q37	6515.77	7244.82	6797.95	7966.97	17124.42	
Q43	7246.47	5012.21	5146.99	6104.93	5186.62	19169.01
Q44	6404.16	5596.76	5522.98	5935.58	5025.21	13732.77
Q45	5901.39	5216.57	5283.28	5527.25	4695.40	11166.08
Q46	4680.35	4560.23	4296.69	4900.77	3828.97	11212.84
Q49	6463.89	5161.46	5238.65	5502.75	3829.10	11316.89
Q53	4682.60	3449.81	3200.81	3311.87	2870.85	6665.94
Q58	6098.80	4975.10	4978.29	5091.74	4197.49	9250.48
Q59	8208.37	6305.72	6297.27	6715.17	5835.63	10566.54

PCAN1	7023.68	5663.16	5869.80	6517.14	4812.09	11723.92
Q60	5728.23	5046.13	4928.51	5731.49	4233.94	8100.23
Q62	6173.31	4847.83	5026.81	5713.43	4929.44	7478.24
Q63	5628.46	4489.97	4579.44	5217.29	4026.15	6716.97
Q64	5991.58	4621.17	4914.74	5715.12	4354.00	6383.48
Q65	6000.71	4924.87	5305.31	5675.40	4472.95	7973.62
Q66	6701.40	4989.45	5288.21	5759.18	4713.13	8022.17
Q75	5651.71	4264.35	4160.63	4841.47	4527.85	4375.85
Q76	5878.58	4980.47	4583.52	5219.76	4316.51	4972.44
ACMOT1	4863.95	3970.24	3840.18	4238.98	3626.38	3699.21
Q78	6657.86	5489.62	5299.67	5858.60	4839.44	6522.58
Q79	7008.26	5732.83	5417.29	6305.43	5042.71	7421.56
Q80	6192.37	5404.41	5464.79	5952.05	4943.76	6517.33
Q81	6505.54	4767.56	4497.36	5713.12	4717.29	6470.57

Covariance Matrix to be Analyzed

	Q44	Q45	Q46	Q49	Q53	Q58
Q44	19819.43					
Q45	11699.10	15702.20				
Q46	12047.31	11312.76	19499.50			
Q49	10666.72	8479.58	9359.79	17930.56		
Q53	6516.30	5323.82	5926.41	7103.18	14078.94	
Q58	9480.74	7304.26	8332.46	10006.38	6839.19	17408.09
Q59	10747.36	8782.97	9147.26	10986.17	7883.02	13052.61
PCAN1	11304.59	9143.53	10172.01	12579.69	7857.42	10785.17
Q60	7950.08	7186.58	6983.45	7626.86	4473.85	7128.80
Q62	7022.68	6770.81	6413.39	6898.28	4399.82	6320.46
Q63	6829.53	6302.50	5808.16	6178.67	3810.13	5777.44
Q64	6146.58	5756.10	5302.98	5846.43	3529.22	5559.70
Q65	7663.63	7370.99	6750.57	7249.57	4511.68	6616.46
Q66	7888.23	7182.31	6717.94	7784.02	4765.55	7393.81
Q75	4102.69	2968.27	2494.92	4738.12	3710.15	4574.41
Q76	4552.50	3898.45	2944.01	5022.56	3619.50	5380.20
ACMOT1	3443.86	2461.71	1997.02	4115.63	2855.38	4024.02
Q78	6150.03	6301.67	5388.33	6800.88	4197.85	6326.63
Q79	7281.40	6590.63	6179.32	7286.94	4779.44	6744.23
Q80	6318.03	5795.54	5364.84	6382.69	4190.66	5709.76
Q81	6250.06	5459.72	5062.48	6777.82	3932.69	5976.24

Covariance Matrix to be Analyzed

	Q59	PCAN1	Q60	Q62	Q63	Q64
	--------	--------	--------	--------	--------	--------
Q59	18159.79					
PCAN1	12162.11	17071.60				
Q60	8158.03	8160.08	14370.15			
Q62	7369.54	7363.70	8612.46	13152.60		
Q63	6781.24	6520.33	6784.60	7518.60	13034.88	
Q64	6835.61	6529.42	7386.68	9432.13	7798.38	14761.55
Q65	7555.29	7907.49	8768.42	8669.78	7118.68	8192.55
Q66	8688.37	8771.67	8176.61	7952.10	7001.50	7857.55
Q75	5500.08	5114.91	5411.05	5123.34	4581.09	4984.01
Q76	6018.97	5313.17	5878.77	5344.22	5120.24	5629.84
ACMOT1	4918.71	4279.37	4851.17	4630.99	4316.84	4657.61
Q78	7499.00	6892.58	7623.68	7495.29	6604.41	6984.34
Q79	8037.85	7595.66	8511.04	7696.39	6711.06	7346.93
Q80	7069.62	6537.46	7442.75	7601.07	6527.12	6930.64
Q81	6972.43	6569.39	7622.34	7156.34	6462.45	6987.99

Covariance Matrix to be Analyzed

	Q65	Q66	Q75	Q76	ACMOT1	Q78
	--------	--------	--------	--------	--------	--------
Q65	14372.81					
Q66	10085.88	14419.71				
Q75	4967.75	5326.62	13110.04			
Q76	5306.27	6182.46	9314.09	13312.54		
ACMOT1	4410.46	4962.63	8134.45	8043.47	10418.62	
Q78	7659.90	7735.35	5505.22	6971.93	5073.14	13280.65
Q79	7927.36	8211.92	6083.27	7149.37	5482.43	10140.97
Q80	7163.73	7316.83	5617.12	6572.65	5149.71	9908.79
Q81	7463.45	7280.94	5923.42	6714.12	5155.93	9703.18

