A WEB BASED MULTI-CRITERIA DECISION SUPPORT SYSTEM FOR DEPARTMENT SELECTION PROCESS OF VOCATIONAL HIGH SCHOOL STUDENTS

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2013

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Thesis submitted to the
Institute for Graduate Studies in the Social Sciences
in partial fulfillment of the requirements for the degree of

Master of Arts
in
Management Information Systems

by
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Boğaziçi University
2013

A Web Based Multi-Criteria Decision Support System
for Department Selection Process of Vocational High School Students

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July 2013

Thesis Abstract

Mustafa Coşkun, "A Web Based Multi-Criteria Decision Support System for Department Selection Process of Vocational High School Students"

Education Management Information Systems have been going under direct mutation in Turkey during last decade. In this manner, educational data mining becomes very essential to be discussed with the data gathered by those systems. In this study, a web-based decision support system (WBDSS) is designed with multiple linear regression algorithm for the department selection process of vocational high schools by the help of the individual correlation between 9th level courses and 10th level departmental and common courses of students. The main knowledge discovery sequences of data mining have been applied to the methodology of WBDSS and the system is implemented by the data gathered from Bahçelievler Vocational Trade High School. As a result of the research a combination between E-Okul and WBDSS is found to be remarkable for best implementation and evaluation purposes.

Tez Özeti

Mustafa Coşkun, "Meslek Lisesi Öğrencilerinin Bölüm Seçim Süreci için Web Tabanlı Çok Kriterli Karar Destek Sistemi"

Son on yıl içerisinde Eğitim Yönetim Bilişim Sistemleri Türkiye'de direk bir değişinim içerisindedir. Bu bağlamda, bu sistemlerden elde edilen veriler ile yapılacak eğitsel veri madenciliğinin çok gerekli olduğu düşünülmektedir. Bu çalışmada, meslek lisesi öğrencilerinin bölüm seçim süreci için, öğrencilerin 9. sınıf dersleri ve 10. sınıf bölüme bağlı ve genel dersleri arasındaki bireysel ilgileşim yardımıyla çalışan basit lineer regresyon algoritması ile bir web-tabanlı karar destek sistemi (WTKDS) tasarlanmıştır. WTKDS'nin metodolojisine temel bilgi keşif dizisi aşamaları uygulanmış ve yürütülme aşaması Bahçelievler Ticaret Meslek Lisesi'nden edinilen veriler ile gerçekleştirilmiştir. Bu çalışma neticesinde, en iyi yürütme ve değerlendirme için E-Okul ve WTKDS'nin kombinasyonunun gerekli olduğu sonucuna varılmıştır.

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to my master thesis advisor, Prof. Dr. Meltem Özturan for her valuable guidance and continuous support throughout my academic work.

I would like to thank Asist. Prof. Sona Mardikyan and Prof. Dr. Yavuz Akpınar for participating my thesis committee.

I am also grateful to my colleagues in Department of Information Technologies in Bahçelievler Vocational Trade High School for their precious support and comments, without their sympathy I could not finish my study.

I owe my special thanks to my family for their heartfelt encouragement, patience and moral support which have accompanied me through this stressful period.

Finally, I would like to express my deepest appreciation to my love Bircan Coşkun for being in my life and for her endless belief and understanding.

To My Daughter Nehir Ela

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FORMULAS

ABBREVIATIONS

AF: Accounting and Finance Department
ANN: Artificial Neural Network
ANOVA: Analysis of Variance
AVU: General Adult Education in Denmark
BED1: Physical Education 1 Course
BED2: Physical Education 2 Course
BIY: Biology Course
BOP1: Office Programs Course
BOP2: Office Programs Course
BTT: Fundamentals of Information Technologies Course
BTYKA: Survey of Information Technologies Usage and Penetration
BVTHS: Bahçelievler Vocational Trade High School
CA: Computerized Accounting Branch of Accounting and Finance Department
CAL: Working Life Course
CNCP: National Catalogue of Qualifications in Spain
COG1: Geography 1 Course
COG2: Geography 2 Course
CTE: Career and Technical Education in USA
CyLLS: Cyprus Lifelong Learning Strategy
DIL2: Turkish Language 2 Course
DIN2: Religion and Ethics Science 2 Course
ECVET: European Credit System for Vocational Education and Training
EDB1: Literature 1 Course
EDB2: Literature 2 Course
ESO: Spanish Secondary Education
FIZ1: Physics 1 Course
FTOS: Foreign Trade Office Services Branch of Accounting and Finance Department
FVU: Preparatory Adult Education in Denmark
GPA: Grade Point Average
ICT: Information and Communication Technology
ISCED: Includes Scuola Primaria in Italy
IT: Information Technologies Department
KIM: Chemistry Course
KLA: Keyboard Writing Course
MAT1: Mathematics 1 Course
MAT2: Mathematics 2 Course
MEB: Turkey Ministry of National Education
MEBBIS: Information System of Ministry of National Education
MEGEP: Vocational-Technical Education Promotion Program
MES: Professional Development Course
MIL: National Security Course

MUH1: Accounting 1 Course
MUS: Customer Relationships Course
MR: Marketing and Retail Department
NQF: National Qualification Framework
OECD: Organization for Economic Co-operation and Development
PAP: Package Programs Course
PCPI: Initial Vocational Qualification Programs in Spain
PISA: Program of International Student Assessment
SME: Small and Medium-Sized Enterprises
TAR1: History 1 Course
TAR2: History 2 Course
TEO: Basic Electronics and Measurement Course
TIC: Commercial Accountings Course
TMR: Technical and Professional Drawing Course
TSI: Turkish Statistical Institute
TUBITAK: The Science and Technological Research Council of Turkey
VET: Vocational Training and Education
VMBO: Voorbereidend Middelbaar Beroepsonderwijs in Netherlands and Czech Republic
WBDSS: Web Based Department Selection System
WP: Web Programming Branch of Information Technologies Department
YBD1: Foreign Language 1 Course
YBD2: Foreign Language 2 Course

CHAPTER 1

INTRODUCTION

Education is the most important and endless process of human life and technology is the name of the current century. Computers, as the "The most powerful invention of the history", have caused a big impact, evolution and diversity in education like any other aspects of modern life. Therefore, "information technology" and "education" terms have become a part of each other. Information technology is used not only for constructing the most effective education environment but also for improving the quality of education by evaluating and recommending best solutions. In this sense, data mining, which is today's most popular method of technological data investigation, comes to mind for educational evaluation and guidance.

Currently, education is undergoing change to make itself more practical. Since with small communication devices, people can reach information everywhere, and use it where they want, education does not mean "learning more information and memorizing", anymore, as it was accepted before technology revolution.

During recent decades, computers, progressively, have taken the role of the steam engine that had revolutionary effects on the process of becoming an industrial society, by converting it into an information society. Today, computers and the internet, the main complementary feature of computers, have become the most adaptive concept of the society. The reflections of the fact on education can be concluded, briefly, as; improving the effectiveness and efficiency of the education system, converting education into a continuous process independent from place and time. Considering these facts, developed countries have taken into consideration the use of internet and computers in the study of education much more than they have the traditional methods.

Computer technology and internet, as a complementary feature, not only play a determinant role on creating the individuals of the future, but also have a specific position on the process of solving the main problems of the current education system. In other words, computer and internet utilization is an essential factor, today, in order to cope with such problems as orienting individuals to the growing complexity of social life, making learning activities effective and efficient regarding the needs of individuals, transforming main capabilities of education system (time and place) to limitless features in the modern era.

The complex architecture of the computer provides a much greater capability for the education system than do all the other educational technology devices. Because of these specific features of the computer, usage of this technology in education has many benefits. These advantages can be listed as: making students self-confident, providing a secure platform for education, giving immediate feedback, direct access to rich information sources, ability to present the information by new methods, giving opportunity to group work (Rıza, 2001, c.f. Yılmaz & Horzum, 2005).

Since computers and the internet are the main considerable part of the modern education system, these concepts should be figured out not only a "pre" or "sub" process instruments, but also a "post-instrument". In other words, computers and the internet would be supporting elements of education system during the feedback and evaluation processes. Therefore, in Turkey, as a developing country, a new Learning Management System called "E-Okul" was created as one of the two management information systems of The Ministry of National Education - MEB (The other one is called "MEBBIS", which directly consists of human resources management applications).

In addition to these facts, vocational education has been focused specifically by the largest companies of the market in our country as a European Union candidate. During this developmental process, a new and superior project was declared by the largest conglomerate of Turkey: "Vocational Education is a Country Issue" (*Meslek Lisesi Memleket Meselesi*). By the help of this evolutionary project; curriculum, courses, structures, facilities and many other aspects of vocational education and training system of Ministry of National Education had been redesigned.

