IDENTIFYING FACTORS THAT FACILITATE THE USE OF MULTI-PURPOSE SMART CARDS BY UNIVERSITY STUDENTS: AN EMPIRICAL INVESTIGATION

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Approval of the Graduate School of Informatics

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ABSTRACT

IDENTIFYING FACTORS THAT FACILITATE THE USE OF MULTI-PURPOSE SMART CARDS BY UNIVERSITY STUDENTS: AN EMPIRICAL INVESTIGATION

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The aim of this thesis is to identify factors that affect the university students' acceptance of multi-purpose Smart Cards. The findings of this study will be beneficial to facilitate the use of Smart-Card enabled system both n universities and in other institutions which either have these systems in use or plan to invest on these systems in the future. The research methodology employed within this

study is based on quantitative methods. A survey instrument comprising 51 5-point Likert-type questions has been developed and applied to 207 university Middle East Technical University students.

The data collected has been analyzed using Exploratory Factor Analysis to categorize factors having items. According to analysis results, the data classified under 5 factors; Perceived Usefulness, Perceived Ease of Use, Behavioral Intention, Anxiety, and Technological Complexity. Then, the relations between these 5 factors identified and a measurement model was created. For assessing the proposed model Discriminant and Convergent Validity scores were calculated by Confirmatory Factor Analysis. Then, Structural Equation Modeling was conducted with Partial Least Squares for validating the model's estimated influence. The study has shown that the main Technology Acceptance Model constructs fit for determining the university students' intention of Smart Card usage except for Perceived Ease of Use over Behavioral Intention. Moreover, study showed that Anxiety and Technological Complexity were the external factors that have effect on willingness of using multi-purpose Smart Cards. If students have Anxiety, this affects their perception of easiness of the system and it has negative indirect effect on the perceived usefulness and direct effect on intention. Technological Complexity is another factor which has direct affect on the perception of easiness and usefulness and intention.

Keywords: *Technology Acceptance Model, Smart Card, Structural Equation Modeling, Partial Least Square.*

ÖZ

ÜNİVERSİTE ÖĞRENCİLERİNİN ÇOK AMAÇLI AKILLI KART KULLANIMLARINI ETKİLEYEN FAKTORLERİN BELİRLENMESİ: GÖZLEMSEL BİR ARAŞTIRMA

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Yüksek Lisans, Bilişim Sistemleri Bölümü

Tez Yöneticisi: Yard. Doç. Dr. Sevgi ÖZKAN

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Bu tez çalışmasının temel amacı üniversite öğrencilerinin çok amaçlı Akıllı Kartlara kaşı algılarını etkileyen faktörleri ortaya çıkarmaktır. Çalışmanın sonuçları hâlihazırda Akıllı Kart kullanılmakta olan veya Akıllı Kart sistemine yatırım yapmayı planlayan organizasyonlara (sadece üniversite olmamakla birlikte) yardımcı olmaktır. Bu çalışma nicel araştırma yöntemine göre yapılmıştır. Bu nedenle 5'li derecelendirme ölçütüne sahip 51 sorudan oluşan bir anket hazırlanmış ve toplamda

207 Orta Doğu Teknik Üniversitesi öğrencisine uygulanmıştır. Toplanan veriye, hangi maddenin hangi faktör altında yer aldığını belirlemek için Açımlayıcı Faktör Analizi uygulanmıştır. Analiz sonuçlarına göre sonuçlar 5 farklı faktör altında toplanmıştır. Bunlar Algılanan Kullanım Kolaylığı, Algılanan Fayda, Niyet, Kaygı ve Teknolojik Karmaşıklıktır. Sonrasında, faktörler arasındaki ilişki belirlenerek bir ölçme modeli oluşturulmuştur. Oluşturulan ölçme modelini doğrulamak için yakınsak ve ayırt edici geçerlikler Doğrulayıcı Faktör Analizi yoluyla doğrulanmıştır. Ön analizler yapıldıktan sonra, Yapısal Eşitlik Modeli, En Küçük Parsiyel Kare ile uygulanarak oluşturulan modelin etki değeri hesaplanmıştır. Bu çalışmanın sonuçlarına göre Teknoloji Kabullenme Modeli öğeleri üniversite öğrencilerinin Akıllı Kart kullanımına karşı davranışsal niyetlerini belirlemek için Algılanan Kullanım Kolaylığı dışında tamamen uygundur. Ayrıca çalışma sonuçları göstermiştir ki; Kaygı ve Teknolojik Karmaşıklık çok amaçlı Akıllı Kart uygulamalarının kullanımında istek yönünden etkilidir. Eğer öğrenciler sistem ile ilgili Kaygı sahibi iseler bu onlar açısından sistemin kullanım kolaylığı ve algılanan faydasını negatif olarak etkilemektedir. Teknolojik Karmaşıklık ise Algılanan Kullanım Kolaylığı, Algılanan Fayda ve Niyeti direkt olarak etkilemektedir.

Anahtar Kelimeler: *En Küçük Parsiyel Kare, Teknoloji Kabullenme Modeli, Akıllı Kart, Yapısal Eşitlik Modeli*

To my beautiful fiancée Gülşen TAŞDELEN…

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LIST OF ABBREVIATIONS

ANX	Anxiety
BI	Behavioral Intention
CFA	Confirmatory factor analysis
EFA	Exploratory Factor Analysis
IS	Information System
IT	Information Technology
METU	Middle East Technical University
PEOU	Perceived Ease of Use
PLS-PM	Partial Least Square-Path Modeling
PU	Perceived Usefulness
SEC	Security
SEM	Structural Equation Modeling
SI	Social Influence
TAM	Technology Acceptance Model
TC	Technological Complexity
TRA	Theory of Reasoned Action

CHAPTER I

INTRODUCTION

The first chapter includes introduction for the study, background of the problem. Moreover, objective and scope of the study are given in detailed. Furthermore, research questions that the study deals with are presented and significance of the study is presented.

1.1. INTRODUCTION

Smart card is an ordinary plastic card having a memory chip and processor embedded in it, like a credit card, which people use in all part of their life. The inside chip is security enabled and holds necessary data about its owner. This stored data could be information (about owner), value or both of them. Chip stores this data, and in necessary conditions, it processes and stores modified/updated data again to a memory or microprocessor. Even though it includes very basic processor, it can run encryption algorithms, handle files, execute calculations and store related data regarding to these operations.

Smart Card technology is evolving very fast and application areas are broadening with technology growth. As a result of advancement in the smart card technology, smart cards are going to replace cash, medical records, credit cards, ID cards etc… All these are results of the increased memory capacity in the microchips and better security using encryption (Al-Alawi, Al-Almer, 2006)

Smart Cards are portable and provide maximum security for its owners. With the help of the smart card, executing applications that require reliability is very easy and much more portable. Moreover it provides much more security when the magnetic strip cards are taken into consideration. Even the security issue makes Smart Card important in worldwide, there are several factors which make it beneficial such as the portability, intelligence, and its compatibility with other devices.

Smart Cards have a very broad usage area in the worldwide concept. Education, health, government, telecommunication and many other industries either has this kind of technology or planning to apply this kind of application. Smart Cards improve the quality of services and increase the security during any kind of transaction in these industries.

When considered the education side (especially for the universities), Smart Card usage is increasing day by day. A university student can use the university ID card (identification card) for accessing to the any kind of facilities such library usage, purchasing meal at the cafeteria, using vending machines, opening security enabled doors. There are some applications that even require Smart Cards to connect to the university local network or internet. Multi-purpose usage of Smart Cards can reduce the necessary costs and human effort, enhancing the user satisfaction.

This kind of a new technology (or innovation) in universities depends on acceptance rate that is whether students accept it or not. Developing such an advanced technology does not mean that students will accept in their first usage and make this to an acceptance (or adoption).

1.2. BACKGROUND OF THE PROBLEM

When looked at in a random person's wallet, there can be many cards such as driving license, identity card, library card, transportation card, insurance cards, etc... All these cards or documents can be changed with one or two smart cards because Smart

Cards could store and secure much more data compared to the non-smart or paper based cards and as a result, Smart Cards are replacing our wallets' content day by day (Fancher, 1997).

Smart Cards put the security issue one step further by providing much more enhanced security measures. Banks have started to use one card instead of several cards such as credit card, and ATM card, debit card. Moreover, some countries are already using electronic purses and multipurpose smartcard applications. These cards are also used as national ID cards such as in Malasia (Loo et all.., 2009). In university case, for example in Turkey majority of universities are using Smart Cards as their students' and also as staff's identity cards. For instance, there could be some rooms that only authorized people can enter; using special keys makes users' life painful for each door. There could be a hierarchy that one may be able to open two doors but cannot open another door. In this hierarchy, when considered the necessary keys for doors, Smart Cards can save life. Just the authorized Smart Card is enough for creating the mechanism inside the building. Furthermore, the tracking of the open-close logs could be possible by the help of the Smart Cards; whereas in traditional method it cannot be done. Maximum security, portability, and traceability can be achieved by Smart Cards.

The technology behind the smart card is very sophisticated and important but for the end user this technology is not meaningful. If the users do not use this enhanced technology, how much it is sophisticated will not be important. Educating and supporting the users is more important for technology usage. The users should know what their cards could achieve and be aware of their advantages, features, and characteristics. Different technology implementations face with different user behaviors, so the users should be aware of application and usage of their cards.

Researchers are wondering why people accept information technology and are trying to design, evaluate, and predict how users are going to react to new technology with better models (Dillon&Morris, 1996). Technology Acceptance Model (TAM) is one of the most widely used technology acceptance models that is used to explore users'

intention towards technology in many different areas such as e-learning, e-government, health etc. This study proposes an extended technology adoption model using TAM as the base and adding two external factors; Anxiety and Technological Complexity.

1.3. OBJECTIVES OF THE STUDY

The aim of this research is;

1. to investigate university students' perceptions of Smart Cards,
2. to develop an adoption model extending TAM by adding factors related to the context of Smart Cards.
3. to explore the effects of personal differences on university students' intention of Smart Cards usage.

1.4. SCOPE OF THE STUDY

The aim of this study is to create a model for investigating university students' user acceptance of Smart Cards so, for this purpose questionnaire was distributed. This study just focuses on the factors which are included in the proposed model to investigate the user acceptance among the university students. The total number of people participated in this research is 207 and all of them were user of the Smart-Card system of Middle East Technical University (METU).

1.5. RESEARCH QUESTIONS

This study is guided by these research questions:

- What are the factors affecting the university students' behavioral intention towards using multi-purpose Smart Cards?

- What are the connections between the factors which affect the university students' intention towards using multi-purpose Smart Cards?

1.6. SIGNIFICANCE OF THE STUDY

Nowadays, in most of the countries every citizen including university students is carrying multiple cards inside their wallet. Some of these cards are identification card, automatic teller machine (ATM) card, credit cards etc. Maybe people are not aware but the cards became a very important part of their lives without notice.

With the development of enhanced Smart Card technologies, every year, more and more universities are starting to implement Smart Cards as their students' identification cards. However, in order to make effective use of Smart Cards in universities, students' adoption behaviors should be investigated. Technology Acceptance Model is one of the widely used theoretical methods used by Information Systems (IS) researchers to explore the intentions of end users' about the actual system use.

Results found by this research could be used by every institution (could be different than university as well) planning to implement multi-purpose Smart Cards. Moreover findings also could help policy makers controlling the Smart Card implementation. The literature review shows that there is no existing research investigating multi-purpose Smart Card acceptance among the university students. As a result, this research will have beneficial to the literature as new knowledge in this field. This study intends to present essential information which will be a base for the future studies about the information technology acceptance especially acceptance of multi-purpose Smart Cards.

CHAPTER II

LITERATURE REVIEW

2.1. SMART CARD USAGE

Nowadays, technology is developing in an unforeseen pace and every day is coming with a change in our life. Smart card is one of these changes that penetrated our lives a long time ago and being used in everywhere around us. Our wallets include a number of credit cards, automatic teller machine (ATM) cards, plastic transportation cards, etc. (Rankl & Effing, 2003). This section will give detailed information about the smart card technology and its sub categories.

2.1.1. Definitions and key concepts of smart cards

Smart card is a tool including an integrated circuit inside it and this circuit could be security enabled micro controlling unit or a memory chip only. (Leng, 2009) They look like credit cards (just as the same size) and they are made of plastic. (Rankl & Effing, 2003)

Smart cards have capability of communicating with the computerized system they are used and they can provide and record information about the user when it is need. For instance, we can use them to authorize a payment without a visible connection between the user and the system. (Mcelroy & Turban, 1998)

Today, universities in Turkey also started to maintain students' identity and account inside these cards. Inside campus, students can take books from library, pay their library debt, purchase meal from cafeteria, and enter computer laboratories (that require authentication) with their smart card. In Figure 1 you can see a sample smart card that belongs to Middle East Technical University.