Covariance Matrix to be Analyzed

	Q79	Q80	Q81
	--------	--------	--------
Q79	13791.47		
Q80	10381.58	12490.59	
Q81	9346.51	9482.55	14777.64

Parameter Specifications

ACH1 = 1.00*ach, Errorvar.= 1.19, R^2 = 0.29

ACH2 = 0.87*ach, Errorvar.= 1.24, R^2 = 0.23

ACH3 = 0.35*ach, Errorvar.= 0.40, R^2 = 0.13

ACH4 = 0.98*ach, Errorvar.= 1.58, R^2 = 0.23
Q5 = 2367.94*int, Errorvar.= -5592130.00, R^2 = 373.00

W_A_R_N_I_N_G : Error variance is negative.

Q6 = 0.24*int, Errorvar.= 15683.51, R^2 = 0.00

Q14 = 3.13*int, Errorvar.= 16496.19, R^2 = 0.00059

Q15 = 3.72*int, Errorvar.= 14095.79, R^2 = 0.00098

INTTOP6 = 2.39*int, Errorvar.= 13422.84, R^2 = 0.00043

Q18 = 4.29*stumot + 7.64*imp, Errorvar.= 18227.17, R^2 = 0.0042

Q19 = - 1844.62*stumot, Errorvar.= 3419153.68, R^2 = 0.50

Q20 = - 1.22*stumot, Errorvar.= 13657.61, R^2 = 0.00011

Q23 = 1282.77*imp, Errorvar.= -1629713.12, R^2 = 104.27

W_A_R_N_I_N_G : Error variance is negative.

Q24 = 2.14*imp, Errorvar.= 18554.06, R^2 = 0.00025
Q25 = 0.65*imp, Errorvar.= 14709.86, R^2 = 0.00

Q26 = 0.32*imp, Errorvar.= 9811.52, R^2 = 0.00

Q27 = - 0.37*imp, Errorvar.= 12245.33, R^2 = 0.00

Q28 = - 0.20*imp, Errorvar.= 12363.45, R^2 = 0.00

Q29 = 1.14*imp, Errorvar.= 15091.23, R^2 = 0.00

Q30 = 3085.20*enj, Errorvar.= -9503388.86, R^2 = 631.49

W_A_R_N_I_N_G : Error variance is negative.

Q31 = 2.11*enj, Errorvar.= 15104.88, R^2 = 0.00030

Q35 = 4.38*enj, Errorvar.= 16563.78, R^2 = 0.0012

Q37 = 0.95*enj, Errorvar.= 17123.52, R^2 = 0.00

Q43 = 4204.32*ptanx, Errorvar.= -17657167.15, R^2 = 922.13
W_A_R_N_I_N_G : Error variance is negative.

Q44 = 1.27*ptanx, Errorvar.= 19817.82, R^2 = 0.00

Q45 = 2.03*ptanx, Errorvar.= 15698.07, R^2 = 0.00026

Q46 = 3.70*ptanx, Errorvar.= 19485.83, R^2 = 0.00070

Q49 = 4100.20*pcanx, Errorvar.= -16793741.73, R^2 = 937.60

W_A_R_N_I_N_G : Error variance is negative.

Q53 = 0.87*pcanx, Errorvar.= 14078.18, R^2 = 0.00

Q58 = - 0.94*pcanx, Errorvar.= 17407.22, R^2 = 0.00

Q59 = 2.56*pcanx, Errorvar.= 18153.21, R^2 = 0.00036

PCAN1 = 1.04*pcanx, Errorvar.= 17070.51, R^2 = 0.00

Q60 = 3272.32*scon, Errorvar.= -10693699.25, R^2 = 745.16

W_A_R_N_I_N_G : Error variance is negative.

Q62 = 2.68*scon, Errorvar.= 13145.44, R^2 = 0.00054
Q63 = 2.38*scon, Errorvar.= 13029.19, R^2 = 0.00044

Q64 = 1.28*scon, Errorvar.= 14759.91, R^2 = 0.00011

Q65 = 3.28*scon, Errorvar.= 14362.06, R^2 = 0.00075

Q66 = 1.41*scon, Errorvar.= 14417.73, R^2 = 0.00014

Q75 = 2307.98*achmot, Errorvar.= -5313676.86, R^2 = 406.31

W_A_R_N_I_N_G : Error variance is negative.

Q76 = 4.31*achmot, Errorvar.= 13294.00, R^2 = 0.0014

ACMOT1 = 0.37*achmot, Errorvar.= 10418.48, R^2 = 0.00

Q78 = 3215.22*seff, Errorvar.= -10324333.95, R^2 = 778.40

W_A_R_N_I_N_G : Error variance is negative.
Q79 = 3.36*seff, Errorvar.= 13780.15, R^2 = 0.00082

Q80 = 1.29*seff, Errorvar.= 12488.91, R^2 = 0.00013

Q81 = - 0.46*seff, Errorvar.= 14777.42, R^2 = 0.00

ach = 0.25*int + 0.37*stumot + 0.23*imp + 0.31*enj + 0.30*ptanx + 0.31*pcanx + 0.36*scon + 0.26*achmot + 0.37*seff,

Errorvar.= -0.37, R^2 = 1.74

W_A_R_N_I_N_G : Error variance is negative.