While the period of high school education was 3 year before this project, it was simultaneously increased to 4 years in the process of converting obligatory education period of Turkish National Education System from 8 years to 12 years. Also, the first year of all high schools (including vocational ones) was made identical in terms of courses and curriculum except for elective courses. After the first year (9th grade), students are allowed to choose their departments in vocational high schools. Although there is a systematic selection process in Anatolian high schools for the departmental allocation of students in which students who have verbal course high scores get transferred to the literature department and the others are enrolled in the mathematics department, there is no such detailed process in vocational high schools. In fact, there are more departments in vocational high school than in Anatolian ones.

The aim of this study is to design a web-based multi-criteria decision support system for the process of student allocation to the departments in vocational high schools. The current process depends on only two general criteria which are "9th grade cumulative score" and "primary school diploma degree". It is believed that a systematic multi-criteria decision support system which executes with the information given by an associative educational data mining algorithm would be determinant in this process.

CHAPTER 2

LITERATURE SURVEY

Computers & Internet versus Education in Turkey

According to the Turkish Statistical Institute's (TSI) report, called "Information and Communication Technology (ICT) Usage Survey on Households and Individuals, 2012." the proportion of households with Internet access rose to 47.2 % in Turkey while it was 42.9 % in April, 2011. Additionally, 43.2% of those households had broadband connection and percentage of households with access to the Internet was 55.5% in urban areas and 27.3% in rural areas.

Moreover, the speed of technology awareness and internet demand in our society, due to the interactive web applications (web 3.0 features), would have increased internet access.

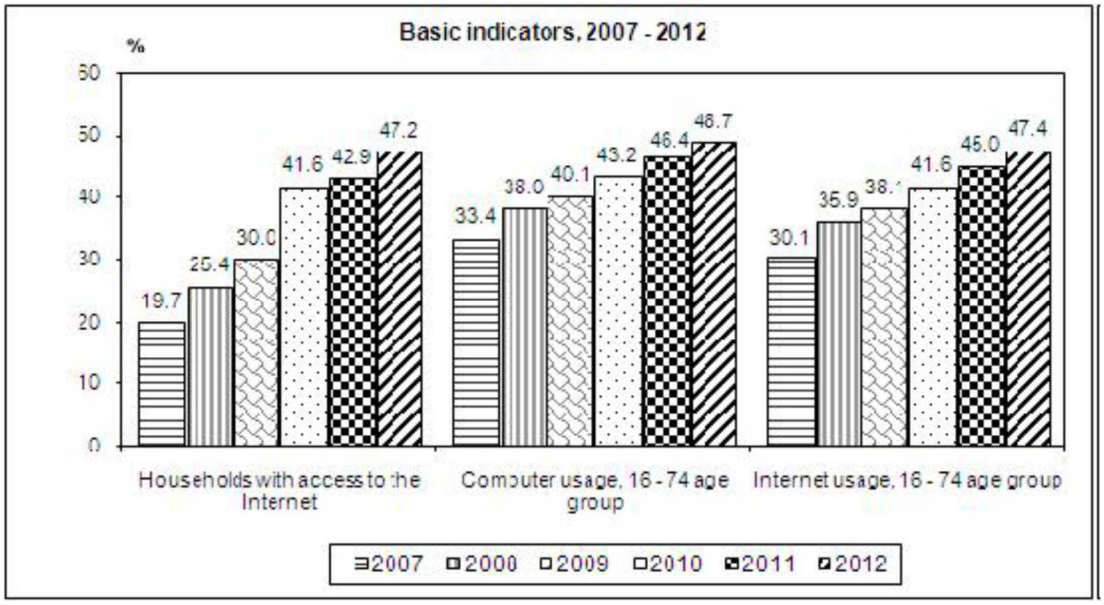


Figure 1. Number of internet users in Turkey (TSI, 2012)

Table 1. Computer and Internet Usage by Gender and Education Level in 2012 (TSI, March 2012)

Education Level	Computer Usage (%)		Internet Usage (%)	
	Male	Female	Male	Female
Literate without a diploma	9.6	1.7	10	1.6
Primary School	23.1	14.5	22	13.5
Secondary School	64.5	51.0	63.8	49.4
High School	80.5	72.4	79.7	71.3
University/Master/Doctorate	93.7	92.7	93.1	92.8

Table 2. Computer and Internet Usage by Gender and Age Group in 2012 (TSI, March 2012)

Age Group	Computer Usage (%)		Internet Usage (%)	
	Male	Female	Male	Female
16 - 24	81.1	56.4	80.6	55.4
25 - 34	70.0	48.1	69.6	47.2
35 - 44	54.3	32.7	53.3	31.8
45 - 54	36.3	17.0	34.8	16.2
55 – 64	19.1	6.1	18.5	5.6
65 - 74	6.9	1.3	6.4	1.3

As the Figure 1, Table 1 and Table 2 show, the number of internet usage increases rapidly in Turkey concerning with the Age, Gender and Education Level. Also, it can be easily found that the demand for the internet is positively related to education level.

Moreover, Ministry of National Education's "National Education Statistics Report (MEB, 2013)" summarizes the high schools and student numbers of our National Education System. In accordance with the results of the 2011-2012 terms, there were 9672 total high schools, consisting of 4171 Anatolian high schools and 5501 vocational high schools. In 2012, these values increased to 10148 high schools, which consisted of 4214 Anatolian high schools and 6204 vocational high schools. These values show that the number of vocational high schools rise quickly compared to general ones. This fact definitely directs a technical infrastructure need for education system in order to conduct a better technical and vocational education system. In this

manner, 2012 Annual Report of MEB shows that a big attempt to enhance the technological structure by improving the internet access and computer laboratory numbers of schools. According to the Annual Report (2012), all of the schools that include more than 8 classes have at least one information technology laboratory (total number is 28912 laboratories and 896521 computers). Also, 38500 schools have broadband internet connection and 4500 schools have satellite internet connection. By these numbers, it is stated in the report that 100 % of high schools and 98% of primary schools have internet connection.

Lastly, according to TSI March 2012 report, the percentages of internet applications that the respondents intend to use are;

- Sending/receiving e-mails (66.8 %)
- Telephoning / video calls (via web cam) over the Internet (42.5 %)
- Posting messages to chat sites, social networking sites, blogs, news groups, or online discussion forum, use of instant messaging (41.6 %)
- Reading or downloading online news/newspapers/news magazines (72.5 %)
- Finding information about goods or services (61.3 %)
- Listening to web radios or watching web televisions (39.2 %)
- Playing or downloading games, images, films or music (49.1 %)
- Playing networked games with other persons (28.8 %)
- Uploading self-created content (text, photos, music, videos, software etc.) to any website to be shared (33.7 %)
- Making an appointment with a practitioner via a website (19.6 %)
- Using services related to travel or travel related accommodation (18.9 %)
- Internet banking (17.1 %)

In conclusion, these research studies show that internet and computer technology usage has a big demand, while the evaluation and education systems do not use such kind of instruments, yet.

Vocational Education and Training (VET) in the World

VET in the world is started to be changed deeply in the 90s, "toward a broader preparation that develops the academic and technical skills of students as well as the vocational" (White-Clouds, 2006). Throughout this perspective countries signed a lot of critical agreements in which billions of funds are set aside to improve vocational education internationally. Since the world is global now, governments are trying to improve their vocational education level by signing international agreements and applying each other's best methods of education in order to combine their market place and vocational schools. As it is explained in this chapter, the vocational education methods of Europe, USA, and Turkey have been changing and resembling each other since the beginning of 1990s.

Vocational Education and Training in Europe

In European countries, income inequality is much greater than in the USA. As a union of many countries, European Commission has considered a common VET system. But before constructing this kind of system, there should be a preparation phase. In this phase, countries needs to learn each other's systems and improve their own ones by the help of researching neighbors' ones.

Therefore, The European Recommendation on the European Credit System for Vocational Education and Training (ECVET) in June 2009 encouraged the start of

ECVET tests and experimentation. Most countries have started work, among them, Belgium (Wallonia), Germany, Austria and Finland have developed national initiatives which illustrate the diversity of approaches. They are considering ECVET either for enabling learning and aiding mobility or for supporting permeability within VET; they are carrying out feasibility or impact studies and, as in Belgium (Wallonia), the development of ECVET is nurtured by the developments and results of European ECVET projects (Cedefop, 2010).

The purpose of the Recommendation (ECVET) is to create a European Credit System for Vocational Education and Training, ECVET intended to facilitate the transfer, recognition and accumulation of assessed learning outcomes of individuals who are aiming to achieve a qualification. It is believed that this will improve the general understanding of citizens' learning outcomes and their transparency, transnational mobility and portability across and, where appropriate, within Member States in a borderless lifelong learning area, and will also improve the mobility and portability of qualifications at national level between various sectors of the economy and within the labor market furthermore, it will contribute to the development and expansion of European cooperation in education and training (European Commission, 2009, p. 11).