Figure 1 - Sample University Smart Card

As it is shown in Figure 1, smart card is the same with the university identification cards used before. They have the same size and shape and have identity information about the students. However, the difference is the abilities that the card has. With the help of this card, students can take advantage of lots of facilities inside the campus, that otherwise require other means of authentication. A credit card an be associated with this card and students can pay several fares inside the campus such as library debt or swimming pool fee. With technological advances in card technology university identity cards became more powerful. While before they were just using identity assess, now they can both store and process data as well. (Mcelroy & Turban, 1998)

2.1.2. Types of smart cards

Smart card technology has been developed very much since the idea of using plastic cards. (Ferrer, Posegga, Sebe´ & Torra, 2007) In 1968 two German scientists Helmut Grötrupp and Jürgen Dethloff decided to use plastic cards for implementing micro

chips inside them and took the patent of this idea and this became the first smart-card related research in this field. Today, smart cards are used in all parts of our life such as building access systems to electronic payment systems, in access methods for satellite TV, and electronic signature applications, and while using the public transportation applications (Husemann, 1999). So far, smart card technology has been developed substantially and has adapted different technologies, diverting smart cards for different applications.

According to the research done by Leng; we can classify the smart cards in two categories according to communication style with the reader as “contact smart cards” and “contactless smart cards”. Smart cards have gold-plated points for contact on the surface. With the help of these connection points card readers can read and write data to the card. (Leng, 2009) However contactless smart card is different from contact smart cards in a detailed way. Contactless smart card has RF point that allows it to easily communicate with the reading machine in a short range. (Smart Card Alliance, 2003) .In Figure 2 you can see a contactless smart card example figure.

Figure 2 - Contactless Smart Card, Source: Finkenzel (2003)

2.1.3. Usage areas of smart cards

The smartcard’s capability of storing and manipulating information makes it available in lots of applications, which is the main issue for industrial expansion. In

his research, Farell presents the smart card technology as an international technology and describes it as an electronic card having a micro computer in it. (Farell, 1999) Smart card can be used as license card, ATM card, citizenship card, health information card, transportation card, and as passport. Today governments are also trying to apply this concept to the citizen cards to make citizens connect to the services directly such as applications including taxes declaration and payment, registration to social services, etc... (Reillo, et all, 2009) Especially in Turkey, there are pilot studies conducted about this issue.

The main domains that make use of smart cards very efficiently are (Hendry, 2001)

- Telecommunication
- Banking
- Health care systems
- Identification
- Transportation
- Access control

Also new kind of services such as authentication and loyalty applications are other types of applications that have smart card usage. Moreover, as e-services become popular, smart card usage is increasing in these services such as E-commerce, remote banking because of the security enhancements that smart cards provide. (Sauveron, 2009)

One another important usage area of smart card is health care system. In health care systems, smart cards can contain all of the information about the patient from the identity information, to the emergency data (such as allergic data, blood values), treatment history, medicines given. This makes the card an electronic medical recorder for patients. (Aubert, et all, 2001) With the help of the card reader, users can access all the medical data concerning the patient and this makes long paper-based work unnecessary.

In a university, multi-application smart cards can control physical entrance systems to buildings and computer laboratories, make possible storing and processing

administrative data, and also can be used as a means of financial transactions (paying at cafeteria, paying easily at vending machines, paying deposits for services).(Kassie, 2002-Master thesis published)

2.1.4. Security issues of smart cards

Systems having embedded contactless smart cards have several security characteristics that guarantee the stability, secrecy and confidentiality of information recorded or sent. They include (Smart Card Alliance, 2003) these properties:

- Mutual authentication.
- Strong information security.
- Strong contactless device security
- Authenticated and authorized information control.
- Powerful assistance for information confidentiality.

The microcontrollers inside smart cards are designed especially for limiting the access to the data inside it and have very strong crypto technique to prevent unauthorized access. According to the security level of information on the smart card, system security can be built on a personal identification number, biometrics that are unique information between the smart card and card reader, a well designed safe data encryption method like Data Encryption Standard (DES), or a well secured public key method. (Farrell, 1996)

2.2. END-USERS INTENTIONS TOWARDS SMART CARDS

2.2.1. General Theories to investigate end-users behavioral intentions toward usage of technology

2.2.1.1. Theory of Reasoned Action (TRA)

This theory is mainly coming from social physcology. In 1980, Ajzen and Fishbein worked on a sophisticated behavioral model called Theory of Reasoned Action

(TRA). It is used for determining the agents about the planned behaviors (Fishbein & Ajzen, 1975) and up to now in related literature, TRA is used by the studies, as the base for attitude and behavior relation.

Ajzen and Fishbein's model tries to define relationship between beliefs, attitudes, norms and behavioral intention (Sarver, 1983). The relationship that the theory deals with can be seen in Figure 3.

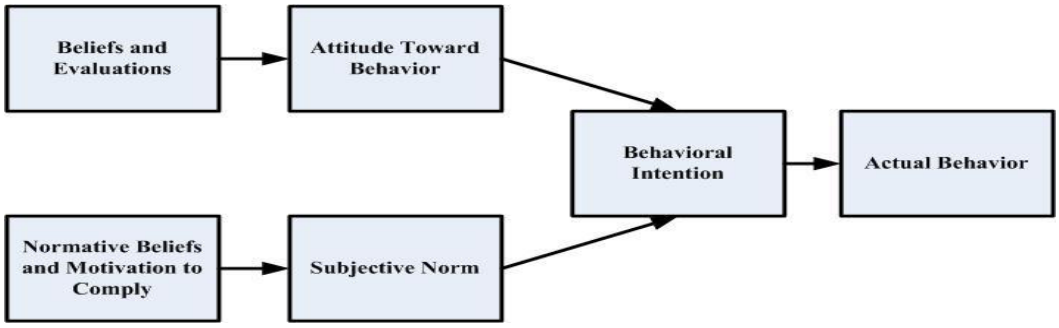


Figure 3 - Theory of Reasoned Action, Source: Ajzen & Fishbein (1980)

According to Ajzen & Fishbein, people's attitude and social norms are influenced by their beliefs and with respect to that this causes change in their behavioral intention (Ajzen & Fishbein, 1980). Actual Behaviour is the person's observable reaction for performing a specified behavior (Fishbein & Ajzen, 1975).

TRA has two important topics about intention in it. They are:

- Attitude Towards Behavior

  Attitude is defined as the person's negative or positive thoughts to perform the aimed behavior (Davis et al., 1989). Attitude towards behavior (ATB) could be defined as the former attitude of people about accomplishing that behavior. While making decisions people think about the possible results that this decision will produce. According to the theory, intention and attitude is determined by the beliefs, and evaluation of behavioral results that can be negative or positive. As a

result, for a person if s/he has strong belief about a particular behavior, this will cause positive results and positive attitude for this behavior. However, contrary situation is also true and if s/he has beliefs about negative results from the behavior will have negative attitude towards the behavior.

- Subjective Norms

"Subjective norms" (SN) is defined as the user's opinion about the social force that whether user should or should not carry out the particular behavior. As deciding about performing or not performing a behavior, person takes the group who are influential to him into consideration (Fishbein & Ajzen, 1975) and as a result person takes others' opinion before deciding.

Theory of Reasoned Action is a broad, and it does not explain the attitude which cause a particular behavior so the researchers dealing with this model firstly should identify the beliefs related to the behavior that they are investigating (Davis et al., 1989). Moreover, TRA is appropriate to explain behavior but it does not consider the outcomes or the events caused by behaviors (Sheppard, Hartwick & Warshaw, 1988) In addition, according to Sheppard et al. (1988) if the performance of an action needs knowledge, ability, or requires going beyond environmental obstacles, the model cannot be met and it means that the person can fail even his intention is so high. For instance, a person may not achieve buying a house because the current owner does not want to sell or the bank may not give loan even his intention to buy could be very high (Sheppard et al., 1988)

2.2.1.2. Innovations Diffusion Theory

Innovation Diffusion Theory (IDT) has been used since 1950s to clarify process of innovation-decision. It was introduced by Rogers (1962) and during the years it has steadily been developed until the best shape of it was created. The theoretical perspective of the TAM is coming from IDT that used at both the personal and

organizational level (Dillon & Morris, 1996). DIT presents a theoretical agenda for explaining acceptance at large-scale. (Dillon & Morris, 1996).

For Rogers (1995), the diffusion is the procedure that involves the innovation's communication on the channels over time between the users of a social organization. Moreover, the diffusion is a process which is thought as two ways of convergence which people crate and distribute this information among each other to get a common perceptive (Rogers, 1995).

Rogers (1995) defines innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption". Newness is the key concept in innovation diffusion process. Innovation diffusion theory tries for explaining the factors which cause the effect on the adoption of information technology. Factors, contributing to the acceptance of information technology change within types of adopters. As a result, innovation diffusion theory gives importance to the level of users. Moreover they offer that there are some adopter groups on the diffusion stage (Rogers, 2003). Technology or innovation adopters are divided into five groups (Rogers, 2003):

- **Innovators**: own multiple information sources, risk takers and educated.
- **Early Adapters:** leaders in the society, popular and educated.
- **Early majority:** owns lots of social links, planned.
- **Late Majority:** own worse social economical condition, doubtful and traditional one.
- **Laggards:** do not own many information sources; the ones in the surroundings are the main information sources.

The innovation-decision process groups the steps that an individual takes as (1) knowledge; learning the (meeting) innovation and its functionalities, (2) persuasion; induced about the innovation that it is valuable, (3) decision; deciding adopting or rejecting, (4) implementation; using the innovation, (5) confirmation; ultimate acceptance or rejection of it (Rogers, 1995). Therefore, the process of innovation-

decision could cause either adoption to the innovation or rejection that is a result of decision not to adopt it.

DIT (see Figure 4) is a well known and applied theory related with the acceptance of a new kind of technology.

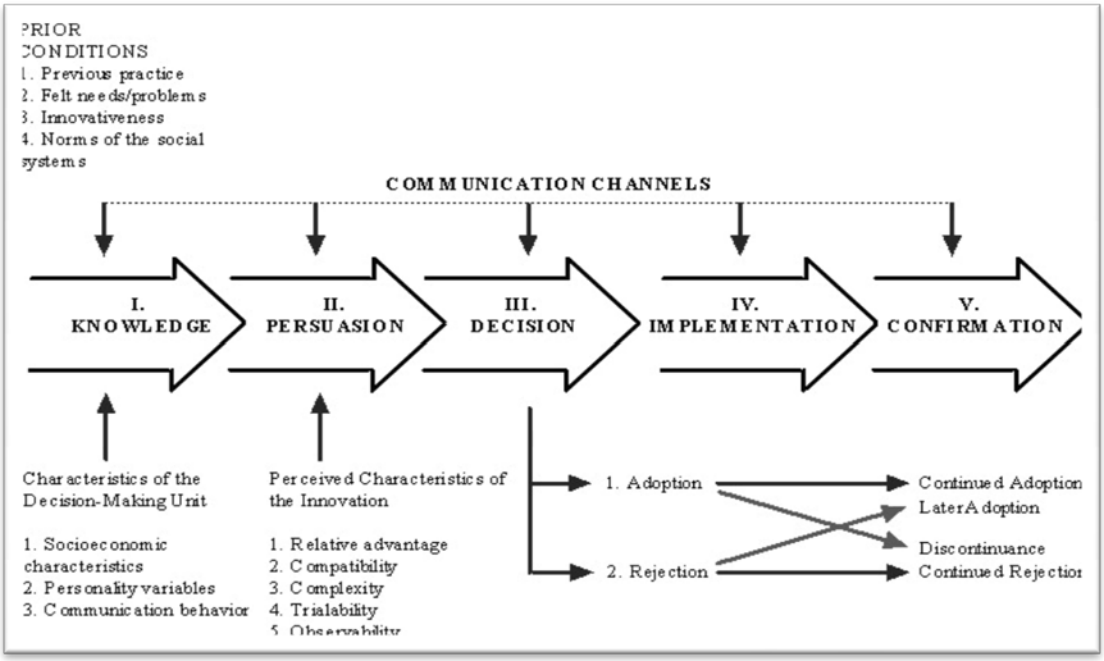


Figure 4 - Innovation-Decision Process, Source: Rogers (1995)

According to Innovation-diffusion process, different innovations have different acceptance rates just because they have different adoption probabilities (Bates & Manuel, 2007). In the persuasion stage Rogers gives five features which convince a person to accept the related innovation (Rogers, 1995):

- **Relative Advantage:** the degree to that a technology presents advancements over the one that is currently available or which the innovation is seen to be superior to the one it supersedes.

- **Compatibility:** the degree to which an innovation is parallel with social practices and norms or the degree, to which an innovation is seen as parallel by means of livings, needs of the user or the existing values.
- **Complexity:** the extent to which a new concept is perceived as hard to use or comprehend. The main concept here is that the difficulty of the new thing is pessimistically related with acceptance of it.
- **Trialability**: the degree to extent an innovation can be used on a limited condition or the chance to try it before using.
- **Observability**: the degree to extent the outputs and gains of an innovation are clear and noticeable to other possible users.

Moore and Benbasat (1991) developed a mechanism which could be used for evaluating the adopter perceptions of information technology innovations. Their findings propose that the most essential features of a technological innovation which has influence on the use are: ease of use, willingness of use, image, relative advantage, coherency, triability, demonstrability of outcomes, and the visibility.