Correlation Matrix of Independent Variables

	int	stumot	imp	enj	ptanx	pcanx
int	1.00					
stumot	0.00	1.00				
imp	0.00	0.00	1.00			
enj	0.00	0.00	0.00	1.00		
ptanx	0.00	0.00	0.00	0.00	1.00	
pcanx	0.00	0.00	0.00	0.00	0.00	1.00
scon	0.00	0.00	0.00	0.00	0.00	0.00
achmot	0.00	0.00	0.00	0.00	0.00	0.00
seff	0.00	0.00	0.00	0.00	0.00	0.00

Correlation Matrix of Independent Variables

	scon	achmot	seff
scon	1.00		
achmot	0.00	1.00	
seff	0.00	0.00	1.00

Covariance Matrix of Latent Variables

	ach	int	stumot	imp	enj	ptanx
	--------	--------	--------	--------	--------	--------
ach	0.50					
int	0.25	1.00				
stumot	0.36	0.00	1.00			
imp	0.23	0.00	0.00	1.00		
enj	0.31	0.00	0.00	0.00	1.00	
ptanx	0.30	0.00	0.00	0.00	0.00	1.00
pcanx	0.32	0.00	0.00	0.00	0.00	0.00
scon	0.36	0.00	0.00	0.00	0.00	0.00
achmot	0.26	0.00	0.00	0.00	0.00	0.00
seff	0.37	0.00	0.00	0.00	0.00	0.00

Covariance Matrix of Latent Variables

	pcanx	scon	achmot	seff
	--------	--------	--------	--------
pcanx	1.00			
scon	0.00	1.00		
achmot	0.00	0.00	1.00	
seff	0.00	0.00	0.00	1.00

Initial Estimates (TSLS)

ACH1 = 1.00*ach, Errorvar.= 1.19, R² = 0.29

ACH2 = 0.87*ach, Errorvar.= 1.24, R² = 0.23

ACH3 = 0.35*ach, Errorvar.= 0.40, R² = 0.13

ACH4 = 0.98*ach, Errorvar.= 1.58, R² = 0.23

Q5 = 2367.94*int, Errorvar.= -5592130.00, R² = 373.00

W_A_R_N_I_N_G : Error variance is negative.

Q6 = 0.24*int, Errorvar.= 15683.51, R² = 0.00

Q14 = 3.13*int, Errorvar.= 16496.19, R² = 0.00059

Q15 = 3.72*int, Errorvar.= 14095.79, R² = 0.00098

INTTOP6 = 2.39*int, Errorvar.= 13422.84, R^2 = 0.00043

Q18 = 4.29*stumot + 7.64*imp, Errorvar.= 18227.17, R^2 = 0.0042

Q19 = - 1844.62*stumot, Errorvar.= 3419153.68, R^2 = 0.50

Q20 = - 1.22*stumot, Errorvar.= 13657.61, R^2 = 0.00011

Q23 = 1282.77*imp, Errorvar.= -1629713.12, R^2 = 104.27
W_A_R_N_I_N_G : Error variance is negative.

Q24 = 2.14*imp, Errorvar.= 18554.06, R^2 = 0.00025

Q25 = 0.65*imp, Errorvar.= 14709.86, R^2 = 0.00

Q26 = 0.32*imp, Errorvar.= 9811.52, R^2 = 0.00

Q27 = - 0.37*imp, Errorvar.= 12245.33, R^2 = 0.00

Q28 = - 0.20*imp, Errorvar.= 12363.45, R^2 = 0.00

Q29 = 1.14*imp, Errorvar.= 15091.23, R^2 = 0.00

Q30 = 3085.20*enj, Errorvar.= -9503388.86, R^2 = 631.49

W_A_R_N_I_N_G : Error variance is negative.

Q31 = 2.11*enj, Errorvar.= 15104.88, R^2 = 0.00030

Q35 = 4.38*enj, Errorvar.= 16563.78, R^2 = 0.0012

Q37 = 0.95*enj, Errorvar.= 17123.52, R^2 = 0.00

Q43 = 4204.32*ptanx, Errorvar.= -17657167.15, R^2 = 922.13

W_A_R_N_I_N_G : Error variance is negative.

Q44 = 1.27*ptanx, Errorvar.= 19817.82, R^2 = 0.00

Q45 = 2.03*ptanx, Errorvar.= 15698.07, R^2 = 0.00026
Q46 = 3.70*ptanx, Errorvar.= 19485.83, R^2 = 0.00070

Q49 = 4100.20*pcanx, Errorvar.= -16793741.73, R^2 = 937.60

W_A_R_N_I_N_G : Error variance is negative.

Q53 = 0.87*pcanx, Errorvar.= 14078.18, R^2 = 0.00

Q58 = - 0.94*pcanx, Errorvar.= 17407.22, R^2 = 0.00

Q59 = 2.56*pcanx, Errorvar.= 18153.21, R^2 = 0.00036

PCAN1 = 1.04*pcanx, Errorvar.= 17070.51, R^2 = 0.00
Q60 = 3272.32*scon, Errorvar.= -10693699.25, R^2 = 745.16

W_A_R_N_I_N_G : Error variance is negative.

Q62 = 2.68*scon, Errorvar.= 13145.44, R^2 = 0.00054

Q63 = 2.38*scon, Errorvar.= 13029.19, R^2 = 0.00044

Q64 = 1.28*scon, Errorvar.= 14759.91, R^2 = 0.00011

Q65 = 3.28*scon, Errorvar.= 14362.06, R^2 = 0.00075

Q66 = 1.41*scon, Errorvar.= 14417.73, R^2 = 0.00014

Q75 = 2307.98*achmot, Errorvar.= -5313676.86, R^2 = 406.31

W_A_R_N_I_N_G : Error variance is negative.