By this perspective, the ECVET mobility project has been improving the structure of VET in European countries and also combining a main system for all of Europe. If we consider the European countries vocational education systems individually, the systems of these countries can be summarized as follows:

As it is stated in the ECVET 2012 report of Belgium, in this country, education is compulsory for 6 to 18 year-olds: full-time up to the completion of the second stage of secondary school and part-time as from the third stage, 15/16 years. The Belgian

VET system actually starts at the age of 14, if the pupil follows normal progression. Until the age of 15, only one provider is in charge of VET in compulsory education: the schools, under the responsibility of the Ministry of Education, in each Community. At the start of the secondary education stage, the scope of VET extends to new providers besides the schools. Pupils may orient themselves towards part-time programs, alternating work and learning, organized either by schools or by the training organizations of Small and Medium-Sized Enterprises (SMEs). Adult education may also provide courses for them or as a partner-provider for schools in some programs. Once the students have reached the age of 18, the scope of VET gets even broader. Young people may stay in the education system, go to work or to any public or private vocational training provider, depending on their own professional career objectives, level of studies or other conditions like their social status: students, workers, jobseekers, etc. If the students leave the education system without a certificate/diploma of secondary school, they may continue to adult education. At any time from the age of 18, it is also possible, in Belgium, to move towards a validation via a skills center to obtain a qualification certificate. Basically, Government-Regulated VET systems in Belgium do not really differ in terms of public providers and their basic structure. The same type of device exists in all regions/communities, but sometimes has another name. What really makes the difference is the decision-making and implementing processes. These refer to regional and community policy statements made every four years in the frame of a new political term and agenda (Isabelle, 2012).

Cyprus ECVET 2012 report shows that, in this country, the earliest level at which Vocational Education and Training (VET) is available, is the upper secondary level at the technical schools, including the evening technical schools. VET is also

available through the apprenticeship system, which accepts students who leave formal education between grades eight and ten. Post-upper secondary VET will be provided as of the academic year 2012-13 at the post-secondary institutes of vocational education and training. VET at tertiary level is provided at four public institutes/colleges, which come under the jurisdiction of various ministries and at several private institutes. Furthermore, vocational training is extensively available in Cyprus for employees, the unemployed, other groups at risk of exclusion from the labor market and adults in general through a mixture of public and private provision such as colleges, training institutions, consultancy firms and enterprises. According to Korelli (2012), VET is an important and prominent part of the Cyprus Lifelong Learning Strategy (CyLLS) for 2007-2013. And, the main actions designed to achieve the objectives of the strategy include enhancement of lifelong guidance and counselling services, development of a National Qualifications Framework (NQF) and promotion of actions outlined in the education reform that have a specific impact on VET such as the creation of new VET pathways and facilitate horizontal and vertical movement within education.

Additionally, Denmark Ministry of Education explains their VET system in ECVET Report of 2012 as follows; basic schooling is compulsory from the age of 6 to 16, from pre-school class to ninth grade in that country. After the 9th grade, 60% of a youth cohort elects to continue within the optional 10th grade, rather than direct entry to an upper secondary (youth education) program. The 10th grade is intended as an option for young people in need of further academic competence and clarification regarding their future choices before entering youth education (either general or vocational upper secondary education). Primary and lower secondary education in Denmark is generally integrated and located within the comprehensive Danish Public

School (Folkeskole), although other types of institution, such as private independent schools, also exist. Primary and lower secondary education is completed with a leaving examination providing access to upper secondary (youth) education. In the report Rolles (2012) adds that, within the adult education and continuing training system, there are two programs at this level. Preparatory Adult Education provides courses in basic literacy and mathematics, as well as courses for those with learning difficulties and those with Danish as their second language. General Adult Education is provided to adults who, for whatever reason, did not complete lower secondary education or need a supplement within particular subjects. Qualifications at this grade are equivalent to the 9th or 10th grade leaving examination (Rolles, 2012).

It is a well-known fact that Germany is made up of 16 states and this make the VET system of that country more complex. German Ministry of Education summarizes their VET system in ECVET Report 2012 that there is a distinct cooperative federalism within the State sector, both horizontally between the state and the Federal Government. Educational and cultural legislation and administration is primarily the responsibility of the state. In the field of VET the Federal Government is responsible for in-company vocational training, while the states are responsible for vocational training in schools, and hence also for vocational schools. Vocational training in enterprises has developed a third system situated between market and State, in the form of joint control. The governance of the VET system in Germany is characterized by strong partnership between state employers and trade unions. In this sense, upper secondary education leads either to a higher education entrance qualification or a vocational qualification for skilled work. The vocational track means that pupils may enter into vocational training in full time schools or within the framework of the dual

system or seek employment. Compulsory full-time education must have been completed by the time of commencing vocational training. There are no further requirements for access to training in the dual system; it is essentially open to everybody although the majority of trainees hold either the intermediate certificate. The requirement for entrance to fulltime vocational schools is normally the secondary general school certificate or the final certificate from intermediate school. The primary aim of training is to enable young people to acquire comprehensive vocational competence designed to make them capable of fulfilling their duties as employees efficiently, effectively and innovatively, autonomously, and in cooperation with others (Alice, 2012).

In Italy, it can be gathered from the ECVET Report 2012, first cycle of education (8 years): Includes Primary School (*Includes Scuola Primiria* - ISCED 1) that lasts 5 years and is attended by children aged 6 to 11 and Lower Secondary School (*Scuola Secondaria di I Grado* – ISCED 2) that lasts 3 years and is attended by children aged 11 to 14. At the end of the third year pupils sit a state exam and, if successful, they are awarded a lower secondary school diploma. Second cycle of education comprising two different pathways (ISCED 3):

- Upper Secondary School: falls under the responsibility of the State, lasts 5 years and caters for students aged 14 to 19. This level of education is provided by lyceums, technical institutes and vocational institutes which have been recently reformed in 2010. On completion of the 5-year path students sit an exam and, if successful, they are awarded an upper secondary school diploma;
- Three and four year education and vocational training courses (*Percorsi Triennali e Quadriennali di Istruzione e Formazione Professionale* – IFP): organized

> by the Regions, they cater for students who have completed their first cycle of education. A vocational certificate is awarded on the completion of three-year vocational courses and a vocational diploma is awarded on the completion of four-year courses. (Pitoni, 2012)

Koukku who is the director of VET project in Finland states their VET system in ECVET report of 2012 that almost all VET provision is government-regulated in their country. Most of the funding comes from the State and from local authorities. The qualification requirements for the different professions are also decided at a national level. Vocational education and training starts at upper secondary level. Students who have successfully completed compulsory education are eligible for general and vocational upper secondary education and training. Student selection is mainly based on the students' grades on their basic education certificate. The selection criteria used by vocational institutions may contain work experience and other comparable factors, including entrance and aptitude tests. More than 40 per cent of the relevant age group starts vocational upper secondary studies immediately after basic education. The biggest fields are technology, communications and transport and social services, health and sports. (Koukku, 2012)

Additionally, according to Martina, who reported their VET system in 2012, the Czech Republic shows a very high proportion of persons who attain at least Upper Secondary Education (ISCED 3 or higher) and Vocational Education as such has a long tradition there. In student numbers, vocational education accounts for almost three quarters of secondary education. This type of education is either concluded by a Maturity Examination (ISCED 3A – 47% of upper secondary level graduates) enabling to continue the studies at tertiary education or it does not include maturity and then it is

intended mainly for direct entry into the labor market (ISCED 3C – 29% of upper secondary level graduates). Over a long term, the Czech Republic records a decline in interest in secondary vocational education at the expense of secondary general education and in secondary education without maturity at the expense of the secondary education concluded by a maturity examination. While the population decreases, the absolute numbers of study places at the secondary general schools (*gymnázia*) stay the same in the country, which results in declining proportion of vocational education. The position of graduates of vocational education without maturity in the labor market is not particularly favorable. This group is very sensitive to fluctuations in the economy. Compared to experienced workers, the graduates are disadvantaged and employers often complain about poor quality of the graduates from vocational education without maturity. This is also due to the decline in interest in this type of vocational education, which often makes it a 'second-choice' education. (Martina, 2012)

In Netherlands, there is a systematic VET system constructed into special parts, according to Visser. This system starts with Pre-Vocational Secondary Education (VMBO – *Voorbereidend Middelbaar Beroepsonderwijs*) lasts 4 years. The first two years consist of general subjects only and years 3 and 4 are characterized by three system elements:

1. Pupils can receive extra support in the different programs;
2. Pupils choose a 'learning path' characterized by 'level differentiation', programmatic orientation and different transfer possibilities in the education system. The four learning pathways are:
    a. The Theoretical Learning Pathway (VMBO-TL–*Theoretische Leerweg*). Those graduating from the theoretical learning pathway can transfer to

upper secondary vocational education (especially long courses at the highest levels of upper secondary VET – MBO levels 3 and 4) or continue their education in the fourth year of upper secondary general education.

b. The Mixed/Combined Learning Pathway (VMBO-GL – *Gemengde Leerweg*). This is similar to the theoretical learning pathway but with a more pre-vocational orientation for about ten to fifteen per cent of the study time. Progression routes towards upper secondary VET are the same as for the theoretical pathway.

c. The Pre-Vocational Learning Pathway – Higher Level (VMBO-KL – *Kaderberoepsgerichte Leerweg*): preparation for long courses in VET at secondary level – MBO levels 3 and 4.

d. The Pre-Vocational Learning Pathway – Lower Level (VMBO-BL – *Basisberoepsgerichte Leerweg*): preparation for short courses in upper secondary VET – MBO level 2. Within this pathway, some pupils can participate in a dual track that combines learning and working. Various experiments were started in 2008, including the full integration of these programs and MBO level 2 programs in collaborations between schools.