Considering the adopter characteristics Rogers (2003) (see Figure 4) defined properties of Decision-Making as:

I. Socio-economic
II. Personal values
III. Communication Behavior

Each of the groups of users (from innovators to the laggards) has different sub characteristics in them.

2.2.1.3. Technology Acceptance model

Technology Acceptance Model has a very broad application range in information systems. It was introduced in 1986 by Davis (1986); in IS field TAM is still one of the commonly applied theoretical models (Lee & Kozar & Larsen, 2003). TAM is mainly a version of the Theory of Reasoned Action (Fishbein & Ajzen, 1975) that is used to model acceptance of users in IS. TAM is not as broad as TRA and it is

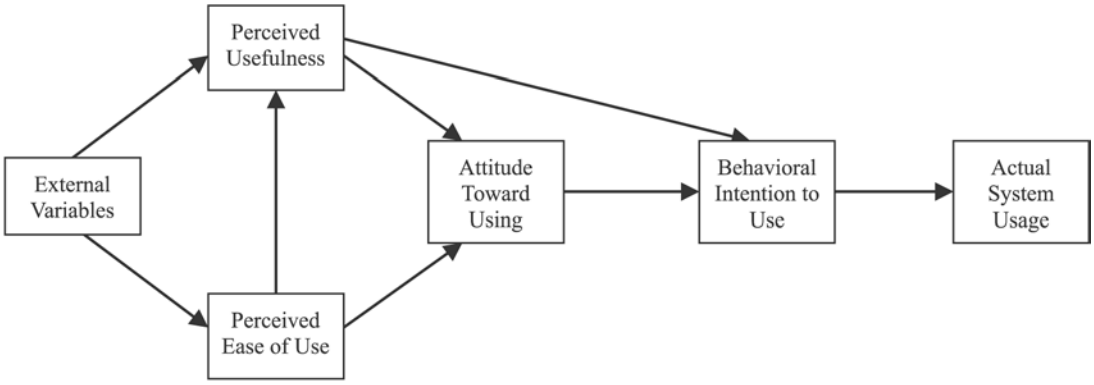
mainly created to be applied to explore behavior on computer usage. It incorporates many findings over decades of IS research (Davis et al., 1989). TAM aims to explain adoption of information system and find possible designing troubles before the end users face with the related innovation. Its founders reasoned that to increase the use of information technology, firstly the acceptance of it should be increased which could be achieved by asking the users about their future intentions to use the related IT (Holden & Karsh, 2010). Knowing the possible factors, which could shape the end-users' intentions can help organizations to promote the acceptance and increase the use of IT.

TAM was applied by many studies to identify the factors affecting the adoption of behaviors for a variety of technological implementations. Recently, the extended versions of the theory are widely being applied in the literature. During the decomposition of the intention into factors, two main factors remained as the same. Researches dealing technology acceptance propose that the most important evidence of the actual use of the system is the users' intention to use it. Users' attitude for the system use determines the intention of the user (BI). Moreover, beliefs decide Attitude; "Perceived Usefulness (PU), the user's perception of the degree to which using a particular system will improve her/his performance", and "Perceived Ease of Use (PEOU) the user's perception of the extent to which using a particular system will be free of effort (Davis, 1989; Davis et al., 1989)". According to TRA the effect of ideas on BI should be entirely through the attitude of the user about the related behavior but the original TAM and related researches showed that the impact of the PU over BI is not fully reasoned by attitude about the related system usage. (Davis & Venkatesh, 1996). This was explored by Davis et al. (1989) that users could employ in a technology yet they do not have optimistic attitude towards it because they could think that it just provide usefulness. While original theory has the construct called attitude, according to the observed evidence, the finalized model did not include the construct called attitude as it didn't fully linked to the PU on BI. (Davis & Venkatesh, 1996).

TAM tries to estimate user acceptance about any kind of technological change using two main constructs:

- Perceived Usefulness: PU is thought as the extent to which the user thinks that usage of the related system is going to help his performance on doing necessary job.
- Perceived Ease of Use: PEOU is thought as the extent to which the user thinks usage of the related system is not going to require much effort that is easiness of the system usage.

Figure 5 shows the original TAM proposed by Davis (1989).



Source: Davis *et al*. (1989, p. 985)

Figure 5 - Technology Acceptance Model

Technology Acceptance Model is applied to identify the relationships between Perceived Usefulness, Ease of Use, Actual System Use and Behavioral Intention (Szajna, 1996). TAM accepts that User Intention predicts if the people will be using the related system or not. As a result PU and PEPU become the determinative constructs on the Intention and Actual Use of the system. The external variables given in Fig 5 in original TAM are the factors such as situational involvement, experience with the system, support, education level, training etc. (Burton-Jones & Hubona, 2006).

In information Systems literature TAM has a very effective job in the phase of system usage decision and it is very famous as it is focusing on system usage and it has trustworthy tools supported by superb measuring features, economical to implement, and observable study is easy to apply (Pavlou, 2003). TAM is robust and very useful to evaluate technology or to find differences between applications or groups of the end-users. Nevertheless, TAM is commented for excluding the Social Influence on adoption of technologies; as a result it has some limits about being conducted outside the place of work (Fu & Farn & Chao, 2006). This study includes Social Influence and tries to identify the relation between the intention and main constructs whether they have been mediated by social issues or not.

CHAPTER III

RESEARCH MODEL AND HYPOTHESES

3.1. AN ADOPTION MODEL FOR UNIVERSITY STUDENTS' ADOPTION OF MULTI-PURPOSE SMART CARD

This research intends to identify the factors that affect university students' intention towards the use of multi-purpose Smart Cards. For identifying the factors which affect university students' intention, literature has been reviewed and Technology Acceptance Model (TAM) (Davis, 1989) was decided to be used. The research model that is developed and checked empirically in this research is mainly based on TAM because TAM is one of the most popular theoretical models applied in Information Systems (IS) studies.

This research presents a structural model for end-users' acceptance of smart card. The proposed model in the research is shown in Figure 6.

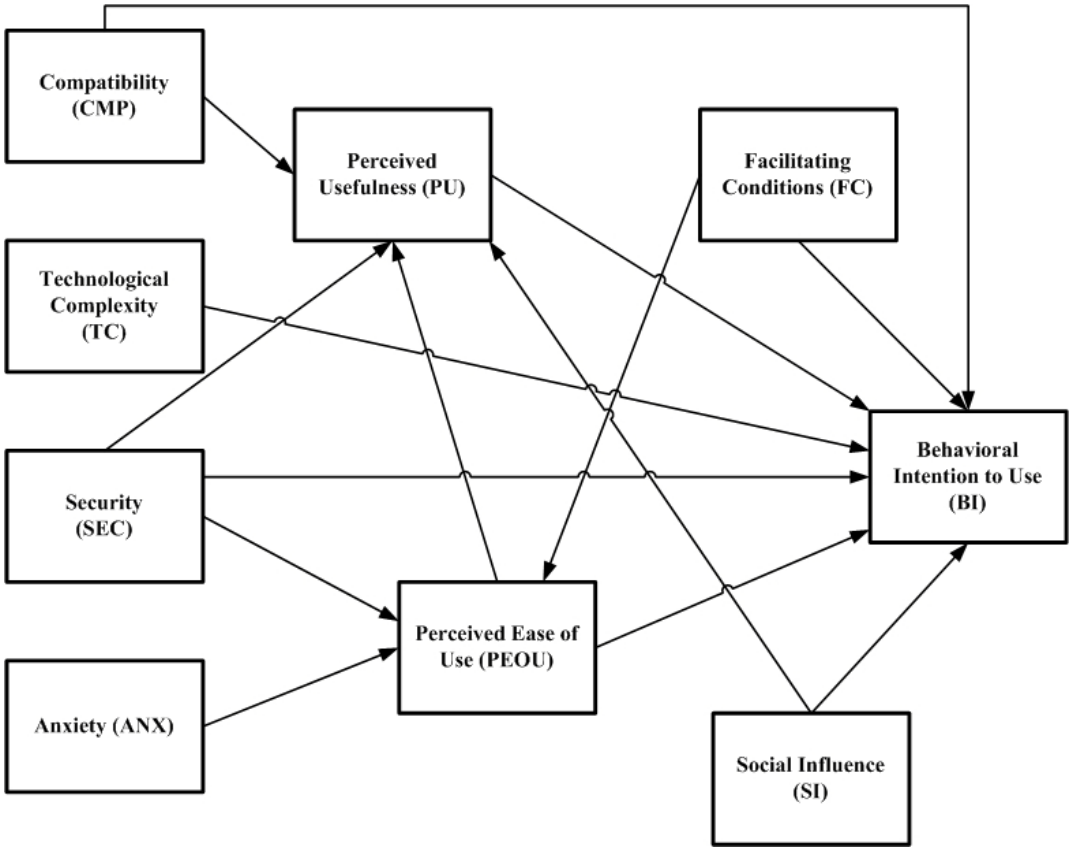


Figure 6 – Proposed Model

The proposed model has two construct categories;

1) Original TAM constructs connected to belief; Perceived Usefulness (PU), Perceived Ease of Use (PEOU), and Behavioral Intention (BI).
2) External constructs added to TAM; Anxiety (ANX), Social Influence (SI), Technological Complexity (TC), Security (SEC), Facilitating Conditions (FC), Compatibility (CMP).

3.2. TECHNOLOGY ACCEPTANCE MODEL FACTORS

There are three constructs from TAM. Two are TAM's main belief constructs; perceived ease of use and perceived usefulness. Other one is BI that is tried to be estimated by the model: this construct is the main estimator of the actual use and shows end-users willingness to actual use.

- Perceived ease of use (PEOU): PEOU refers to "the degree to which a person believes that using particular system would be free of effort" (Davis, 1989). Users more frequently use the system if the related system becomes easy to use for them (Taherdoost et all.., 2009). This construct is used to predict if the end-users will find using the multi-purpose Smart Cards easy or not just because it weights the easiness of the system. Studies Lee (2008), Bernadette & Szajna (1996), Raaj & Schepers (2008), Venkatesh et al. (2003), Sun et al. (2009), Park (2009), found that there exist a significant relation is between PEOU and PU, and also PEOU and BI. The hypotheses for this construct are these:

  H1a: PEOU is positively related to BI.

  H1b: PEOU is positively related to PU.

- Perceived usefulness (PU): PU is given as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Venkatesh & Davis, 2000). Users believing that using multi-purpose Smart Cards can cause in positive consequences have a more favored approach to the related system. Perceived usefulness is related to whether possible users view the innovation as presenting worth over the other ways of doing the same job or not (Agarwal & Prasad, 1999). Moreover, there are empirical evidence about the relationships between intention and perceived usefulness. The studies Moon & Kim (2001), Liu et al. (2009), Lee (2008), Agarwal & Prasad (1999) validated that there exit a significant relation between PU and BI for the adoption of technology.

H2: PU is positively related to BI.

3.3. EXTERNAL FACTORS

External factors refer to the predictors of main belief constructs.

- Compatibility (CMP): CMP is explained as "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (Rogers, 2003). When an idea becomes more compatible also it becomes less uncertain to the potential users. Moreover Rogers (2003) claims that a new system may be compatible or incompatible by means of 1) "socio cultural values and beliefs", 2) "previously introduced ideas", (3) "client needs for innovations". Individual values, working practices and special needs may change between individuals but an innovation should be well-suited for basic and common values, needs and occupation in order to have influence on the adoption (Sonnenwald et al., 2001). As a result compatibility should be positively related with the usefulness and intention. In addition studies Sonnenwald et al. (2001), Chang & Tung (2007) indicates that there exists a positive relation among CMP and BI. Moreover study conducted by Chen & Tan (2003) found that there exists a considerable relation among CMP and PU. So the main hypotheses about CMP is ;

  H3a: CMP is positively related to BI.

  H3b: CMP is positively related to PU.

- Technological Complexity: According to Rogers (2003) Complexity is "the degree to which an innovation is perceived as difficult to understand and use". According to Rogers (2003) some innovations are more complicated than others so these are adopted more slowly than the easy ones. If the end-users think that an application is complex for their skill level, this affects their acceptance of the system. Moreover, especially the ones for end-users

requiring developing new skills and understandings, users try to be out of the system (Rogers, 2003). There is a usual limitation on the people's capacity of data processing so to handle high level of TC users should be more concentrated on their job (Teo, 2010). As a result higher complexity means lower the adoption and there is a negatively relationship between TC and BI. Study conducted by Teo (2010) showed that TC affects BI in a negative way. The hypothesis about the TC is;

H4: TC is negatively related to BI.

- Security (SEC): In his study Vijayasarathy (2004) defines SEC as "the extent to which a consumer believes that making payments on-line is secure". One of the aims of the multi-purpose Smart Card use is that making the payments online that is free of time and place.