Q76 = 4.31*achmot, Errorvar.= 13294.00, R^2 = 0.0014

ACMOT1 = 0.37*achmot, Errorvar.= 10418.48, R^2 = 0.00

Q78 = 3215.22*seff, Errorvar.= -10324333.95, R^2 = 778.40

W_A_R_N_I_N_G : Error variance is negative.

Q79 = 3.36*seff, Errorvar.= 13780.15, R^2 = 0.00082

Q80 = 1.29*seff, Errorvar.= 12488.91, R^2 = 0.00013

Q81 = - 0.46*seff, Errorvar.= 14777.42, R^2 = 0.00

ach = 0.25*int + 0.37*stumot + 0.23*imp + 0.31*enj + 0.30*ptanx + 0.31*pcanx + 0.36*scon + 0.26*achmot + 0.37*seff,

Errorvar.= -0.37, R^2 = 1.74

W_A_R_N_I_N_G : Error variance is negative.

Correlation Matrix of Independent Variables

	int	stumot	imp	enj	ptanx	pcanx
int	1.00					
stumot	0.00	1.00				
imp	0.00	0.00	1.00			
enj	0.00	0.00	0.00	1.00		
ptanx	0.00	0.00	0.00	0.00	1.00	
pcanx	0.00	0.00	0.00	0.00	0.00	1.00
scon	0.00	0.00	0.00	0.00	0.00	0.00
achmot	0.00	0.00	0.00	0.00	0.00	0.00
seff	0.00	0.00	0.00	0.00	0.00	0.00

Correlation Matrix of Independent Variables

	scon	achmot	seff
scon	1.00		
achmot	0.00	1.00	
seff	0.00	0.00	1.00

Covariance Matrix of Latent Variables

	ach	int	stumot	imp	enj	ptanx
ach	0.50					
int	0.25	1.00				
stumot	0.36	0.00	1.00			

imp	0.23	0.00	0.00	1.00		
enj	0.31	0.00	0.00	0.00	1.00	
ptanx	0.30	0.00	0.00	0.00	0.00	1.00
pcanx	0.32	0.00	0.00	0.00	0.00	0.00
scon	0.36	0.00	0.00	0.00	0.00	0.00
achmo	0.26	0.00	0.00	0.00	0.00	0.00
seff	0.37	0.00	0.00	0.00	0.00	0.00

Covariance Matrix of Latent Variables

	pcanx	scon	achmot	seff
pcanx	1.00			
scon	0.00	1.00		
achmot	0.00	0.00	1.00	
seff	0.00	0.00	0.00	1.00

Fitted Covariance Matrix

	ACH1	ACH2	ACH3	ACH4	Q5	Q6
ACH1	1.69					
ACH2	0.43	1.62				
ACH3	0.17	0.15	0.46			
ACH4	0.48	0.42	0.17	2.06		
Q5	587.71	511.95	206.36	574.51	15032.69	
Q6	0.06	0.05	0.02	0.06	571.83	15683.56
Q14	0.78	0.68	0.27	0.76	7405.74	0.76
Q15	0.92	0.81	0.32	0.90	8820.59	0.90
INTTOP6	0.59	0.52	0.21	0.58	5658.41	0.58
Q18	3.35	2.91	1.17	3.27	12.02	0.00
Q19	-670.67	-584.21	-235.49	-655.60	6236.75	0.64
Q20	-0.44	-0.39	-0.16	-0.43	4.13	0.00
Q23	299.47	260.87	105.15	292.74	4451.50	0.45
Q24	0.50	0.44	0.18	0.49	7.42	0.00
Q25	0.15	0.13	0.05	0.15	2.26	0.00
Q26	0.08	0.07	0.03	0.07	1.12	0.00
Q27	-0.09	-0.08	-0.03	-0.09	-1.30	0.00
Q28	-0.05	-0.04	-0.02	-0.04	-0.68	0.00
Q29	0.27	0.23	0.09	0.26	3.97	0.00
Q30	954.77	831.69	335.24	933.31	3700.09	0.38
Q31	0.65	0.57	0.23	0.64	2.53	0.00
Q35	1.36	1.18	0.48	1.33	5.26	0.00

Q37	0.29	0.26	0.10	0.29	1.14	0.00
Q43	1260.55	1098.05	442.61	1232.22	5678.23	0.58
Q44	0.38	0.33	0.13	0.37	1.71	0.00
Q45	0.61	0.53	0.21	0.60	2.75	0.00
Q46	1.11	0.97	0.39	1.08	4.99	0.00
Q49	1293.95	1127.14	454.34	1264.87	5982.54	0.61
Q53	0.28	0.24	0.10	0.27	1.27	0.00
Q58	-0.30	-0.26	-0.10	-0.29	-1.36	0.00
Q59	0.81	0.71	0.28	0.79	3.74	0.00
PCAN1	0.33	0.29	0.12	0.32	1.52	0.00
Q60	1176.03	1024.43	412.94	1149.60	4564.23	0.47
Q62	0.96	0.84	0.34	0.94	3.73	0.00
Q63	0.86	0.75	0.30	0.84	3.33	0.00
Q64	0.46	0.40	0.16	0.45	1.79	0.00
Q65	1.18	1.03	0.41	1.15	4.57	0.00
Q66	0.51	0.44	0.18	0.49	1.96	0.00
Q75	600.13	522.76	210.72	586.64	3242.14	0.33
Q76	1.12	0.98	0.39	1.09	6.05	0.00
ACMOT1	0.10	0.08	0.03	0.09	0.51	0.00
Q78	1178.65	1026.71	413.85	1152.16	4500.17	0.46
Q79	1.23	1.07	0.43	1.21	4.71	0.00
Q80	0.47	0.41	0.17	0.46	1.81	0.00
Q81	-0.17	-0.15	-0.06	-0.17	-0.65	0.00