3. Pupils choose a sector in the pre-vocational oriented pathways (agriculture, technology, economy and business, health and welfare) and further specialties within a sector.

The examination subjects are two obligatory subjects for all pupils (Dutch and English), two sector-specific subjects (limited choice) and two other subjects (different options). The vocationally oriented subjects can be broader or more restricted in nature. The

programs lead to nationally recognized qualifications/diplomas. Some examinations are organized centrally/nationally while others are the responsibility of the schools.

In addition, there is a specific practical pathway for low-achievers, which is geared towards preparing them for the labor market. Some of these pupils also transfer to upper secondary VET. Pupils without qualifications can also enter upper secondary VET. (Visser, 2012)

Lastly, in accordance with the 2012 ECVET report of Spain, in this country, the general education mainstream starting on pre-primary education (up to 6 years of age) and followed by the primary education which is the first compulsory stage of the education system, lasting six years (ISCED1A), and the first basic and compulsory VET program, starts in the Compulsory Secondary Education. Pupils that meet all the standards set for this stage of education, which comprises four years, are awarded with the Certificate of Secondary Education (*Educación Secundaria Obligatoria Certificate* - ISCED2A), which provides them access to Upper Secondary Education either Bachelor Education (*Bachillerato*-ISCED3A) or Intermediate General Vocational Training (*Título de Grado Medio*-ISCED3B), Intermediate Arts and Design or Intermediate Sports VET Diplomas (*Enseñanzas de Artes plásticas y Diseño y Enseñanzas Deportivas de Grado Medio*-ISCED3B) or the labor market. Pupils who do not achieve Spanish Secondary Education (ESO) objectives receive a Certificate (*Certificado de Escolaridad*) stating the number of years of attendance and the marks obtained. For such students Initial Vocational Qualification Programs (PCPI) are organized with the aim of providing professional skills equivalent to level one of the National Catalogue of Qualifications (CNCP) and with which once they pass their PCPI studies (ISCED3C), students may ask the Labor authorities for the accreditation of the correspondent Professional

Certificate level 1. These programs are designed to satisfactory insert social and labor fields and to broaden basic skills so as to continue studies mainly Intermediate VET Diplomas. Initial vocational training diplomas within the education system comprises Intermediate and High Vocational Training Programs named "*Ciclos Formativos*" of around 2000 hours (two academic teaching years) in different sectors or areas aggregated in professional families. In order to gain access to Intermediate VET Diploma (ISCED3B), pupils must hold the Certificate of Secondary Education (ISCED2A). On the other hand, to study advanced vocational training studies, it is necessary to hold the Bachelor (*Bachillerato*) Certificate (ISCED 3A) the same as to have access to university studies. Candidates may also be required to have taken certain specific subjects during their Bachelor (*Bachillerato*) studies related to the studies they wish to pursue. Pupils successfully completing high vocational studies are awarded the High Technical VET Diploma (*Técnico Superior* ISCED 5B), allowing them to enroll in University studies in fields related to the trade for which they have been trained. Applicants who do not have all the academic requirements may have access to any of the VET Diplomas or University degrees provided they pass a specific access exam and that their background in the area will enable them to take full advantage of such training and with specific age requirements. (Talavera, 2012)

Vocational Education and Training in the USA

President Barack Obama has said in the parliament speech on February 13th, 2012 that "an economy built to last demands that we keep doing everything we can to help students learn the skills that businesses are looking for." In the United States, ministry of education department calls vocational education as "Career and Technical Education". And in their expanding report, they stated that, "as the administration's

blueprint for a reauthorized Carl D. Perkins Career and Technical Education Act of 2006 ushers in a new era of rigorous, relevant, and results-driven Career and Technical Education (CTE), we must both identify effective programs and support the expansion of programs that have a record of success. To increase opportunities for students to gain exposure to rigorous college preparatory and work-based career and technical curricula, President Obama is proposing a new $1 billion competitive fund over three years to increase the number of high-quality career academies". (ed.gov, 2012)

It is clearly stated in the US Department of Education's CTE April 2012 report that the administration's blueprint for a reauthorized Perkins Act would transform CTE and usher in a new era of rigorous, relevant, and results-driven CTE shaped by four core principles: Alignment, Collaboration, Accountability and Innovation. In order to supply a more active role for states, there are three main activities are decided as "Increasing Secondary School Teacher and College Faculty Effectiveness", "Accelerated Completion Through Articulation Agreements", "Not Just Skills for a Single Job but Skills for a Lifetime of Career and Community Success".

Also, the US Department of Education believes that students in these CTE programs would be motivated to learn because they are challenged by the rigor and engaged by the relevance. They would be prepared to complete their studies with industry certifications or licensures and postsecondary certificates or degrees that employers use to make hiring and promotion decisions. They would start careers that lead to increased employment and earning prospects over time, positioning them to become the country's next leaders and entrepreneurs. At the same time, employers and industry would have a strong voice in developing the programs they need to fill positions within their companies. They would have access to a highly-skilled pool of

workers ready to make immediate contributions: educated citizens, skilled workers, competitive businesses, thriving industries.

Lastly, they describe themselves as "The Department of Education's mission is to promote student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access". (CTE, 2012)

Vocational Education in Turkey

In Turkey, as the first serious attempts of to orient students to different educational tracks in order to reduce the load of general/academic track and to strengthen the vocational courses to satisfy the need of future industry, a commission was formed in 1934, and made the following points:

Children graduating from primary schools were expected to be an officer in the government with a diploma of university, high school, or at least a secondary school certificate. Since having a degree for everyone is rather difficult, some students should be directed to have manual skills. And this can be made possible with a rationally planned technical education. (Ministry of National Education 1990: p. 23, c.f. Olkun 1995)

Between 1924 and 1962, vocational and technical education usually took 5 or 6 years of education following the compulsory primary education. Sometimes the first two years, sometimes three years were devoted to general academic preparation and the remaining time was devoted to vocational technical education. (Kıyar, 2010)

Vocational and technical education's poorness, "vocational-technical orientation" was strictly followed in some periods of the republic and the graduates of these schools were not allowed to pursue higher education. If they wished to do so, they required to finish a general high school after graduating from a vocational high school.

However, since the early 1980s, vocational-technical high school graduates have a full right of taking the university entrance examination like a general/academic high school graduate. Since then, vocational-technical education in Turkey has had a dual purpose, both general/academic preparation for university entrance examinations and vocational-technical preparation for the world of work.

In general, most observers of the system agree that, until 1986, a school based vocational-technical education became dominant with less industry training and work-based experience. To a great extent, the 1986 Law of 3308 altered this philosophy. The 3308 Apprenticeship and Vocational Education Act substantially reduced the time spent in school in favor of practical experience in industry settings. Students spend three days a week in the industry for practical training and two days a week in school for general academic or theoretical preparation in their last year of high school education. Since the initiation of the Act, the cooperation between vocational schools and the industry has slightly improved in terms of internships, teacher and resource exchanges, teacher training, and technology transfer (Kıyar, 2010). As of 1995, 336000 students enrolled in 700 vocational-technical schools instructed by 11000 technical teachers in Turkey (State Planning Agency, 1995).

E-Okul Applications among Vocational High School Students

E-Okul is the one of widest e-learning project of MEB, which has begun to be used in 2005 consisting 15 million students and 650 thousands teachers with the contribution of Microsoft (Gültekin, 2010). Also, Gültekin gives the information that, in January 25th 2008 Parent Enlightenment Module (PEM) of E-Okul was starting to be used. By this module parents and students can access to their information recorded by school

directors and related teachers. And, lastly, at the beginning of 2009-2010 term, this module was opened to high schools, including vocational and technical ones.