  Security is an important issue while making payments online because users want to have a system that is secure during the transaction. Moreover, the concern is not just payment related, privacy protection is another issue in Smart Card system because the system is usually used for the replacement of identification card. Privacy and Security have close relationship (Vijayasarathy, 2004). If security leak happens, users could incur damages from invasions of their privacy to financial loss as a result risk of level affects the usage of the system (Suh & Han, 2003). Users try to avoid using the system if there is a potential risk of losing important values. If the system serves enhanced security protection, end-users have more willingness to use it. As a result it is meaningful to be expecting that secured defense could result in a positive consequence on end-users' perception of usefulness and ease of use (Lu et al., 2007). The studies conducted by Vijayasarathy (2004) and Lu et al. (2007) showed that there exists a positive relation among SEC and BI. Moreover Lu et al. (2007) indicated that there is a direct positive relation between SEC and PEOU and PU. Hypotheses mainly linked to these constructs that are;

H5a: SEC is positively related to BI.

H5b: SEC is positively related to PEOU.

H5c: SEC is positively related to PU.

- Anxiety (ANX): Anxiety is the extent that how much the end-user is worried about the usage of a system. ANX results in evoking of reactions that are emotional or worried while trying to perform a behavior, like using a computer (Venkatesh et al., 2003). The study accepts ANX as performing mistakes while using the multi-purpose Smart Card system including the misusage of the card itself. Venkatesh et al. (2003) defines ANX as having no direct influence on the BI itself. This study also uses the ANX as effective on PEOU. ANX is a negative emotion and higher ANX means low easiness of the system usage. For instance, if the users afraid of losing their Smart Card, this will result in decrease on the usage just because the difficulty on the usage of system keeps them out of the system. As a result there should be negative relation among ANX and PEOU. The studies conducted by Hsu et al. (2009), Raaij &Schepers (2008) found that there exists a significant relation among ANX and PEOU. The following is the hypothesis proposed by this study with the factor of ANX;

  H6: ANX is negatively related to PEOU.

- Facilitating Conditions (FC): Facilitating Conditions are defined as “factors in the environment that influence a person’s desire to perform a task” (Teo, 2008). FC in this study includes higher levels of executive supporting, together with administration supporting and core support of information, help desks, online supported services that are any kind of help for the system usage provided by the institution. As indicated by Taherdoost et al. (2009) although technology behind the Smart Card system is vital, educating and

providing support to the end-users is something very important for the implementers. Technology ought to be taught to the users and people should be made aware of the system. In any case, whenever users need assistance, there should be helping spots to be sure about the supportive part of the system. Users tend to search for help when they face with something new for them so if they cannot find support from the intuition this affects their intention in a negative way. The more the FC means the more positive behavioral change towards the new system. A study conducted by Lim and Khine (2006) found evidence about the significance of being in a supported environment. The users participated in their research complained about a need of accessing to computers, inefficient technological support and gave this situation as the factor affecting their behavioral intention towards the system in negative way. Ngai, Poon, & Chan (2007) indicated that FC positively affects BI through the attitude construct. Moreover, Vanketash (2003) found significant relationship between FC and BI. Also Teo (2008) claimed that there exists a positive relation among FC and PEOU just because supportive issues make the system easier to use for the end-users. The followings are the hypothesis proposed by this study with the construct of FC;

H7a: FC is positively related to BI.

H7b: FC is positively related to PEOU.

- Social Influence (SI): Subjective norm is described as “a person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein & Ajzen, 1975). In the literature it was used as different constructs such as “normative beliefs” (Vijayasarathy, 2004), “social norms” (Karahanna & Straub, 1999), “social influence” (Karahanna & Straub, 1999). All of these constructs were originally from TRA (Fishbein & Ajzen, 1975). Davis et al. (1989) were found social influence as problematic so they had taken out it from the original TAM

however in the literature many studies added this construct to their model and proved the influence on BI of the end-user. According to Schepers & Wetzels (2006) mostly there exists a direct and significant relation between end-users' intention toward the usage of the system and SI. The reason behind this that if the people around the end-users think that the system should be used, he tries to match their opinions and easily accept the system (Raaij & Schepers, 2006). A second way of social influence influencing technology acceptance is through PU. When a person thinks that influencing people around him think the system should be used, he mixes his beliefs with the referrers' belief and changes his idea that the system should be useful because a huge number of groups cannot be incorrect in their idea (Raaij & Schepers, 2006). The studies conducted by Venkatesh et al. (2003), Wang & Shih (2008) and Venkatesh & Davis (2000) found that there exists a positive relation among SI and BI, PU. Hence the hypotheses proposed by this study are these;

H8a: SI is positively related to BI.

H8b: SI is positively related to PU.

CHAPTER IV

RESEARCH METHODOLOGY

This chapter is created to clarify the research methodology of the research. Firstly, the study setting is given and then methodology continues with defining the development of instrument. Later the sample selection process and then the data collection and as the last part, data analysis are explained. Data analysis part includes sub sections as Exploratory and Confirmatory Factor Analysis, Structural Equation Model, and Path Modeling.

4.1. STUDY SETTING

This study was done at Middle East Technical University (METU) which has a working smart card system in its campus for almost four years and is one of the leading universities in Turkey. The users participated in the research were all from METU and they were either from the undergraduate or graduate students including preparation classes. All of the participants were active users of the smart card system which means that they know how to use the Smart Card and used their smart-card at least one time.

Smart Cards could be used in a campus for many purposes. For this reason in this study Smart Cards are defined as the “multi-purpose”. In such a system a student in campus can use his Smart Card for both the facilities and as the most important part identification. When the study was being conducted in METU students were able to use their Smart Cards in “Social Lounge, Faculty Club, Library, Sports Centre, Pool,

Health Centre", Computer Labs, Student Affairs Office, Dormitories, and the Computer Centre besides the Campus gates (METU, n.d.).

4.2. INSTRUMENTATION

In order to get required information for the university students' thoughts about multi-purpose Smart Card system in this study, quantitative research method was used. Therefore, survey method was used to collect necessary data. For this purpose a questionnaire was developed. Firstly, the related literature was searched to gather information about questionnaire development. Moreover, related studies were searched for theoretical background of both TAM and Smart Card. There were two steps in the implementation stage of the survey;

- Pilot Study
- Main Study

Pilot Study: After the literature search, a questionnaire including 46 items was generated according to the questions used in the literature. 5-point scale (Likert-type) was used for evaluating items in the questionnaire. Answers were between "1" which indicates "Strongly Disagree" and "5" which indicates "Strongly Agree". According to McMillan & Schumacher (2001) Likert-type scale is used if the measures are attitude, opinion or perception because it is more satisfying for the quantitative approach. Moreover, Likert-type is a most commonly employed scale in the questionnaires (Gliner & Morgan, 2000). As a result Likert-type scale was decided to be employed in research instrument.

The aim of conducting a pilot study was revealing weaknesses of designed questionnaire because a pilot study is the small version of main study. According to pilot survey results, possible problems may exist in the main survey can be seen in advance such as miswording, question sequence and response rate. Morgan, Leeech, Gloeckner & Barett (2004) indicates the importance of the pilot especially while a researcher is developing a new tool. Sample size of the pilot survey is very low in

compared to the main survey and could be between 25 and 100 (Cooper & Schindler, 1998).

The language of the survey was Turkish because the number of Turkish students actively using Smart Card was very high inside the campus. Questionnaire started with study explanation part and then demographic questions. Later the questions about the Smart Card were presented. In explanation page, a summary of Smart Card and the definitions were given. Second part included question about students themselves. The third part was asking about student's Smart Card experiences.

Main Study: After the implementation of pilot study main survey was designed by taking into the consideration of pilot survey results. It was seen that the number of items for some structures were not adequate so the number of items in the main survey was increased to 51. Moreover some visual changes were made on the survey. Problematic items in the pilot survey were checked and some explanation sentences added to the related items. There were no changes on demographic information part and the explanation part. Main survey cover page and demographic information page are given in APPENDIX D and the questions asked in the main survey are given in APPENDIX E.

4.3. SAMPLE SELECTION

Sample is defined as a small portion of the population (Ary et al., 2002). This study was implemented using non-probability sampling. Non probability sampling is used when the researcher has no chance to reach all the properties of the selected domain. Therefore the researcher makes assumptions regarding the population of interest.
This study involves two samples as: 1) Pilot Study 2) Main Study.
The detailed characteristics of these samples are:

Pilot Study: Pilot study sample included 80 university students, 38 females and 42 males. Gender frequency of Pilot Study is given in Table 1. Sample was formed by

63 undergraduate, 3 graduate and 14 prep class university students. Detailed grade level frequency is given in Table 2.

Table 1 - Pilot Study Gender Information

	Frequency	Percent
Woman	38	47,5
Man	42	52,5
Total	80	100,0

Table 2 - Pilot Study Grade Level

	Frequency	Percent
Freshman	24	30,0
Sophomore	21	26,3
Junior	11	13,8
Senior	7	8,8
Master	2	2,5
Doctorate	1	1,3
Prep	14	17,5
Total	80	100,0

Moreover as the demographic information credit card usage was asked students because of the similar characteristics of credit card and smart card. Credit Card usage of the pilot study is presented in Table 3.

Table 3 - Pilot Study Credit Card usage.

	Frequency	Percent
No	31	38,8
Yes	49	61,3
Total	80	100,0

Main Study: Main study sample included 207 university students, 88 females and 119 males. Gender frequency of Main Study is given in Table 4. Main study sample consists of 196 undergraduate, 10 graduate and 1 prep class students. A detailed frequency of student grade level is given in Table 5.

Table 4 - Main Study Gender Information

	Frequency	Percent
Woman	88	42,5
Man	119	57,5
Total	207	100,0

Table 5 - Main Study Grade Level

	Frequency	Percent
Freshman	67	32,4
Sophomore	61	29,5
Junior	37	17,9
Senior	31	15
Master	3	1,4
Doctorate	7	3,4
Prep	1	0,5
Total	207	100

Also credit card usage frequency is given in Table 6.

Table 6 - Main Study Credit Card Usage Frequency

	Frequency	Percent
No	69	33,3
Yes	138	66,7
Total	207	100,0

In addition to the information given above Age and Department information was collected and this information is presented in APPENDIX F.

4.4. DATA COLLECTION

In this study the data needed was collected from university students studying at METU. Prepared surveys for both pilot and main study were distributed at several places where smart card was used actively. For this reason Library, Cafeteria and Sport Hall were chosen as main distribution places. Instrument was distributed by hand and students were given time to fill the survey. Later on completed surveys were collected from participants. While distributing the survey age and department weren't taken into consideration so instrument was randomly given to students. Related department and age frequency was given in part 4.3. In addition participation to the survey was voluntary.

4.5. ETHICAL CLEARANCE

In order to conduct a survey and collect data from students *Research Center for Applied Ethics* departments' permission is needed because human participation is something very important. For this reason survey was sent to the *Research Center for Applied Ethics* department and written permission was taken. Mentioned written ethical clearance document is given in APPENDIX G.

4.6. DATA ANALYSIS

After finishing the data gathering stage, collected data was checked in order to be able to perform Exploratory Factor Analysis and Confirmatory Factor Analysis. First of all missing values inside the data set were taken into consideration and data analysis continued with outlier examining outliers. Next issue was checking for the normality of the data. Detailed information of Missing value, Outliers, and Normality is given in Chapter 5.

4.6.1. Exploratory Factor Analysis

Factor analysis one of the multivariate analysis which was firstly used in psychology and pioneers in this analysis were Thomson, Spearman, and Thurstone (Lawley & Maxwell, 1963). The goal of the Exploratory Factor Analysis (EFA) is summarizing the orders of correlation between observable variables and variable numbers into small (Field, 2005; Tabachnick & Fidell, 2007). Furthermore, EFA is generally performed in the early stages of research and also the variables themselves may not be chosen with potential process in researcher's mind (Tabachnick & Fidell, 2007). EFA can be conducted via software in computers, and PASSW 18 (formerly known as SPSS) which is used in this study is one of them.

Before conducting Factor Analysis to the data, sample size should be checked because correlation coefficients are less reliable when they are estimated from small samples. In the literature there is no clear cut information about sample size. According to Comrey and Lee (1992) mentioned in Tabachnick & Fidell (2007) sample size of this survey, 207, is fair to apply Factor Analysis whereas Tabachnick & Fidell (2007) also claims that if there are strong correlations and few factors a smaller sample size may be adequate. Moreover, Kaiser-Meyer-Olkin (KMO) and Bartlett' test of sphericity should be calculated for sample adequacy and correlations among the variables. KMO score should be greater than 0, 5 to apply factor analysis appropriately and p value in Bartlett's test of sphericity score must be smaller than .05 to be significant (Pallant, 2001). Moreover, Pallant (2001) strongly indicates that

for the Bartlett's test of sphericity value decreases when the sample size increases. Factor Loadings are checked after applying EFA. Field (2005) suggests that during the EFA application items having factor loadings less then 0,6 should be excluded from data set.