Fitted Covariance Matrix

	Q14	Q15	INTTOP6	Q18	Q19	Q20
	--------	--------	--------	--------	--------	--------
Q14	16505.97					
Q15	11.65	14109.67				
INTTOP6	7.47	8.90	13428.55			
Q18	0.02	0.02	0.01	18303.86		
Q19	8.24	9.81	6.29	-7879.11	6821765.57	
Q20	0.01	0.01	0.00	-5.22	2253.31	13659.10
Q23	5.88	7.00	4.49	9792.14	6257.67	4.14
Q24	0.01	0.01	0.01	16.33	10.43	0.01
Q25	0.00	0.00	0.00	4.97	3.17	0.00
Q26	0.00	0.00	0.00	2.47	1.58	0.00
Q27	0.00	0.00	0.00	-2.86	-1.83	0.00
Q28	0.00	0.00	0.00	-1.50	-0.96	0.00
Q29	0.01	0.01	0.00	8.73	5.58	0.00
Q30	4.89	5.82	3.73	14.78	6168.37	4.08
Q31	0.00	0.00	0.00	0.01	4.23	0.00

Q35	0.01	0.01	0.01	0.02	8.77	0.01
Q37	0.00	0.00	0.00	0.00	1.90	0.00
Q43	7.50	8.93	5.73	11.34	7287.27	4.83
Q44	0.00	0.00	0.00	0.00	2.20	0.00
Q45	0.00	0.00	0.00	0.01	3.52	0.00
Q46	0.01	0.01	0.01	0.01	6.41	0.00
Q49	7.90	9.41	6.04	11.98	6697.20	4.44
Q53	0.00	0.00	0.00	0.00	1.43	0.00
Q58	0.00	0.00	0.00	0.00	-1.53	0.00
Q59	0.00	0.01	0.00	0.01	4.19	0.00
PCAN1	0.00	0.00	0.00	0.00	1.70	0.00
Q60	6.03	7.18	4.61	9.62	6164.48	4.08
Q62	0.00	0.01	0.00	0.01	5.04	0.00
Q63	0.00	0.01	0.00	0.01	4.49	0.00
Q64	0.00	0.00	0.00	0.00	2.41	0.00
Q65	0.01	0.01	0.00	0.01	6.18	0.00
Q66	0.00	0.00	0.00	0.00	2.65	0.00
Q75	4.28	5.10	3.27	8.51	5670.73	3.76
Q76	0.01	0.01	0.01	0.02	10.58	0.01
ACMOT1	0.00	0.00	0.00	0.00	0.90	0.00
Q78	5.94	7.08	4.54	12.19	6664.35	4.41
Q79	0.01	0.01	0.00	0.01	6.97	0.00
Q80	0.00	0.00	0.00	0.00	2.68	0.00
Q81	0.00	0.00	0.00	0.00	-0.96	0.00

Fitted Covariance Matrix

	Q23	Q24	Q25	Q26	Q27	Q28
	--------	--------	--------	--------	--------	--------
Q23	15780.74					
Q24	2743.92	18558.63				
Q25	834.65	1.39	14710.28			
Q26	415.20	0.69	0.21	9811.62		
Q27	-480.89	-0.80	-0.24	-0.12	12245.47	
Q28	-251.52	-0.42	-0.13	-0.06	0.07	12363.49
Q29	1466.81	2.45	0.74	0.37	-0.43	-0.22
Q30	4888.34	8.15	2.48	1.23	-1.43	-0.75
Q31	3.35	0.01	0.00	0.00	0.00	0.00
Q35	6.95	0.01	0.00	0.00	0.00	0.00
Q37	1.51	0.00	0.00	0.00	0.00	0.00
Q43	4747.25	7.92	2.41	1.20	-1.39	-0.73
Q44	1.43	0.00	0.00	0.00	0.00	0.00
Q45	2.30	0.00	0.00	0.00	0.00	0.00

Q46	4.17	0.01	0.00	0.00	0.00	0.00
Q49	4624.86	7.71	2.35	1.17	-1.35	-0.71
Q53	0.98	0.00	0.00	0.00	0.00	0.00
Q58	-1.05	0.00	0.00	0.00	0.00	0.00
Q59	2.89	0.00	0.00	0.00	0.00	0.00
PCAN1	1.18	0.00	0.00	0.00	0.00	0.00
Q60	4020.56	6.70	2.04	1.01	-1.17	-0.61
Q62	3.29	0.01	0.00	0.00	0.00	0.00
Q63	2.93	0.00	0.00	0.00	0.00	0.00
Q64	1.57	0.00	0.00	0.00	0.00	0.00
Q65	4.03	0.01	0.00	0.00	0.00	0.00
Q66	1.73	0.00	0.00	0.00	0.00	0.00
Q75	3642.48	6.07	1.85	0.92	-1.06	-0.56
Q76	6.79	0.01	0.00	0.00	0.00	0.00
ACMOT1	0.58	0.00	0.00	0.00	0.00	0.00
Q78	4647.22	7.75	2.36	1.17	-1.36	-0.71
Q79	4.86	0.01	0.00	0.00	0.00	0.00
Q80	1.87	0.00	0.00	0.00	0.00	0.00
Q81	-0.67	0.00	0.00	0.00	0.00	0.00