According to the survey prepared by "Again Health and Education Association" (*Yeniden Sağlık ve Eğitim Derneği*) in 2010; the respondents who are 3483 vocational high school students conclude these results:

- 15.8% of vocational high school students use internet
- 20% of students use computers to play games
- 6.2% of students go internet cafe to access internet
- The ratio of male and female about the demand on playing computer games is 4.7, on internet usage is 2.5 and ongoing to internet cafe 7.2

The importance of E-Okul usage in vocational high schools would be listed as followings;

Since the curriculum design method of vocational high schools is very flexible and can be changed by the teachers committee in departments, these facts force the E-Okul to be more complicated in vocational high schools (Gültekin, 2010). Also, the usage rate of E-Okul would be more effective and wide through technical school students; however, the tendency to the use of internet and E-Okul should be improved in vocational high schools for this purpose. Because, according to Bakay (2001), the demand on internet among Anatolian and science high schools' students is more than the ones in technical high schools.

Since the students of vocational high school are not at school all the time (they have vocational training program in 3 days of week in the 12th grade), E-Okul plays a deeper role for communication (Demir, 2006).

As a result, according to Akar (2009) the immediate feedback mechanism in E-Okul Applications would be motivating for the users (directors, teachers, parents and students).

"*Meslek Lisesi Memleket Meselesi*" Project

Koç Group initiated "Vocational-Technical Education Promotion Program" (MEGEP) in 2006 in cooperation with the Ministry of National Education. By the help of this project, successful primary school graduates (especially, young people with fewer opportunities) are aimed to be directed to vocational high schools and to have the best education linked with the industry's, IT and service sectors' needs by improving their practical and technical skills.

The project is wide among 81 cities of Turkey in 250 vocational high schools with 8000 students.

This widespread project started in 2006 with the aim of;

- creating awareness about vocational technical education's importance for the country's economy in all sections of society
- opening the way for trained work force by throwing the seeds of school-industry cooperation
- promoting the education of qualified technical personnel
- encouraging young people to vocational training

By the help of this project, the whole curriculum and educational design of vocational education had changed. In order to make the school more flexible in their own environment, course hours and yearly course plans are allowed to be designed by school's departmental committee which consists of technical teachers. Ministry of Education only states the must courses that should be given in whole period of high

school, but do not interfere the decisions of committee to their own choices in terms of school environment such as laboratory, facilities etc.

Also, the modular system of curriculum which includes modules like units of a course was decided to be given to the committee, and teachers would decide the decoration of the modules, courses and yearly plans.

As a conclusion, the new modular curriculum design and course allocation model makes the vocational high schools mutually exclusive. But the totally exhaustive construction of the period makes the entire schools plan on the same objectives.

Department Selection Process of Vocational Education and Training Students

Applications in Europe

This crucial process begins generally at the beginning of the vocational education in many countries. But, as it is shown in Table 3, in developed countries students are allowed to choose their occupations and departments with a guidance and school individual selection criteria, generally. In addition, choosing a department is not seen as an ordinary school process, but a considerable fact of their life. So that, students, at the year of their pre-vocational education level (at the last year of the school which is before vocational school), have given some seminars and surveys to choose their best departments. Also, guidance offices gather information from teachers and families about the relevance of the students to the departments. The table which illustrates the department selection process of European countries is summarized from the ECVET 2012 reports of the related countries.

It can be concluded from Table 3 that many of the countries of European Union give responsibilities for department selection process and student approval for

the departments to the schools, individually. In other words, schools determine their own examination and allocation system and declare to the candidate students.

Table 3. VET Department Selection Processes of European Countries

Country	Obligatory Education Period	Vocational High School Selection Method and Alternatives	Additional Description
Austria	8-year • Volkschule • Grundschule	Central exam • Berufsbildende mittlere Schule	There is an elective pre-VET system for 8 year students (Polytechnische Schule)
Czech Republic	9-year • Základní škola • Gymnázium	School individual exam • Střední odborná škola	Students may apply to 8-year gymnázium at 5th year or 6-year základní škola at 7th year
Denmark	9-year • Folkeskole	School individual exam • Erhvervsgymnasiale uddannelser	VET is after 3 year gymnasium education at 16 or 17 years old
Finland	9-year • Peruskoulu • Grundskola	Central application, individual school criteria • Ammatillnen oppolaitos • Yrkeslaroanstalt	%90 high school application and %36 of the appliers choose VET
France	11-12 year • école élementaire • collège	School individual exam • classe de seconde • lycée d'enseignement général et technologique • lycée professionnel	3 types of higher education after collège
Germany	12-year (Upper) • Grundschule • Orientierungsstufe • Gymnasium/ Realschule/ Hauptschule	School and Bundes individual criteria • Berufsfachschule • Fachoberschule • Barufsoberschule • Duales system	
Italy	12-year • Scuola primaria • Scuola secondaria di I grado	Individual school criteria • Istituto Tecnico • Istituto professionale	Education is not priceless, but students would have gorvernmental scholarships
Poland	9-year • Szkola podstawowa • Gimnazjum	GPA from Gimnazjum and Central Exam • Liceum profilowane • Technikum • Zasadnicza szkoła zawodowa	individual criteria of schools would be applied
Spain	11-year • Primary school • First higher education	School individual exam • Middle stage VET	

In this perspective, school individual progresses for department selection process would be more affective for students and schools approach, because every school has its own organization, physical structure and conditions. Therefore, organizing a central exam or method, as in Turkey, cannot be efficient and effective in this kind of important educational and vital situation, when we consider this process as not only choosing a department but also determining the occupation.

Applications in Turkey

As it is clearly explained in the Circular of Department Selection Process reported by Ministry of National Education (Appendix A-B), this process does not begin in the first year of vocational high school education for the students (9th grade). When students proceed to the 10th grade with a cumulative of 9th year GPA, they are allowed to choose departments primarily from their school or (if needed) on another one.

General tendency of the students of high schools is choosing a department from their schools, since they already have a choice in mind when enrolling in high school.

As a conclusion of the circular, the process begins with collecting selection petitions of students with signature of their parents. Afterwards, system calculates the "Department Placement Grade" by summing 60% of 9th grade cumulative GPA and 40% of primary school's cumulative GPA.

But, it is obvious that cumulative GPA of students would not be relative to students' personal tendency to a department. For instance, let's consider two kinds of students, one of them with verbal or linguistic course abilities and the other with practical and mathematical skills. Let's assume both of these students have the same cumulative GPA in 9th year of their education period (first year of high school) and also nearly same cumulative GPA of primary school. These facts do not mean that both of

them should be enrolled in the same department. However, unfortunately, the current department selection system applies this problematic allocation process.

Educational Data Mining

Educational data mining is the process of converting raw data from educational systems to useful information that can be used to inform design decisions and answer research questions. According to Heiner (2007), data mining encompasses a wide range of research techniques that includes more traditional options such as database queries and simple automatic logging as well as more recent developments in machine learning and language technology.

While data mining have been increasingly encouraging on marketing, finance and management researches because of its high estimation accuracy, systematic forecasting abilities; educational data mining is a new and developing subject area of today's educational researches. It is obvious that this area of study would be very helpful to increase the quality of education, since the term education means exactly a process of improvement. Educational data mining techniques are now being used in ITS (Information Technology Systems) and Artificial Intelligence in Education (AIED) research worldwide. For example, researchers have used educational data mining to:

- Detect affect and disengagement
- Detect attempts to circumvent learning called "gaming the system"
- Guide student learning efforts
- Develop or refine student models
- Measure the effect of individual interventions
- Improved teaching support
- Predict student performance and behavior. (Heiner, 2007)

In addition to these reasons of educational data mining subjects, Han (2006) explains the "Knowledge Discovery" process consists of the iterative sequence of following steps:

1. Data cleaning (to remove noise and inconsistence data)
2. Data integration (where multiple data sources may be combined)
3. Data selection (where data relevant to the analysis task are retrieved from the database)
4. Data transformation (where data are transformed or consolidated into forms appropriate for data mining by performing summary or aggregation operations)
5. Data mining (an essential process where intelligent methods are applied in order to extract data patterns)
6. Pattern evaluation (to identify the truly interesting patterns representing knowledge based on some interestingness measures)
7. Knowledge presentation (where visualization and knowledge representation techniques are used to present the mined knowledge to the user)

Supervised Educational Data Mining Models for Grade Estimation

Artificial Neural Networks

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. Stergiou (2008) states that the key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific

problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well.

According to Dayhoff (1990), the strength of ANN is pattern recognition and pattern classification, but these programs can also be used for predictive purposes.