4.6.2. Confirmatory Factor Analysis

Confirmatory Factor analysis (CFA) is a spesific type of Factor Analysis. While in EFA the concern was constructs, Tabachnick & Fidell (2007) indicates that "the question in confirmatory FA is: Are the correlations among variables consistent with a hypothesized Factor structure?" While EFA statistics tell researcher the number of factors and loadings in his data, CFA statistics gives information about how well his theoretical specification of the factors matches reality so CFA is a method enabling researcher to whether "confirm" or "reject' his predetermined theory (Hair, Black, Babin, Anderson & Tatham, 2006).Compared with EFA, CFA is much more sophisticated technique usually used in advanced stages of the research. In the literature CFA is performed through Structural Equation Modeling Tabachnick & Fidell (2007).

4.6.3. Structural Equation Modeling

Structural equation modeling (SEM) is a set of models used in statistics which are used for explaining the relation between multiple variables (Hair et al., 2006). In the literature Structural Equation Modeling is also used as "causal modeling, causal analysis, simultaneous equation modeling, analysis of covariance structures, path analysis, or confirmatory factor analysis" (Tabachnick & Fidell, 2007). SEM is used to evaluate relation among constructs (both independent and dependent) including latent variables. Latent variables (constructs) are the variables which cannot be measured (not observable) directly so inferred from a set of variables that researchers do measure using tests, surveys, and so on such as intelligence (Schumacker & Lomax, 2004). According to Yılmaz & Çelik (2009) the first steps in SEM application

process is model specification. Model specified according to the previous theories conducted. In this study this step was completed in Chapter3.

In SEM Model there should be causal connections between variables and this is not possible without theoretical support. A model could be given as equations listing or as a pathway diagram. Usually diagram for the path is chosen because it is better for representation. Second step is model identification and Tabachnick & Fidell, 2007 indicates that “a model is said to be identified if there is a unique numerical solution for each of the parameters in the model”. After model identification is completed, model estimation is done and population parameters are estimated. The fourth stage is checking with the model fit. The aim of testing model fit is deciding about whether the proposed model is good or not. The fifth also the last step includes respecification and interpreting the results. In this step, researcher tries to modify the model by adding new paths or removing related path (if there is any non-significant) (Kelloway, 1998).

SEM has two main type of analysis which are; Component based and Covariance based SEM (Thompson et al., 1995). Covariance based SEM is very popular in the literature just because there are many software available like LISREL, AMOS, EQS, and SEPATH. The main difference between Covariance based SEM and PLS is the required sample size because while Covariance based SEM requires at least 200 participants (Tenenhaus, 2008), PLS could be applied to smaller sample (Thompson et al., 1995). Moreover, PLS tries to explain proposed model with high variance (R^2) and considers significant t-values between the constructs. While results of covariance based SEM are generalisable to the population, objective of the PLS is the best prediction of relation of latent variables. There are several programs for conducting PLS path modeling such as SmartPLS, and PLS-Graph. This research used SmartPLS (Ringle, Wende, Will, 2005) which is free for noncommercial to assess model proposed through the Partial Least Square based SEM.

4.6.4. Partial Least Square Path Model (PLS-PM)

A measurement model and construct model are created to describe PLS path model. Measurement model specifies the indicators of each construct and enables researcher to

assess validity of the construct (Hair et al., 2006). Moreover a structural model is created to represent the relations among latent variables. Convergent and discriminant validity are checked for validating the measurement model. Convergent validity is proved by calculating factor loadings, Composite Reliability, and Average Variance Extracted values (AVE) (Chin, 1998). Discriminant validity is proved via calculating the square root of AVE values for each construct. For qualified discriminant validity calculated square root of AVE values for each latent variable in the model should be higher than correlation of any latent variable pair (Gefen & Straub, 2005). Furthermore, structural model is evaluated with significant path coefficients and R^2 (variance) of latent variables.

CHAPTER V

DATA ANALYSIS

This chapter includes the detailed information about statistical analysis of the data set. Firstly, Preliminary Analysis is explained, and then Exploratory and Confirmatory Factor Analysis is given in detailed.

5.1. PRELIMINARY ANALYSIS

The main data analysis includes confirmatory factor analysis to confirm the proposed model. In order to apply CFA, data should be checked. In the following parts the data was checked for suitability for further analysis.

5.1.1. Handling Missing Data

Missing data means any blank parts in the data set and should be handled, since missing data can affect analysis and cause problems (Field, 2005). In order to go one step further in the data analysis phase, gathered data should be checked for any missing data that could cause problem. In the literature there are several steps that could be done to handle missing data analysis. As also noted by Hair, Black, Babin, Anderson & Tatham (2006) handling the missing data begins with deciding if the missing cases are enough to be ignored or not. For this reason firstly the number of missing data cases should be checked. The dataset checked for missing data and seen that only five cases had missing values. As a result these five cases having missing part were excluded from data set.

5.1.2. Outlier Detection

An outlier is defined by Tabachnick & Fidell (2007) as “case with such an extreme values on one variable or such a strange combination of scores on two or more variables that it distorts statistics”. Outliers are the extreme values in a dataset (Pallant, 2001) and should be determined for further data analysis. There are several ways in statistics literature such as box plot and trimmed means to find outliers in data set. Box plot is the graphically representation of data and trimmed means is calculating means by temporarily eliminating extreme observations at both ends of the sample. In this study to decide for cases with outliers mean and %5 trimmed mean values of each case was compared. According to comparison table of each mean and %5 trimmed mean values in APPENDIX A; there is not extreme difference between mean and %5 trimmed mean. As a result the outliers in the data were disregarded.

5.1.3. Testing Normality

The normal means symmetry in statistics that is normal is expressed as a symmetric, (like a bell) curve with highest frequency of scores in the central point and minor frequencies at the edges (Gravetter & Wallnau, 2000). Figure 7 shows the graphical representation of normality. Normality can be seen checking Kolmogorov-Smirnov statistic and skewness and kurtosis values (Tabachnick et al., 2007) Skewness and kurtosis values are categorized as positive and negative. Positive skewness tells that values are gathered at the left and negative means the opposite that is scores are clustered to the right. Figure 8 shows positive and negative skewness. Moreover positive kurtosis tells the spiky allocation and negative kurtosis tells smooth allocation (Tabachnick & Fidell, 2007) Figure 9 shows positive and negative kurtosis. When a distribution is normal it means that the skewness and kurtosis values are equal to zero. However Tabachnick & Fidell (2007) indicates that skewness and kurtosis values between [-3, +3] were assumed to be normal. According to this interval as it is given in APPENDIX B; the values of skewness and kurtosis for each item in the dataset fits for the normality.

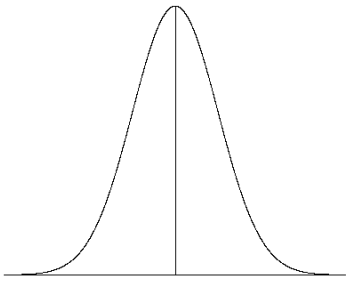


Figure 7 - Normal Distributed Data Set

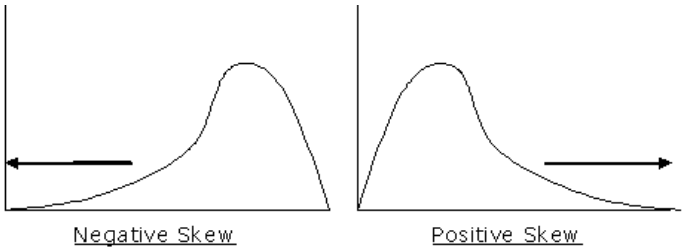


Figure 8 - Negative and Positive Skewness

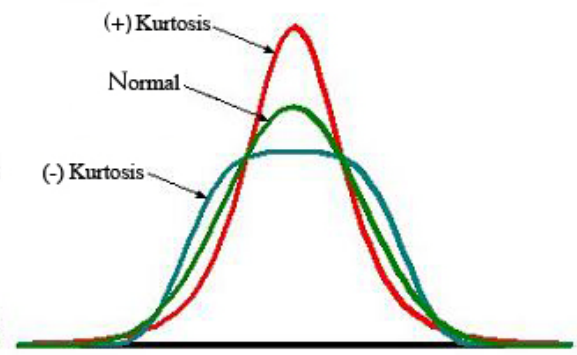


Figure 9 - Negative and Positive Kurtosis

5.1.4. Reliability Analysis

For supporting the internal consistency of the dataset and checking the consistency of the instrument with what it measures (Ary et al., 2002). Cronbach's Alpha (coefficient of reliability) is checked for measuring the internal consistency (Pallant, 2001). Cronbach's alpha score is between 0 and 1 (Hair et al., 2006) and approaching to 1 indicates more reliable data. Although getting closer to the 1 is important 0, 7 and higher values are treated as acceptable. For this reason before conducting, factor analysis, total reliability of the data was checked by Cronbach's Alpha value. The obtained Cronbach's Alpha score given in Table 7 is 0,894 which is suitable with the required value 0, 7 for accepting the data as reliable. Total reliability statistics were also given in APPENDIX C.

Table 7- Total Reliability of the Data Set

Reliability Statistics	
Cronbach's Alpha	N of Items
,894	207

5.2. EXPLORATORY FACTOR ANALYSIS

The aim of the Explanatory Factor Analysis (EFA) is identifying structure or model of the factors by deciding the amount of presented factors for a dataset (Stevens, 2002). With the help of EFA, researcher could show variables loading on each factors. Before conducting factor analysis researcher should be sure about the sample size. For this research Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity is used to check for sample size adequacy. Table 8 shows the result of KMO and Barlett's Test results. KMO measure is 0,894 and is greater than the required value because 0, 5 is required. Furthermore value of Bartlett's test of sphericity should be smaller than .05; p (Sig.) value is .000 for this study. According to these results the data set is suitable for EFA.

Table 8 - KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,894
Bartlett's Test of Sphericity	Approx. Chi-Square	2649,041
	df	351
	Sig.	,000

EFA was conducted in PASW Statistics 18 by Maximum Likelihood estimation and rotation of direct oblimin. The reason why Maximum Likelihood and Direct Oblimin Rotation were used is that the factors in the dataset are related with each other (Şimşek, 2007). The pattern matrix obtained was analyzed to determine the factor structure. The pattern matrix is given in Table 9.

Table 9 - The results of EFA

Pattern Matrix[a]

	Factor					
	1	2	3	4	5	6
item_34	-,977					
item_35	-,511					
item_9		,801				
item_1		,708				
item_14		,658				
item_18		,657				
item_7		,618				
item_19		,581				
item_16		,533				
item_8			-,822			
item_11			-,770			
item_17			-,577			
item_38			-,553			
item_2			-,505			
item_12			-,411			
item_6			-,400			
item_21				,613		
item_29				,656		
item_36				,498		
item_45					,657	
item_41					,622	
item_50					,609	
item_30					,480	
item_39					,408	
item_47						,518
item_48						,447
item_43						,375

Extraction Method: Maximum Likelihood.

Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 13 iterations.

According to pattern matrix, the items not loaded to any of the factors were extracted from the data to be used in confirmatory factor analysis (CFA). Also the items having factor load smaller than 0, 3 were extracted from further analysis.

For the pattern matrix values, the items were clustered under six meaningful constructs. After that, each factor' reliability was examined by checking at the Cronbach's Alpha scores. The factorial reliability outcomes are given in Table 10 and also according to pattern matrix factors were given their names according to the related literature.

Table 10 - Reliability Results according to factors

Factor Name	Cronbach' Alpha	Item	Literature Item Code	FACTOR Loading
TC	0,789	item_34	TC1	-0,977
		item_35	TC2	-0,511
PU	0,884	item_1	PU1	0,708
		item_9	PU2	0,801
		item_14	PU4	0,658
		item_16	PU3	0,533
		item_19	PU5	0,581
		item_18	PU6	0,657
		item_7	PU7	0,618
PEOU	0,837	item_8	PEOU1	-0,822
		item_2	PEOU2	-0,505
		item_38	PEOU3	-0,553
		item_11	PEOU4	-0,77
		item_12	PEOU5	-0,411
		item_17	PEOU6	-0,577
		item_6	PEOU7	-0,4
ANX	0,69	item_29	ANX1	0,656
		item_21	ANX2	0,613
		item_36	ANX3	0,498
BI	0,853	item_45	BI1	0,657
		item_30	BI2	0,48
		item_39	BI3	0,408
		item_41	BI4	0,622
		item_50	BI5	0,609
SI	***0,474	item_47	SI1	0,518
		item_48	SI2	0,447
		item_43	SI3	0,375
*** Excluded from the data set; should be >0,6				

Table 10 shows the reliability scores, factor loadings. According to reliability scores the factor Social Influence was excluded from dataset in further analysis, since the reliability scores did not meet the required value.

5.3. CONFIRMATORY FACTOR ANALYSIS

Confirmatory Factor Analysis (CFA) was used for validating the correlation between items and factors. CFA was conducted with SmartPLS which is a free tool for path modeling (Ringle, Wende, Will, 2005).

5.3.1. Measurement Model

For validating the proposed measurement model CFA was used. The Figure 10 shows the measurement model obtained in CFA, by illustrating factor loadings and path coefficient between latent variables. In order to validate the measurement model convergent and discriminant validity were taken into consideration in the following parts.