Fitted Covariance Matrix

	Q29	Q30	Q31	Q35	Q37	Q43
Q29	15092.54					
Q30	4.36	15073.05				
Q31	0.00	6519.96	15109.35			
Q35	0.01	13525.76	9.26	16583.00		
Q37	0.00	2937.34	2.01	4.17	17124.42	
Q43	4.23	5034.23	3.45	7.15	1.55	19169.01
Q44	0.00	1.52	0.00	0.00	0.00	5327.23
Q45	0.00	2.43	0.00	0.00	0.00	8546.23
Q46	0.00	4.43	0.00	0.01	0.00	15544.81
Q49	4.12	5179.03	3.55	7.36	1.60	11341.34
Q53	0.00	1.10	0.00	0.00	0.00	2.42
Q58	0.00	-1.18	0.00	0.00	0.00	-2.59
Q59	0.00	3.24	0.00	0.00	0.00	7.09
PCAN1	0.00	1.32	0.00	0.00	0.00	2.89
Q60	3.58	5075.10	3.48	7.21	1.57	8137.19
Q62	0.00	4.15	0.00	0.01	0.00	6.65
Q63	0.00	3.70	0.00	0.01	0.00	5.93
Q64	0.00	1.99	0.00	0.00	0.00	3.18
Q65	0.00	5.09	0.00	0.01	0.00	8.15

Q66	0.00	2.18	0.00	0.00	0.00	3.50
Q75	3.25	4285.40	2.94	6.09	1.32	4390.57
Q76	0.01	7.99	0.01	0.01	0.00	8.19
ACMOT1	0.00	0.68	0.00	0.00	0.00	0.70
Q78	4.14	5510.55	3.77	7.83	1.70	6541.67
Q79	0.00	5.77	0.00	0.01	0.00	6.84
Q80	0.00	2.22	0.00	0.00	0.00	2.63
Q81	0.00	-0.79	0.00	0.00	0.00	-0.94

Fitted Covariance Matrix

	Q44	Q45	Q46	Q49	Q53	Q58
Q44	19819.43					
Q45	2.58	15702.20				
Q46	4.68	7.52	19499.50			
Q49	3.42	5.48	9.97	17930.56		
Q53	0.00	0.00	0.00	3580.04	14078.94	
Q58	0.00	0.00	0.00	-3834.78	-0.82	17408.09
Q59	0.00	0.00	0.01	10515.87	2.24	-2.40
PCAN1	0.00	0.00	0.00	4276.66	0.91	-0.98
Q60	2.45	3.93	7.16	7656.39	1.63	-1.75
Q62	0.00	0.00	0.01	6.26	0.00	0.00
Q63	0.00	0.00	0.01	5.58	0.00	0.00
Q64	0.00	0.00	0.00	3.00	0.00	0.00
Q65	0.00	0.00	0.01	7.67	0.00	0.00
Q66	0.00	0.00	0.00	3.29	0.00	0.00
Q75	1.32	2.12	3.86	4752.62	1.01	-1.08
Q76	0.00	0.00	0.01	8.87	0.00	0.00
ACMOT1	0.00	0.00	0.00	0.75	0.00	0.00
Q78	1.97	3.16	5.75	6815.98	1.45	-1.55
Q79	0.00	0.00	0.01	7.13	0.00	0.00
Q80	0.00	0.00	0.00	2.74	0.00	0.00
Q81	0.00	0.00	0.00	-0.98	0.00	0.00

Fitted Covariance Matrix

	Q59	PCAN1	Q60	Q62	Q63	Q64
Q59	18159.79					
PCAN1	2.68	17071.60				
Q60	4.79	1.95	14370.15			
Q62	0.00	0.00	8753.48	13152.60		

Q63	0.00	0.00	7803.10	6.38	13034.88	
Q64	0.00	0.00	4188.89	3.42	3.05	14761.55
Q65	0.00	0.00	10730.19	8.77	7.82	4.20
Q66	0.00	0.00	4599.52	3.76	3.35	1.80
Q75	2.97	1.21	5439.53	4.45	3.96	2.13
Q76	0.01	0.00	10.15	0.01	0.01	0.00
ACMOT1	0.00	0.00	0.86	0.00	0.00	0.00
Q78	4.26	1.73	7659.16	6.26	5.58	3.00
Q79	0.00	0.00	8.01	0.01	0.01	0.00
Q80	0.00	0.00	3.08	0.00	0.00	0.00
Q81	0.00	0.00	-1.10	0.00	0.00	0.00

Fitted Covariance Matrix

	Q65	Q66	Q75	Q76	ACMOT1	Q78
	--------	--------	--------	--------	--------	--------
Q65	14372.81					
Q66	4.61	14419.71				
Q75	5.45	2.34	13110.04			
Q76	0.01	0.00	9936.03	13312.54		
ACMOT1	0.00	0.00	846.13	1.58	10418.62	
Q78	7.67	3.29	5526.79	10.31	0.88	13280.65
Q79	0.01	0.00	5.78	0.01	0.00	10815.87
Q80	0.00	0.00	2.23	0.00	0.00	4161.98
Q81	0.00	0.00	-0.80	0.00	0.00	-1487.28

Fitted Covariance Matrix

	Q79	Q80	Q81
	--------	--------	--------
Q79	13791.47		
Q80	4.35	12490.59	
Q81	-1.56	-0.60	14777.64

F_A_T_A_L E_R_R_O_R: Unable to start iterations because Fitted

Covariance Matrix is not positive definite.

Please provide better Starting Values.