Also, Berry (1996) explains that the main advantage in using ANN for prediction is that a prior assumption about the relations between independent and dependent variables are not necessary. However, those relations learned by an ANN are hidden in its neural architecture and cannot be expressed in traditional mathematical terms.

Decision Tree

Decision Trees are simple, but powerful form of multiple variable analyses. They provide unique capabilities to supplement, complement and substitute for

- traditional statistical forms of analyses (such as multiple linear regression),
- a variety of data mining tools and techniques (such as neural networks),
- recently developed multi-dimensional forms of reporting analysis found in the fields of business intelligence. (Ville, 2006)

In his research Rokach (2008) indicates that in data mining, decision tree is a predictive model which can be used to represent both classifiers and regression models. In operations research, on the other hand, decision trees refer to a hierarchical model of decisions and their consequences.

Regression Analysis

There are three regression types. The first one is simple linear regression. Simple linear regression is for modeling the linear relationships between two variables, one is dependent and the other is independent.

The simple linear regression model is often written as in the form of Equation 1 where y is the dependent variable, β_0 is the y intercept and β_1 is the gradient or the slope of the regression line, x is the independent variable and ε is the random error. (Yan, 2009)

Equation 1. Simple Linear Regression Formula

$$y = \beta_0 + \beta_1 x + \varepsilon$$

The second type of regression is the multiple linear regression which is simply differs from linear regression with more than one independent variable.

The general form of multiple linear regression is as in Equation 2 where y is the dependent variable, β_0 is the y intercept, $\beta_1 \ldots \beta_p$ are regression coefficients and x_1, $x_2 .. x_p$ are the independent variables. (Yan, 2009)

Equation 2. Multiple Linear Regression Formula

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots\ldots \beta_p x_p + \varepsilon$$

The third type of regression is non-linear regression, which assumes that the relationship between dependent and independent variables is not linear in regression parameters. According to Brown (2001), it is necessary to implement a protocol that will fit a non-linear function to the data used in regression analysis. A method that is suitable for this procedure is called iterative nonlinear least squares fitting. This process uses the same goal as for linear regression, i.e. minimize the value of the squared sum of the

difference between data and fit. However it differs from linear regression in that it is an iterative, or cyclical process.

As a conclusion, after examining these supervised educational data mining methods for grade estimation, multiple regression model was chosen for the process because open source form of this complex method in PHP language was found. (Detailed information will be given in Chapter 5)

By the help of this brief literature analysis, the goals and hypothesis listed and discussed in the following chapter (Chapter 3).

CHAPTER 3

GOAL AND HYPOTHESES

Goal of the Study

As it is discussed in Chapter 2 briefly, technology is an essential concept of education in this era. By this perspective, a lot of data about the students in vocational high schools have been stored for 5 years (E-Okul). But, currently, these data are not used for guiding students in continuing year's appropriately.

Also, the department selection process of vocational high schools in the USA and European countries are intended to be changed rapidly during last decade in order to find the best method. The main argument of this changing and improving process is that school individual way of allocation is the best. Additionally, the department selection method of vocational high schools in Turkey in which primary school diploma GPA and 9th grade GPA is considered, would be upgraded with data gathered from the E-Okul system. Therefore, the main aim of this research is to develop a systematic web based educational data mining software which states possible best departments of vocational high school students orderly in order to guide students on their department selection process.

In this Web Based Department Selection System (WBDSS), since the ratio of students who choose other schools' departments is in neglectable range (Chapter 2), the departments of other schools are not included and school based selection method is decided. But, the students who transferred to other school while their departmental education period (10th or higher grades) in the previous years are still included to gather more data.

Moreover, it is strictly believed that a systematic multi criteria decision support system which executes with the information given by an associative educational data mining algorithm would be extremely effective and deterministic on this department selection and allocation process.

On the other hand, it should not be forgotten that this software is aimed to be a decision support system instead of being a real decider for students. In other words, the goal of modeling this system is making a guidance platform to the students when they are choosing their departments. The main decision fact of this goal is that, there would be two types of students with same 9th grade GPA but having different course grades related to the departmental courses. Therefore, one of them would be successful in the department while the other fails.

In addition, since the primary schools have their own atmosphere, the students' diploma grades would change with objective evaluation methods of teachers. In other words, the primary schools are the most objective school types of the whole education system, and because of this fact, the diploma grades of students from different primary schools cannot be eligible. Due to this fact, in this system primary school diploma grade is not intended to be included as an independent variable for finding departmental course grades.

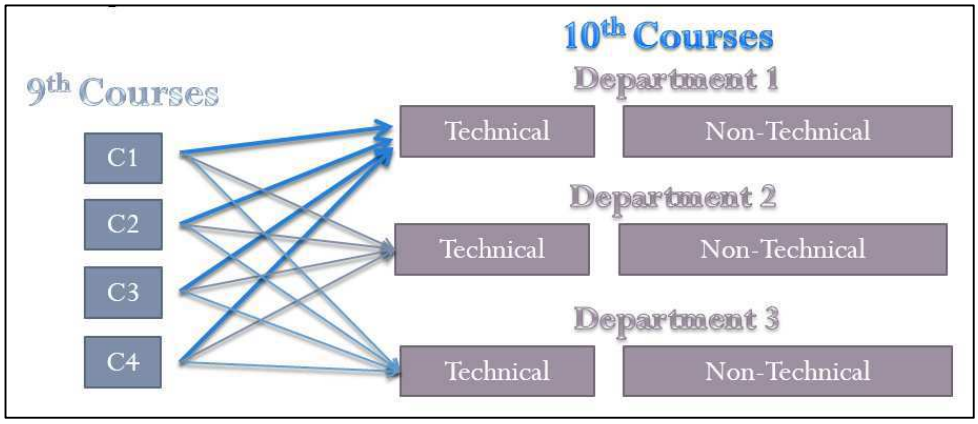


Figure 2. Structure of WBDSS's supervised educational data mining model

As a result, the goal of this research is to conduct a web based decision support system for guiding students on the process of department selection. It is believed that by the help of this system, possible departmental course grades of students can be estimated with the results of an educational data mining algorithm on previous years' students' course grades which describes possible relationships between 9th year course grades and departmental course grades as shown in Figure 2. Then, these estimated scores become valuable criterion for guiding students to choose their best departments.

Hypotheses of the Study

In this study below hypotheses are analyzed:

Hypothesis 1: Students' previous years' course grades of in vocational high schools are determinant for predicting their current year course grades and these predictions can support department selection process.

Hypothesis 2: The current department selection process does not have enough specific variables for students' best allocation to the departments, because in this process students are evaluated with their 9th year GPA, while two students may have same GPA with different course grades.

Hypothesis 3: Students who have absolutely higher and lower GPAs in 9th year have the tendency to choose inappropriate departments.

Hypothesis 4: Students in the inappropriate departments tend to be in a failure in 10th grade and the reason of these failures is the current allocation system without guidance of any educational data mining.

CHAPTER 4

ANALYSIS OF THE SYSTEM

Based on the Literature Survey written in the Chapter 2, a vocational guidance analysis is done for the procedure of Department Selection Process of Vocational High Schools. This analysis progress consists of 2 main phases; questionnaire with students and interview with technical personnel of vocational high schools.

Students Questionnaire

In order to search a possible necessity for guidance in the process of department selection in vocational high schools, a questionnaire is applied to Bahçelievler Vocational Trade High School (BVTHS) students (Appendix C). The results of the questionnaire are as follows:

In accordance with the questionnaire; there are 77 male and 90 female students in 167 allocated non-transferred students. Also, the number of students' allocation to current departments is as following:

- 122 students in Accounting and Finance
- 15 students in Marketing and Retail
- 30 students in Information Technologies

Moreover, 80 students (over 167) have marked the answer of "Vocational Education" to question 3 "Which high school did you want to choose when you graduated from primary school?" This 47.9 % percentage of result over 6 choices shows that the test data set students have influence to vocational education and enrolled to the BVTHS with positive feelings. Thus, another question should be discussed whether those students have any information about the department that they study (Question 7). Again, more than half of the students (55.7 %) say "No" to this question. Therefore a

cross-tabulation analysis comes to mind between these two questions. But, before executing this analysis, the results of question 3 is recoded into a new variable values: "2" means "Vocational High School" and "1" is all the other choices. Also, as the answers of question 7, "1" means "Yes" and "2" means "No". Then, Table 4 shows the result of this cross-tabulation analysis.