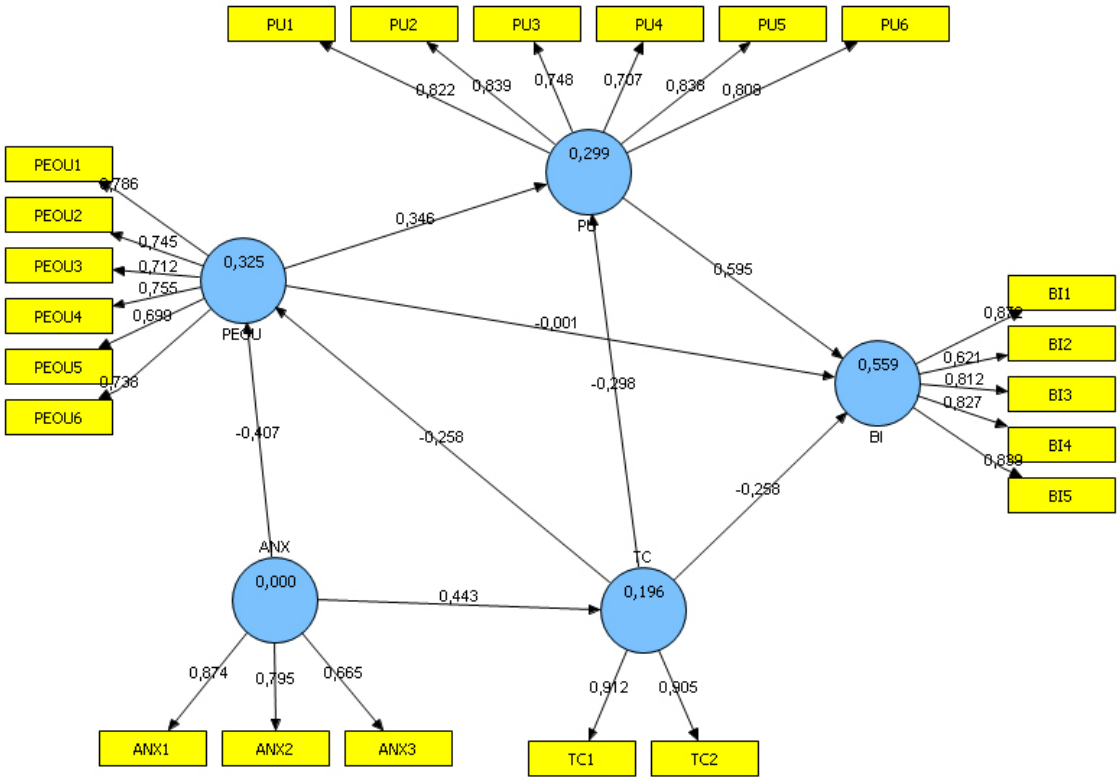


Figure 10 - Measurement Model

Explanation of symbols used in measurement model is given in Figure 11.

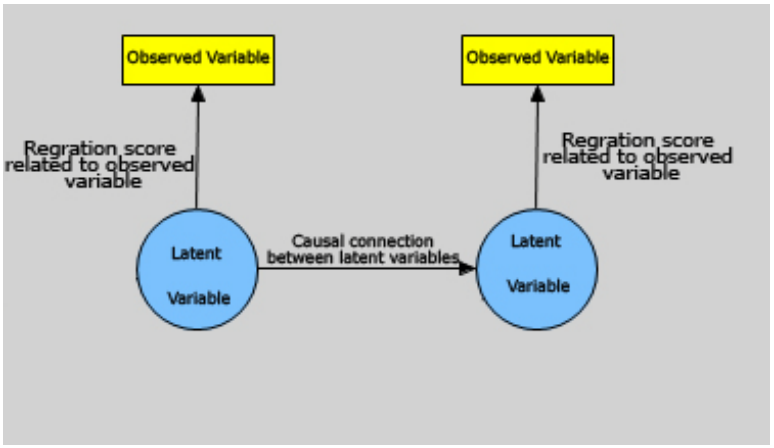


Figure 11 - Symbols used in Measurement Model, Adapted from: Yılmaz & Çelik (2009)

5.3.2. Convergent Validity

In order to check convergent validity, Factor Loadings, Composite Reliability and Average variance Extracted scores were checked.

5.3.2.1. Factor loadings

Factor loading shows the score of the variance shared among an item and factor and it is acceptable if it is higher than 0, 7 however 0, 5 and bigger values are thought as acceptable for convergence validity. For this reason “ANX3”, “BI2”, “PEOU5” values are used for further statistics whereas “PEOU7” and “PU7” are excluded from data set because their values were lower than 0, 5. Detailed factor loadings are given in Table 11.

Table 11 - Final Factor Loadings Included in Analysis

	ANX	BI	PEOU	PU	TC
ANX1	0,874364				
ANX2	0,795007				
ANX3	0,664723				
BI1		0,871958			
BI2		0,620962			
BI3		0,811673			
BI4		0,826577			
BI5		0,83932			
PEOU1			0,786368		
PEOU2			0,744565		
PEOU3			0,712053		
PEOU4			0,75454		
PEOU5			0,698845		
PEOU6			0,737643		
PU1				0,821885	
PU2				0,839297	
PU3				0,74818	
PU4				0,707286	
PU5				0,838128	
PU6				0,808479	
TC1					0,912404
TC2					0,905186

5.3.2.2. Composite Reliability

Composite reliability (CR) shows the internal consistency that indicates all the items represents the same latent construct. Composite reliability value should be equal or greater than 0, 7. CR values in this data set between 0, 8 and 0, 9 and refers to the good reliability. Table 12 shows the detailed CR scores of each construct.

Table 12 - Composite Reliability Scores

Composite Reliability	
ANX	0,824256
BI	0,897134
PEOU	0,878529
PU	0,911461
TC	0,904661

5.3.2.3. Average Variance Extracted

Average Variance Extracted (AVE) shows that whether constructs were powerfully linked to their items or not. AVE values must be 0, 5 or bigger to present sufficient validity of convergence. In this study AVE scores are between 0, 5 and 0, 8 and which means all of them are acceptable. Details of the AVE values for each construct are given in Table 13.

Table 13 - AVE Scores

	AVE
ANX	0,612802
BI	0,638481
PEOU	0,546934
PU	0,632673
TC	0,825921

5.3.3. Discriminant Validity

In order to show that all of the constructs in the data set were different from each other Discriminant Validity scores were calculated. Discriminant Validity scores are the square root of AVE values (Bove et al., 2009). Square root AVE values for each constructs should be higher than correlation values of constructs. The Table 14 shows the detailed Discriminant validity scores and according to these values all of the constructs were different from each other.

Table 14 - Discriminant validity scores for the constructs

	ANX	BI	PEOU	PU	TC
ANX	0,782817				
BI	-0,41157	0,79905			
PEOU	-0,5216	0,396261	0,73955		
PU	-0,39659	0,71095	0,476842	0,795407	
TC	0,442926	-0,52569	-0,43814	-0,45005	0,908802

5.3.4. Structural Model

Given convergent and discriminant validity proves that the measurement model was validated. Furthermore PLS Bootstrapping (BT) was used to find out t-values to identify the relations between latent variables. Detailed t-values are given in Table 15. Moreover, Figure 12 shows the related coefficient path (original TAM factors are shaded ones). According to BT results there weren't any non-significant relations. Also inside the latent variable images total variance explained information is given in parentheses.

Table 15 - Detailed t-values

	T Statistics (|O/STERR|)
ANX -> PEOU	4,925293
ANX -> TC	6,515583
PEOU -> BI	0,008279
PEOU -> PU	3,745627
PU -> BI	8,051967
TC -> BI	3,644636
TC -> PEOU	2,889044
TC -> PU	3,227733

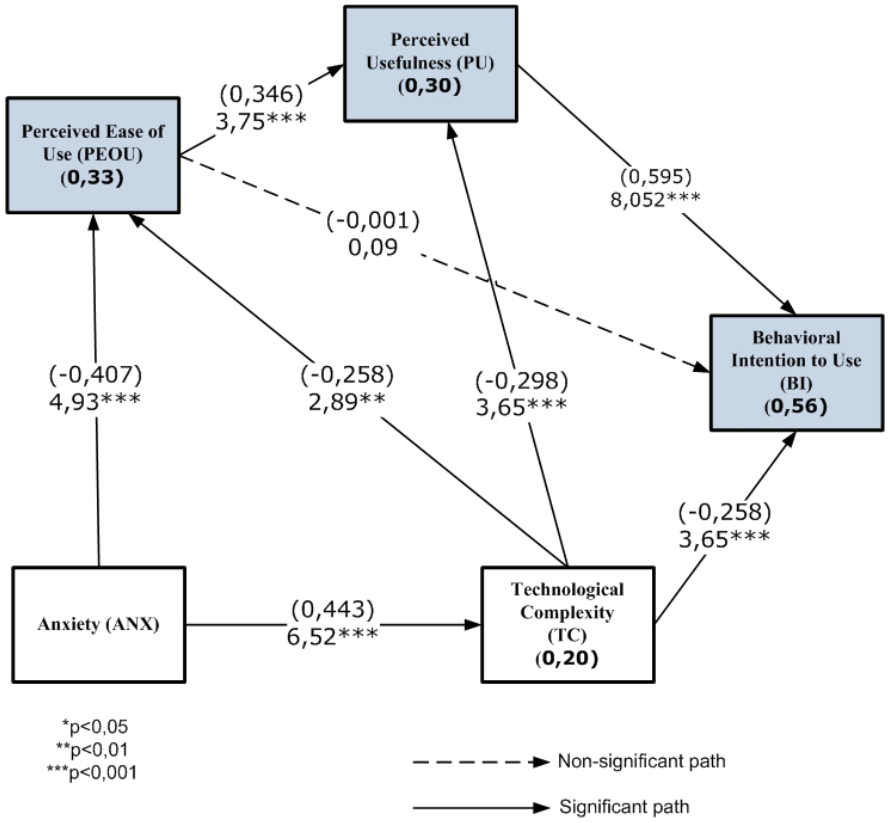


Figure 12 - Structural Model

5.4. HYPOTHESES TESTING AND RESULTS

In Table 16 results of the relations and hypotheses are given in detailed. As given in part 5.2 (EFA), according to EFA sufficient number of items did not cluster under CMP, SEC, FC factors and also SI did not have enough factor loadings, therefore those were excluded from the data set. For this reason H3a, H3b, H5a, H5b, H5c, H7a, H7b, H8a, H8b which are related with these constructs couldn't be measured in this model.

According to results several strong relations were found over $p<0.001$ level. Besides these significant values, one relation didn't provide meaningful t-value as a result

hypothesis related given as rejected. According to t-values given in Table 16 between PEOU ->PU, PU ->BI, TC -> BI, ANX -> PEOU, there were strong relations as a result H1a, H1b, H2, H4, H6 were accepted. Positive strong relations found between between PEOU ->PU, PU ->BI therefore H1b and H2 were accepted. Moreover there were negative relations between TC -> BI, ANX -> PEOU so H4 and H6 were accepted too. In addition Results showed that t-values between PEOU ->BI was very low as a result H1a was rejected. Besides these accepted hypotheses ANX -> TC, TC -> PEOU, and TC -> PU relations weren't hypothesized but when checked for relation during the BT phase, results showed that there were also strong relations between these constructs. ANX -> TC, TC -> PU were strong relations over p<0,001 and TC -> PEOU was a significant relation with p<0, 01 level. Furthermore, according to standardized loadings while there were negative relations between TC -> PEOU and TC - >PU, there was a positive relation between ANX -> PU. As a result these additional three hypotheses were also supported.

Table 16 - Relations and tested hypotheses

Relations	Hypotheses	T-Values	Standardized Loadings	Supported
PEOU ->BI	H1a	0,008279	-0,000592	Rejected
PEOU ->PU	H1b	3,745627	0,346098 ***	Yes
PU ->BI	H2	8,051967	0,595053 ***	Yes
CMP -> BI	H3a	-		Cannot be measured
CMP -> PU	H3b	-		Cannot be measured
TC -> BI	H4	3,644636	-0,25815 ***	Yes
SEC -> BI	H5a	-		Cannot be measured
SEC -> PEOU	H5b	-		Cannot be measured
SEC -> PU	H5c	-		Cannot be measured
ANX -> PEOU	H6	4,925293	-0,407474 ***	Yes
FC -> BI	H7a	-		Cannot be measured
FC -> PEOU	H7b	-		Cannot be measured
SI -> BI	H8a	-		Cannot be measured
SI -> PU	H8b	-		Cannot be measured
ANX -> TC	Additional hypothesis	6,515583	0,442926 ***	Yes
TC -> PEOU	Additional hypothesis	2,889044	-0,257662 **	Yes
TC -> PU	Additional hypothesis	3,227733	-0,298406 ***	Yes
*p<0.05; **p<0.01; ***p<0.001				

5.5. COMPARISON WITH ORIGINAL TAM

Original TAM Davis et al. (1989), tries to predict acceptance (behavioral intention) any technology using two main constructs; PEOU and PU. However this study proposed a model which is an extended form of the original TAM defined by Davis. Therefore, here the extended TAM model used in this research was compared with original model. Structural Model of the original TAM was created in SmartPLS and PLS algorithm and Bootstrapping was executed with the same data with excluding external factors added by this study. Results showed that R^2 value of the extended

model was bigger than the original TAM. While in Davis' model R^2 of PU was 0, 30 in original TAM this was only 0, 24. Furthermore, while in modified model R^2 of BI was 0, 56 in original TAM this was 0, 51. As a result of the variance (R^2) differences between two models, it is observed that the modified model used in the research clarifies the acceptance of the usage of the related technology well when compared to the original TAM. The results of original TAM model structure results are given Figure 13.