APPENDIX J

SYNTAXES OF THE SECOND HYPOTESIZED MODEL

Syntax of the Beginning Form of the Second Hypothesized Model

```
Observed Variables
Q5 Q6 Q14 Q15 INTTOP6 Q18 Q19 Q20 SM2122 Q23
Q24 Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32
Q33 Q35 Q36 Q37 Q38 Q43 Q44 Q45 Q46
PTAN2 Q49 Q53 Q56 Q58 Q59 PCAN1 Q60 Q61
Q62 Q63 Q64 Q65 Q66 Q75 Q76 ACMOT1 Q77
Q78 Q79 Q80 Q81 ACH1 ACH2 ACH3 ACH4
Raw Data From File
C:\DOCUME~1\OZLEMT~1\DESKTOP\TEZDEN~1\TEZDEN.TXT
Sample Size = 1366
Latent Variables  int stumot imp enj ptanx pcanx scon achmot seff ach
Relationships
Q5 Q6 Q14 Q15 INTTOP6 = int
Q18 Q19 Q20 = stumot
Q18 Q23 Q24 Q25 Q26 Q27 Q28 Q29 = imp
Q30 Q31 Q35 Q37 = enj
Q43 Q44 Q45 Q46 = ptanx
Q49 Q53 Q58 Q59 PCAN1 = pcanx
Q60 Q62 Q63 Q64 Q65 Q66 = scon
Q75 Q76 ACMOT1 = achmot
Q78 Q79 Q80 Q81 = seff
ACH1 ACH2 ACH3 ACH4 = ach
int stumot imp enj ptanx pcanx scon achmot seff = ach
Path Diagram
Iterations = 250
Method of Estimation: Maximum Likelihood
End of Problem
```

Syntax of the Final Form of the Second Hypothesized Model

```
Observed Variables
Q5 Q6 Q14 Q15 INTTOP6 Q18 Q19 Q20 SM2122 Q23
Q24 Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32
Q33 Q35 Q36 Q37 Q38 Q43 Q44 Q45 Q46
PTAN2 Q49 Q53 Q56 Q58 Q59 PCAN1 Q60 Q61
Q62 Q63 Q64 Q65 Q66 Q75 Q76 ACMOT1 Q77
Q78 Q79 Q80 Q81 ACH1 ACH2 ACH3 ACH4
Raw Data From File
C:\DOCUME~1\OZLEMT~1\DESKTOP\TEZDEN~1\TEZDEN.TXT
Sample Size = 1366
Latent Variables  int stumot imp enj ptanx pcanx scon achmot seff ach
Relationships
Q5 Q6 Q14 Q15 INTTOP6 = int
Q18 Q19 Q20 = stumot
Q18 Q23 Q25 Q26 Q27 Q28 Q29 = imp
Q30 Q31 Q35 Q37 = enj
Q43 Q44 Q45 Q46 = ptanx
Q49 Q53 Q58 Q59 PCAN1 = pcanx
Q60 Q62 Q63 Q64 Q65 Q66 = scon
Q75 Q76 ACMOT1 = achmot
Q78 Q79 Q80 Q81 = seff
ACH1 ACH2 ACH3 ACH4 = ach
int stumot imp enj ptanx pcanx scon achmot seff = ach
pcanx = ptanx
seff = scon
scon = ptanx
scon seff = achmot
int = pcanx
pcanx = achmot
imp = stumot
int = stumot
Path Diagram
Iterations = 250
Method of Estimation: Maximum Likelihood
End of Problem
```