Table 4. Cross-Tabulation Results of Question 3 (Recoded) and Question 7

		Which High School did you wanted to enroll in when you graduated from primary school?		
		1 (Other)	2 (VET)	Total
Have you got any information about the department you study	1 (Yes)	35	39	74
	2 (No)	52	41	93
Total		87	80	167

This table shows that nearly 48.75 % of vocational high school choosers in the primary school graduation session, had information about the department they enrolled while the other half did not. Furthermore, more percentage (59.77) of the students, who did not want to enroll to vocational schools, does not have any information about their departments. This cross-tabulation analysis can be assumed as the result of that nearly half of the students who have influence of vocational education does not have enough idea about their departments before the allocation progress, and this ratio increases for the non-influenced ones. Therefore, this would mean, students generally consider the departmental allocation when they face with the question in 9th to 10th grade passing summer.

In conclusion a systematic data mining model calculated in that time for supporting this decision process would be very helpful at least for these confusing students. The guidance of the analysis results of Web Based Department Selection

System (WBDSS) would also helpful for the ones who have information about the department they choose. This result comes from the 8th, 9th and 10th questions of the questionnaire.

As the answer of the Question 8, "Why did you choose your department?" (Students allowed selecting more than one choice), students responded the answers as given in Table 5.

Table 5. Percentages of Students' Responses to Question 8

Answer	Response (%)
There is no reason	24
To have a valid job	60.5
There are many alternative university choices entered with additional points	13.2
To continue my family profession	3
Because it is easier to graduate	12
Because my close friends are in / choose this department	9
Because my teachers recommended it	23.4
Because I did not want to study at the university	11.4
Other	4.2

In addition to these results, the most frequent option of Question 9 ("Who influenced you to choose this department?") is "My Own Accord" with the percentage of 46.1, while the highest near frequency is 40% ("My Family"). On the other hand, 60% of the students want to do this profession in the future according to the results of Question 10.

Furthermore, another cross-tabulation analysis has been applied to Question 1 and Question 4. As shown in Table 6, 72 (42+10+20) of 167 students said that they would have chosen their own department if they had been given the chance.

Table 6. Cross-Tabulation Analysis Result of Question 1 and Question 4

		If you had chance, which department would you choose except for your department			
		1 (AF)	2 (MR)	3 (IT)	Total
Department	1 (AF)	42	15	65	122
	2 (MR)	2	10	3	15
	3 (IT)	6	4	20	30
Total		50	29	88	167

To combine the results of these questions, students can be called as confused in choosing their department and responded, "There is no reason for choosing it" at a ratio of 1 to 4. Also, they want a valid job but choose their department by their own accord although they do not have enough information and guidance for selection. But, after selecting or being selected by the family, students force themselves and self-motivate to like their department and occupations. This would be called "espousal".

As a result of these facts, if we construct a guidance supporter system for this department selection process, the interest and motivation of occupation on these youngsters would be highly improved to 90-100 percentages, because it is now 60% in this current blind and intricate process.

Lastly, as a descriptive analysis, 9th and 10th grade disciplinary punishments of those students were examined with two questions (Question 5 and 6). The results of these questions can be concluded in minimal level with 6% and 13 %. These percentages would be affective in a Science or Anatolian High School, but can be acceptable and assumed as minimum level in a vocational high school. Therefore, this fact is assumed as ineffective for this study.

Interview with Technical Personnel

In addition to the questionnaire done with students in BVTHS, students' the needs of a decision support system is examined with the technical vice manager, department chiefs and guidance service of the school who are responsible for department selection process of the school (Appendix D). These interviews can be concluded as follows.

Interview with the Technical Vice Manager

First of all, the technical vice manager is responsible for directing students to the departments during the second semester of 9 grade. He explained that some seminars are conducted for students in this semester and information about the departments is given. Also, possible questions about the departments are answered. Additionally, the vice manager says that at the end of the semester students are allowed to give a petition for selecting departments (Appendix A).

Secondly, the main difficulties about the process for the vice manager are that families do not have enough information and guidance for choosing departments for their children. Also, they wonder whether their children can be successful in the department they choose. In other words, students and families need supportive data about the possible grades in the departments. Then, when the question in the interview, "Do you think a decision support system would be helpful for this process?" is asked to the vice manager, he agrees and answers "absolutely".

Lastly, the possible features for the system are asked and the vice manager listed the followings:

- The user of the system should be the manager and the results must be confidential for not negatively conditioning the students
- There should be department suggestions for transfer students
- Course credits should be designed in a flexible way because the modular system allows teachers change credits yearly

Interview with Department Chiefs

There are two department chiefs who are responsible for guiding students through their department selection process. They also determine the departmental quotas with directorate office of school.

They explain that a decision support system which find a correlation between current year students' 9th grade course grades and previous years' students' course grades would be very helpful for guiding students in that process. Also, they state that students are very confused during the process although they have an orientation program in the second semester of 9th grade.

Moreover, the main problem of the process is that students and families cannot predict the success rates in the departments before they start to the departments. But, after enrolling in any department the process cannot be turned back. Therefore this type of decision support system would be useful for counseling students and families.

Also, chief of Computer Department preparing a web-based system would make the guidance process more functional and practical in terms of using purposes. The chief added that since there are more than one manager and many data to input, a web-based model would decrease the time of input progress.

Lastly, the chiefs of departments stated the following suggestions for the system:

- The system should be secure for students' data confidentiality

- Common courses of the departments should be examined separately in terms of departments
- Departmental credits of the both common and departmental courses should be flexible because of the modular structure of curriculum and MEGEP
- There should be multiple and individual ways of input data for making the data input process less time consuming

Interview with Guidance Service

As the last responsible personnel of BVTHS for department selection process, an interview was conducted with guidance teacher of the school.

The responsibilities of the guidance service for this process are; exploring students' abilities and interests over the departments, relating these facts to the most appropriate departments and guiding families and students to those departments. But, as it is explained in the interview, the biggest problem of this progress is observing and stating students' relation to the departments. It is clearly indicated that the main data for this observation are students' interview results and their 9th grade course grades. However, the guidance teacher claims that the correlation between the 9th grade courses and departments cannot be clearly defined. If there is a relation between those two subjects, it would be very supportive in the process of department selection process.

A decision support system for this process is accepted as very helpful for them. But, there should be some features which are obligatory for the guidance service. Those features are as given below:

- Since the data of the students are highly confidential the security of the system must be considered well.

- The access of the system should be only allowed to the management and guidance office of the school.
- The relation between course and departments should be reported by the system for not only department selection but also for other activities of the guidance service.
- There should be a selection report for students with not only one department but also alternative departments. In other words, since the departmental quotas of the school does not allow all students to be allocated to the best departments, there should be other alternatives for the students.
- There would be best departmental quotas determined by the system for current year, because this can help school directors to design the physical environment for best allocation.

As a result of these analysis, it is clear that a decision support system would be very helpful for the process of department selection in vocational high schools. Since this is a support system, the results of the system are aimed to be used for guiding students and families. Also, the data and reports of the system should be confidential and access of the system should be designed in a user authentication form. Additionally, there should be a well-designed data input modules and a web-based design for adding data to the system by a more practical way. Moreover, the results of the students should be done in an alternative way in that system must list all alternative results of students in every department because of departmental quotas. And, the system must be flexible on course credits for each semester because of modular system in vocational high schools. Lastly, since the user group of the system is not made of computer teachers or engineers, it must be user friendly and as simple as it can be.

CHAPTER 5

DESIGN AND DEVELOPMENT OF THE SYSTEM

As an educational data mining model, Web Based Department Selection System (WBDSS) is intended to be designed as a web based software. To achieve this goal, the cloud-computing system procedure was automated. Since the system itself is designed to be a part of school management process, the main users of the system are assumed as the school managers. As a cloud computing system, there is a web server chosen for the best implementation of web algorithms and an application server which is designed for main modules and functions of the system and a relational database which is mainly in 4th normalize form but has some triggered "work" table for speed features. This main architecture of the WBDSS is shown in the Figure 3.