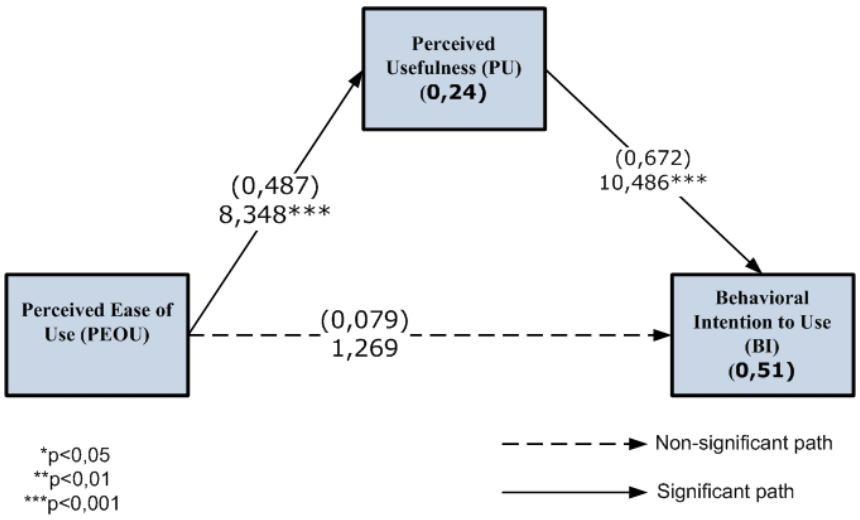


Figure 13 - Original TAM Result

CHAPTER VI

DISCUSSION AND CONCLUSION

In this chapter, discussion of results found at the end of the analysis were presented, and conclusion and recommendations made by the researcher for future research.

6.1. DISCUSSION

Firstly, it has to be indicated that in the literature, there are not enough research examining the factors affecting the university students' behavioral intention towards the multi-purpose Smart Cards or their related applications. In every part of our lives, multi-purpose Smart Cards are used more and more effectively, however there is a gap in the literature in explaining acceptance factors of the users' behavioral intention. With adding external factors to original TAM, this study presents a structural and measurement model to investigate the behavioral intention of university students toward multi-purpose Smart Cards.

The main aim of this research was explaining the reasons affecting university students' adoption of multi-purpose Smart Cards and representing the relations between those factors. In this study original TAM was extended via adding two external factors; Anxiety and Technological Complexity. Consequently, behavioral intentions of university students were examined in two scopes; Original TAM constructs: perceived usefulness and perceived ease of use, and external factors: Anxiety and Technological Complexity. According to study findings hypotheses proposed in study were tested and the results are shown in Table 17.

Table 17 - Hypotheses results

Hypotheses	Independent Variable	Dependent Variable	Result
H1a	PEOU	BI	Rejected
H1b	PEOU	PU	Accepted
H2	PU	BI	Accepted
H4	TC	BI	Accepted
H6	ANX	PEOU	Accepted
Addition	ANX	TC	Accepted
Addition	TC	PEOU	Accepted
Addition	TC	PU	Accepted

Moreover some additional relations were tested in SEM and their results are also shown in Table 17.

The empirical results of this study indicated that perceived ease of use did not directly affect acceptance of the university students' towards multi-purpose Smart Cards however it has an indirect influence on perceived usefulness. Moreover, study showed that perceived ease of use significantly and directly affected perceived usefulness towards the multi-purpose Smart Cards. For this reason while the results were same about PEOU over PU in studies conducted by Bernadette & Szajna (1996), Venkatesh et al. (2003), Raaj & Schepers (2008), Lee (2008), Sun et al. (2009), Park (2009), about PEOU over BI as the direct influence were not similar. The significant relation between PEOU and PU implies that when the multi-purpose Smart Card system is not hard to use, university students are having higher usefulness perception. Furthermore, rejection of PEOU over BI implies that Perceived Ease of Use is not a direct casual factor of behavioral intention of university students towards the Smart Card system. System's easiness of usage does not directly affect university students' behavioral intention towards the actual usage. This means that if students do not have perceived usefulness perception towards the system, system's easiness is not a considerable effect on their behavior.

According to the empirical results perceived usefulness affected university students' intention toward the multi-purpose Smart Cards positively and significantly. This finding is firstly similar to the results of original TAM (Davis et al., 1989) and also Lee (2008), Liu et al. (2009), Moon & Kim (2001), Agarwal & Prasad (1999). According to Davis et al. (1989), PU is the major determinant of users' intention to use and findings of the research also validated the same that when users think that the related tool is useful this affect their intention positively and significantly.

Technological Complexity influenced perceived usefulness, perceived ease of use, and behavioral intention negatively and directly. The influence of TC over BI is similar with Teo(2009). Technological Complexity has negative influence on university students' acceptance towards the multi-purpose Smart Cards. This result implies that if a system is complex than BI perception of the user decreases and users try to keep themselves out of this system so TC is determinant of the BI. Moreover, according to additional hypothesis TC directly influences PU and PEOU so this implies that, if users find the system as complex this affects their perception of system's easiness and usefulness too.

The empirical findings indicated that anxiety affected PEOU and TC directly and significantly. ANX influences PEOU negatively and TC positively. This implies that if the users have ANX towards the system, this affects their easiness perceptions negatively. Results ANX over PEOU are similar with studies conducted by Raaij &Schepers (2008), Hsu et al. (2009). In addition Venkatesh et al. (2003) defined ANX as negative emotion and significant determinant of PEOU, and empirical findings of this research is parallel with his conclusion. Findings of this research indicated that in this research there were very strong and significant relation between ANX and TC. ANX over TC implies that if the users are anxious about the system, this affects their complexity perception positively and makes them think that the system is complex more than they think.

6.2. CONCLUSION

The results of this study showed that there are significant influences of anxiety and technological complexity over original Technology Acceptance Model. The empirical findings of this research indicated that besides original TAM constructs, other factors also should be considered while investigating users' behavioral intention towards technology. This study extended TAM by adding two external factors; anxiety and technological complexity since both factors are negative emotions and have negative effect on users' intention toward technology. According to structural model validated by this study, included factors influenced university students' behavioral intention towards multi-purpose Smart Cards directly or indirectly.

Moreover, as this study is an extended TAM, comparison with original TAM also revealed significant result. The extended TAM in this study clarified the behavioral intention with R^2 score 56% however the real model explained behavioral intention with lower R^2 score 51%. Consequently, this study revealed that the extended model used in the study is more significant in stating the accptance of the university students about the use of multi-purpose Smart Cards.

6.3. CONTRIBUTION OF THE STUDY

With the advances in technology everyday an innovation is becoming popular and entering our lives. Multi-purpose Smart Cards are used in various places including university campuses. In order to make effective usage of multi-purpose Smart Card in campuses, students' intention towards such application should be investigated.

This study contributes to Information Systems literature by identifying factors that affect university students' behavioral intention of multi-purpose Smart Cards. In this study TAM is extended by adding two external constructs; anxiety and technological complexity. Results showed that used extended model is validated because there is significant evidence for the effect of anxiety and technological complexity.

Furthermore with this evidence, study also proved that TAM is applicable to identify users' behavioral intention toward the related technology.

6.4. LIMITATIONS AND FURTHER RESEARCH

The first limitation in this research was about proposed research model that four additional constructs were proposed. According to exploratory factor analysis number of clustered items under FC, SEC, and CMP were not adequate so these constructs were excluded from data set. Moreover under SI construct factor analysis resulted enough items, because of the lower construct reliability SI was also excluded. As a result relations of these constructs over behavioral intention could not be measured in this study. First of all, it is recommended that upcoming research can investigate these constructs and relations. Moreover, a qualitative study could be conducted with a focus group and results can be strengthened.

The second limitation is related with sample. While the survey was being distributed in METU campus, university administration was controlling students' Smart Cards with auto machines and did not let them enter the dormitory unless they had Identification Card. Students were complaining about this new implementation. As a result, researcher had problems about connecting to participants. Moreover this situation may have affected the participants' conception of Smart Cards.

The third limitation is about gender and department. In this study any gender or department differences among the participants were not taken into consideration. The intention towards Smart Cards may vary between males and females or between different departments. Being in a technology related department could result in different effect when compared with being in social science department. In future studies the gender and department differences may be added to the model or even could be investigated as stand-alone.

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APPENDICES

APPENDIX-A – MEAN AND 5% TRIMMED MEAN VALUES

ITEMS	N (Valid Case)	Mean	% 5 Trimmed Mean
item_1	207	3,35	3,39
item_2	207	3,67	3,72
item_3	207	3,10	3,11
item_4	207	2,94	2,93
item_5	207	3,29	3,33
item_6	207	3,67	3,72
item_7	207	2,45	2,43
item_8	207	3,63	3,68
item_9	207	3,29	3,33
item_10	207	3,40	3,45
item_11	207	3,77	3,84
item_12	207	3,40	3,42
item_13	207	3,64	3,71
item_14	207	2,92	2,91
item_15	207	3,04	3,04
item_16	207	2,86	2,84
item_17	207	4,17	4,28
item_18	207	3,37	3,51
item_19	207	3,27	3,30
item_20	207	3,12	3,13
item_21	207	2,70	2,66
item_22	207	3,36	3,40
item_23	207	3,07	3,08
item_24	207	2,77	2,75
item_25	207	3,34	3,38

item_26	207	3,05	3,06
item_27	207	3,23	3,25
item_28	207	2,73	2,70
item_29	207	2,66	2,62
item_30	207	3,80	3,89
item_31	207	3,55	3,61
item_32	207	2,58	2,54
item_33	207	3,13	3,14
item_34	207	2,36	2,31
item_35	207	2,17	2,12
item_36	207	2,55	2,50
item_37	207	2,95	2,95
item_38	207	3,60	3,67
item_39	207	2,96	2,95
item_40	207	2,51	2,48
item_41	207	3,43	3,47
item_42	207	2,66	2,62
item_43	207	3,38	3,42
item_44	207	3,11	3,12
item_45	207	3,43	3,47
item_46	207	3,68	3,76
item_47	207	3,24	3,26
item_48	207	3,83	3,92
item_49	207	3,37	3,41
item_50	207	3,29	3,32
item_51	207	2,96	2,96

APPENDIX B – SKEWNESS AND KURTOSIS VALUES

ITEMS	N (Valid Case)	Skewnes	Std. Error (Skewness)	Kurtosis	Std. Error (Kurtosis)
item_1	207	-,477	,169	-,425	,337
item_2	207	-,828	,169	,217	,337
item_3	207	-,064	,169	-,607	,337
item_4	207	-,041	,169	-1,232	,337
item_5	207	-,438	,169	-,671	,337
item_6	207	-,621	,169	-,458	,337
item_7	207	,135	,169	-,875	,337
item_8	207	-,775	,169	,295	,337
item_9	207	-,440	,169	-,580	,337
item_10	207	-,652	,169	-,294	,337
item_11	207	-1,128	,169	1,597	,337
item_12	207	-,317	,169	-,198	,337
item_13	207	-,924	,169	,134	,337
item_14	207	-,065	,169	-,341	,337
item_15	207	-,222	,169	-,731	,337
item_16	207	-,083	,169	-1,062	,337
item_17	207	-1,361	,169	2,080	,337
item_18	207	-,703	,169	,052	,337
item_19	207	-,605	,169	-,426	,337
item_20	207	-,304	,169	-1,016	,337
item_21	207	,222	,169	-,871	,337
item_22	207	-,610	,169	-,355	,337
item_23	207	-,354	,169	-,946	,337
item_24	207	,113	,169	-,533	,337
item_25	207	-,470	,169	-,270	,337
item_26	207	-,052	,169	-1,340	,337
item_27	207	-,529	,169	-,414	,337
item_28	207	,117	,169	-,956	,337
item_29	207	,308	,169	-,607	,337
item_30	207	-1,066	,169	,244	,337

item_31	207	-,711	,169	-,641	,337
item_32	207	,344	,169	-,641	,337
item_33	207	-,227	,169	-,014	,337
item_34	207	,639	,169	-,085	,337
item_35	207	,736	,169	-,069	,337
item_36	207	,445	,169	-,411	,337
item_37	207	-,191	,169	-1,301	,337
item_38	207	-,758	,169	-,008	,337
item_39	207	-,202	,169	-,979	,337
item_40	207	,175	,169	-,464	,337
item_41	207	-,674	,169	-,229	,337
item_42	207	,358	,169	-,925	,337
item_43	207	-,578	,169	-,557	,337
item_44	207	-,387	,169	-,835	,337
item_45	207	-,730	,169	-,102	,337
item_46	207	-1,043	,169	,942	,337
item_47	207	-,477	,169	-,821	,337
item_48	207	-1,069	,169	,569	,337
item_49	207	-,649	,169	-,183	,337
item_50	207	-,587	,169	-,544	,337
item_51	207	-,159	,169	-,816	,337