APPENDIX K

THE BASIC FINAL MODEL WITH ESTIMATES

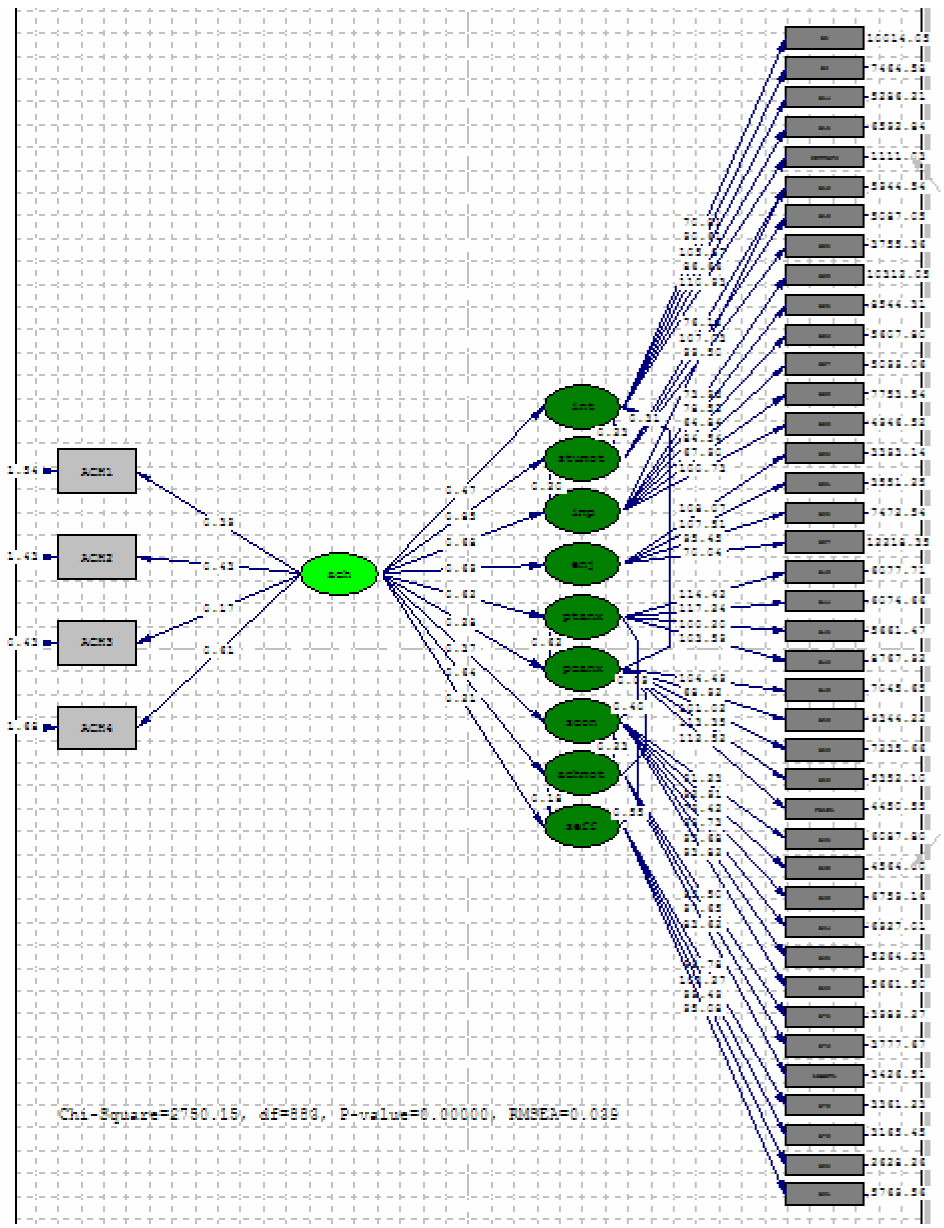

Figure K.1 The Basic Final Model With Estimates

APPENDIX L

THE BASIC MODEL OF THE FINAL MODEL WITH T-VALUES

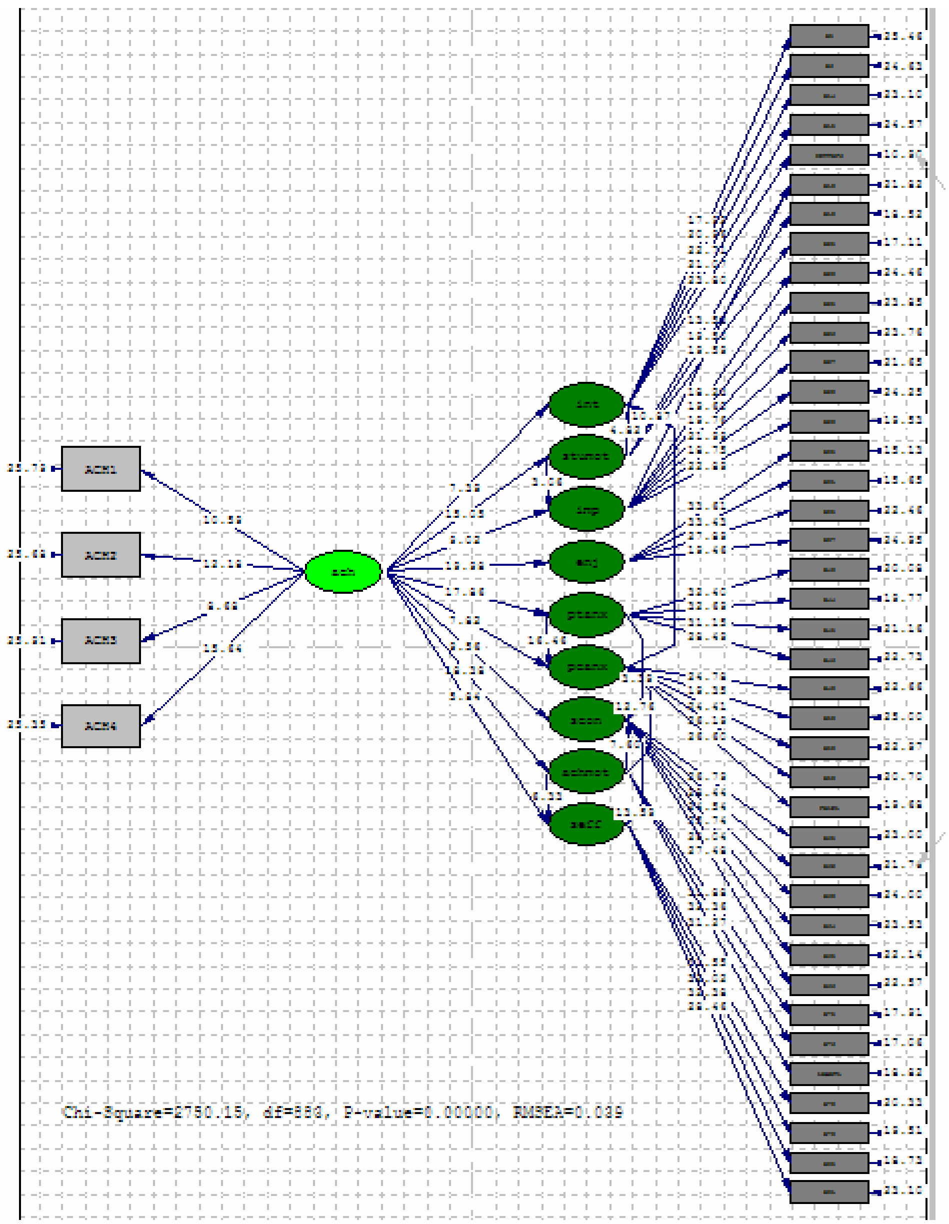

Figure L.1 The Basic Final Model With T-Values