APPENDIX C – RELIABILITY (CRONBACH'S ALPHA) FOR ALL ITEMS

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
item_1	158,43	475,207	,679	,888
item_2	158,11	487,536	,470	,891
item_3	158,68	477,870	,642	,888
item_4	158,84	500,562	,122	,895
item_5	158,48	475,125	,670	,888
item_6	158,11	501,167	,146	,894
item_7	159,33	486,396	,473	,890
item_8	158,15	491,468	,392	,891
item_9	158,48	474,193	,684	,888
item_10	158,38	479,051	,597	,889
item_11	158,00	491,442	,428	,891
item_12	158,38	488,761	,471	,891
item_13	158,14	474,694	,667	,888
item_14	158,86	482,445	,578	,889
item_15	158,74	492,378	,316	,892
item_16	158,92	474,678	,648	,888
item_17	157,60	495,532	,317	,892
item_18	158,41	478,971	,662	,888
item_19	158,51	473,426	,716	,887
item_20	158,66	485,848	,420	,891
item_21	159,08	530,920	-,412	,902
item_22	158,42	491,342	,357	,892
item_23	158,71	469,731	,737	,887
item_24	159,00	515,121	-,145	,898

item_25	158,43	483,412	,540	,890
item_26	158,72	495,705	,189	,895
item_27	158,55	484,161	,500	,890
item_28	159,05	511,066	-,057	,897
item_29	159,12	528,980	-,405	,901
item_30	157,98	484,466	,430	,891
item_31	158,23	488,555	,340	,892
item_32	159,19	484,370	,459	,890
item_33	158,65	491,210	,419	,891
item_34	159,42	528,371	-,431	,901
item_35	159,61	526,608	-,399	,900
item_36	159,23	513,138	-,101	,897
item_37	158,83	511,241	-,060	,897
item_38	158,18	496,148	,253	,893
item_39	158,82	473,225	,678	,887
item_40	159,27	487,623	,450	,891
item_41	158,35	477,773	,605	,889
item_42	159,12	500,278	,142	,895
item_43	158,40	490,105	,362	,892
item_44	158,67	474,534	,662	,888
item_45	158,35	475,268	,676	,888
item_46	158,10	493,738	,331	,892
item_47	158,54	486,968	,424	,891
item_48	157,95	500,114	,159	,894
item_49	158,41	475,912	,654	,888
item_50	158,49	474,358	,676	,888
item_51	158,82	492,791	,301	,893

APPENDIX D – MAIN SURVEY COVER PAGE AND DEMOGRAPHIC QUESTIONS

Cover Page:

Bu araştırma üniversite öğrencilerinin akıllı kart kabullenişlerini belirlemeye yönelik bir araştırmadır. Akıllı Kartlar (Smart Card) üniversite içerisinde kütüphane, kafeterya, bilgisayar laboratuarları ve okul kapı girişlerinde kullanmış olduğunuz üstteki resimde örneği görülen çok amaçlı kimlik kartlarıdır. Anketi cevaplandırmak yaklaşık 10 dakikanızı alacaktır. Ankete katılım gönüllülük esasına dayalıdır ve isim yazmanıza gerek yoktur.

Katılımınız için teşekkür ederiz.
Mahmut TEKER
Bilişim Sistemleri
Yüksek Lisans Öğrenci

Demographic Questions:

1. Cinsiyet □ K □ E
2. Sınıf :……
3. Bölüm:……..
4. Kredi Kartı kullanıyor musunuz? □ E □ H
5. Yaş:……

APPENDIX E- MAIN SURVEY ITEMS

Yönerge: Aşağıdaki maddeler çok amaçlı kimlik kartınızın kabullenişi ile ilgili görüşlerinizi öğrenmek için hazırlanmıştır. Lütfen maddeleri eksiksiz olarak işaretleyiniz. Maddeleri, "**1=Kesinlikle Katılmıyorum**", "**2=Katılmıyorum**", "**3=Kararsızım**", "**4=Katılıyorum**" ve "**5=Kesinlikle Katılıyorum**", şeklinde, sağdaki sütunların yalnız birinin içine "X" işareti koyarak yanıtlayınız.

	1=Kesinlikle Katılmıyorum	**2=Katılmıyorum**	**3=Kararsızım**	**4=Katılıyorum**	**5=Kesinlikle Katılıyorum**
1. Akıllı Kart kullanımı okul içerisindeki işlerim için çok kullanışlıdır.					
2. Akıllı Kart makinelerinin kullanımı anlaşılırdır.					
3. Akıllı Kart ile yapmak istediklerimi daha etkili bir şekilde yapabilmekteyim.					
4. Tecrübeli arkadaşlarım Akıllı Kart kullanımında bana yardımcı olmuşlardır.					
5. Akıllı Kart kullanımı işlerimi kolaylaştırmaktadır.					
6. Akıllı Kart makinelerinin ara yüzü (makinelerden para yüklerken kullanılan ekranlar) bana karışık gelmektedir.					
7. Akıllı Kart kullanımı okul içerisindeki performansımın artmasına sebep olmaktadır.					

8. Akıllı Kart makinelerinin kullanımını kolaydır.					
9. Okul içerisindeki işlemlerimi Akıllı Kart ile daha hızlı gerçekleştirebilmekteyim.					
10. Akıllı kart kullanımı fazla uğraşı gerektirmez.					
11. Akıllı Kart kullanımını öğrenmek kolaydır.					
12. Akıllı Kart makinelerinin ara yüzü kullanıcı dostudur.					
13. Sistemler düzgün çalıştığı sürece Akıllı Kartımı kullanmaya niyetliyim.					
14. Akıllı Kart kullanımı etkinliğimi artırmaktadır.					
15. Okul Akıllı Kart kullanımı için öğrencilerini desteklemiştir.					
16. Akıllı Kart sistemini çevremdekilerin kullanımı için önermekteyim.					
17. Akıllı Kart sistemini kullanmak o kadar zordur ki ne olup bittiği anlaşılamamaktadır.					
18. Genel olarak Akıllı Kart kullanımının pek çok avantajı vardır.					
19. Genel olarak Akıllı Kart sistemini beğenmekteyim.					
20. Akıllı Kart kullanımı alışkın olduğum bir uygulamadır (kredi kartı gibi)					
21. Akıllı Kart kullanımı ile ilgili endişelerim bulunmaktadır.					
22. Akıllı Kart kullanımı için gerekli kaynaklara sahibim.					
23. Akıllı Kart kullanımı benim tercih ettiğim bir uygulamadır.					
24. Akıllı kart kullanımı daha önce kullanmış olduğum kart ile yapılan sistemlerden farklıdır.					
25. Ödemelerimi yaparken Akıllı Kartımı kullanmanın güvenli olduğunu düşünüyorum.					
26. Akıllı Kartımı kaybetmekten korkuyorum.					
27. Okulun kurmuş olduğu Akıllı Kart sistemine güveniyorum.					
28. Akıllı Kart sistemini kullanırken (para yükleme sırasında) düzeltilemeyecek bir hata yapmaktan çekinmekteyim.					
29. Akıllı Kart kullanımı konusunda kaygılarım var.					

30. Akıllı Kart kullanımının kütüphane, bilgisayar laboratuarları gibi yerlerde güvenlik amaçlı kullanımını destekliyorum.					
31. Akıllı Kartın kapı giriş çıkışları, laboratuar gibi yerlerde kullanılmasının güvenliği artırdığını düşünüyorum.					
32. Okulun Akıllı Kart kullanımını özendirici çalışmaları kullanmamda etkili olmuştur.					
33. Akıllı Kart uygulaması diğer sistemlerle uyumlu çalışmaktadır					
34. Akıllı Kart sistemini kullanmak çok zaman almaktadır.					
35. Akıllı Kart sistemini öğrenene kadar çok zaman geçmesi gerekmektedir.					
36. Akıllı Kart kullanımında güvenlikle ilgili çekincelerim var.					
37. Akıllı Kart kullanımı benim için yeni bir deneyimdir.					
38. Akıllı Karta para yükleme işlemleri bana çok karışık gelmektedir.					
39. İşlemleri Akıllı Kart kullanarak gerçekleştirmeyi seviyorum.					
40. Fikirlerine önem verdiğim insanlara göre Akıllı Kart kullanmalıyım.					
41. Akıllı Kart sisteminin okul tarafından desteklenmesini isterim.					
42. Akıllı Kartımın kullanımdan dolayı zarar görmesinden endişeleniyorum.					
43. İçinde bulunduğum ortam Akıllı Kart kullanmamı etkilemiştir.					
44. Akıllı Kart sistemini ihtiyaç olduğu kadar sık kullanmaya niyetliyim.					
45. Akıllı Kart bence kullanılması gereken bir uygulamadır.					
46. Akıllı Kart sistemlerini kullanmak için gerekli bilgiye sahibim.					
47. Arkadaşlarımın çoğu Akıllı Kartını kullanmaktadır.					
48. Okul içerisindeki bazı sistemleri kullanabilmek için sadece Akıllı Kart gerekmektedir.					
49. Akıllı Kart sistemini gelecekte kullanacağım.					
50. Akıllı Kartımı kullanmaya karşı istekliyim.					

51. Akıllı Kart kullanımı için destek alabileceğim kişi veya gruplar bulunmaktadır.					

APPENDIX F – AGE AND DEPARTMENT DETAILS

Age:

Age	**Frequency**	**Percent**	**Cumulative Percent**
18	2	1,0	1,0
19	25	12,1	13,0
20	57	27,5	40,6
21	48	23,2	63,8
22	39	18,8	82,6
23	15	7,2	89,9
24	8	3,9	93,7
25	6	2,9	96,6
27	1	,5	97,1
28	3	1,4	98,6
32	1	,5	99,0
36	1	,5	99,5
45	1	,5	100,0
Total	207	100,0	

Department:

	Frequency	Percent	Cumulative Percent
Havacılık	6	2,9	2,9
Kimya	13	6,3	9,2

İşletme	4	1,9	11,1
Metalürji ve Malzeme Müh.	7	3,4	14,5
Petrol Müh.	5	2,4	16,9
Bilgisayar Müh.	8	3,9	20,8
Endüstri Müh.	8	3,9	24,6
Mimarlık	2	1,0	25,6
Fizik Öğretmenliği	3	1,4	27,1
Psikoloji	4	1,9	29,0
Makine Müh.	19	9,2	38,2
İlköğretim Fen Eğitimi	3	1,4	39,6
Elektrik Elektronik Müh	18	8,7	48,3
Uluslararası İlişkiler	2	1,0	49,3
İktisat	1	,5	49,8
Çevre Müh.	2	1,0	50,7
İnşaat Müh.	19	9,2	59,9
Kamu Yönetimi	3	1,4	61,4
Bilgisayar Öğretmenliği	4	1,9	63,3
İstatistik	10	4,8	68,1
Fizik	17	8,2	76,3
Matematik_öğretmenliği	7	3,4	79,7
Moleküler Biyoloji ve Genetik	1	,5	80,2
Jeoloji Müh.	6	2,9	83,1
Felsefe	2	1,0	84,1
Sosyoloji	3	1,4	85,5
Gıda Müh.	7	3,4	88,9
Matematik	2	1,0	89,9
Tarih	1	,5	90,3

Şehir ve Bölge Planlama	1	,5	90,8
Bilişim Sistemleri	2	1,0	91,8
Kimya Müh.	8	3,9	95,7
Maden Müh.	5	2,4	98,1
İlköğretim Bölümü	4	1,9	100,0
Total	207	100,0	

APPENDIX G – ETHICS CLEARANCE

1956

Orta Doğu Teknik Üniversitesi
Middle East Technical University

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ENFORMATİK ENSTİTÜSÜ MÜDÜRLÜĞÜNE

Üniversitemiz Bilişimi Sistemleri Anabilim Dalı (IS) yüksek lisans programı öğrencisi Mahmut Teker'in Ekim 2010- Ocak 2011 tarihleri arasında *"Üniversite Öğrencilerinin Çok Amaçlı Akıllı Kart Kabullenişlerini Etkileyen Faktörler"* başlıklı araştırmasına ilişkin olarak ODTÜ öğrencilerine ve çalışan yetişkinlere uygulama yapmak için, öğrencinin isteği doğrultusunda görevlendirilmesi Etik Komite onayı ile uygun görülmüştür.

Uygulamanın yapılabilmesi için gereğini arz ederim.

Saygılarımla.

Nesrin Ünsal
Öğrenci İşleri Daire Başkanı

Ekler:
1- İAEK Başvuru Formu
2-İAEK Başvuru Kontrol Listesi
3-İAEK Başvuru Formu Proje Bilgi Formu
4-Anket