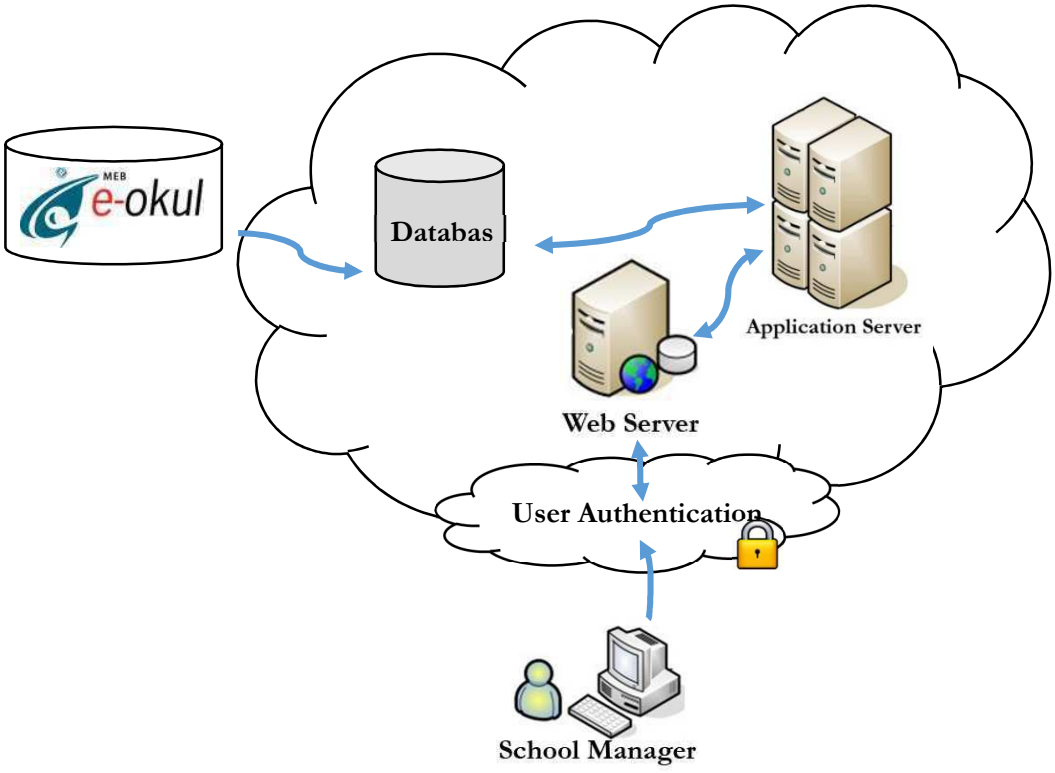


Figure 3. Architecture of WBDSS (Adapted from Sürgit 2010)

Technical Structure & Copyrights

In the technical background of the system "PHP" was chosen for the system as the programming language, since it is an open source and flexible language. Also, there are a lot of source codes and documents in this programming language on the common web libraries. Although there are many educational data mining methods, since the data gathered from E-Okul is completely countable and systematic, a regression algorithm was chosen. Also, having a strict open source code for this method is another reason for this selection. The main regression modules of this system were taken from Shankar Manamalkav (2011) with open source permission. In P Value Calculation phase of the module, Manamalkav uses an algorithm of Prof. Stafen Waner. For the copyright purposes, permission for using, converting and executing his code, was granted from Prof. Stafen Waner (Professor Emeritus of Mathematics, Hofstra University, USA) via e-mail.

Technology Map

As shown in Figure 4, there is a systematic technology map of WBDSS which consists of one user window, three layers and one basement parts. Web Client is the potential user of the system which assumed as the school managers. Presentation Layer stands between web client and system as Graphical User Interface and data input processes. Additionally, Application Layer is the main data mining and programming section of the system. In this part, every operation is executed by application server. Lastly, Data Access Layer deals with the relational database structure which is constructed on MYSQL platform.

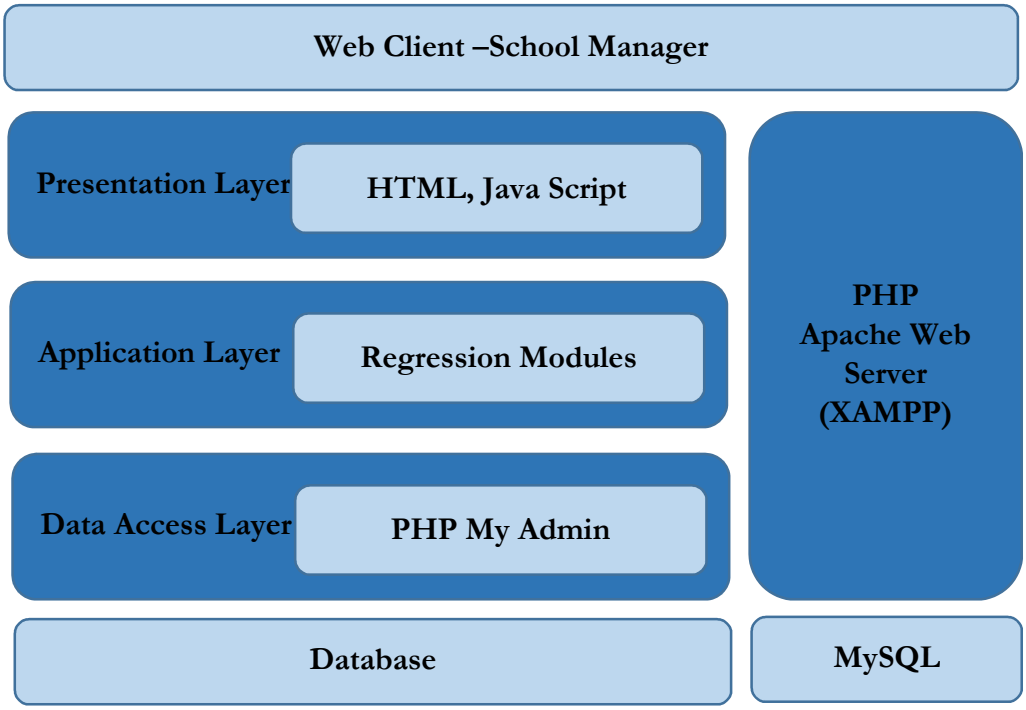


Figure 4. Technology map of WBDSS (Adapted from Sürgit 2010)

Web Client

Web client of the system is directly school managers because they are the only people who can access the students' past year grades on the E-Okul system. Since the data access of the E-Okul system is forbidden now, for a system that use educational data mining or any other application, school managers should input their data to the system for the first time they use the system. On the other hand, when they enter the data into the system first, they can use this data in every continuing years' progresses. In addition, since the system is an educational data mining system, we can conclude that more data means much better results. Due to this fact, it can be assumed that every year the validation of the system will be increased by adding the current year's data.

Since the system is designed in school individual form each school has its own data and code installed. This means every school manager starts with their own null

database and fill it with their grades. But in every phase of the input process they can try department allocation with current data, even the data is not fully imported. This is because the system executes well prepared preprocessing algorithms in order to clarify the data and choose the best related ones for determination process (this process will be explained briefly in preprocessing part (Chapter 5).

Presentation Layer

Since WBDSS is a web based application, it has HTML and Java Script modules mainly inside, in presentation layer. Those basic HTML 5 version codes are used to design the Graphical User Interface of the system and can be executed in any web browser such as Internet Explorer or Chrome or Firefox. But, considering the resolution and execution practices, Internet Explorer is recommended for the users. Additionally, main basic structures of the java script functions such as time, login and drop down menu applications are used in the presentation layer.

Figure 5. Login page screenshot of WBDSS

Secondly, each user can login to the system by entering his/her password on the home page (Figure 5). The passwords are stored in the database and can be changed or added

only by the software engineer. After entering right password and user name, system matches both of these values and directs the user to the main page of the system in which main data input menus are given.

As it is mentioned in web client part, the main part (approx. 60%) of the system is entering data of the students. There are 5 sub menus for this input data process in the system. WBDSS is designed for an important determination process of students' lives; therefore, it is very essential for the school managers to enter real data in true format. However, if the school manager enters a data in wrong format or inappropriate data for the system, the system will be able to cope with this problem as it will be described in preprocessing part (Chapter 5).

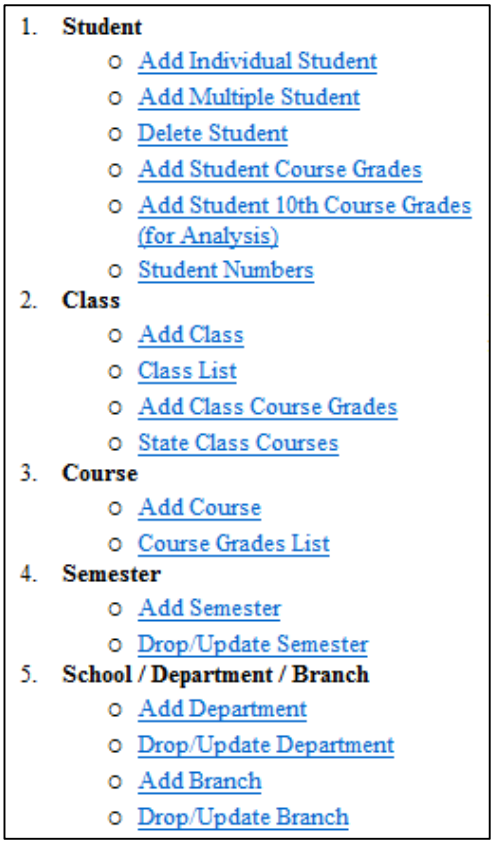


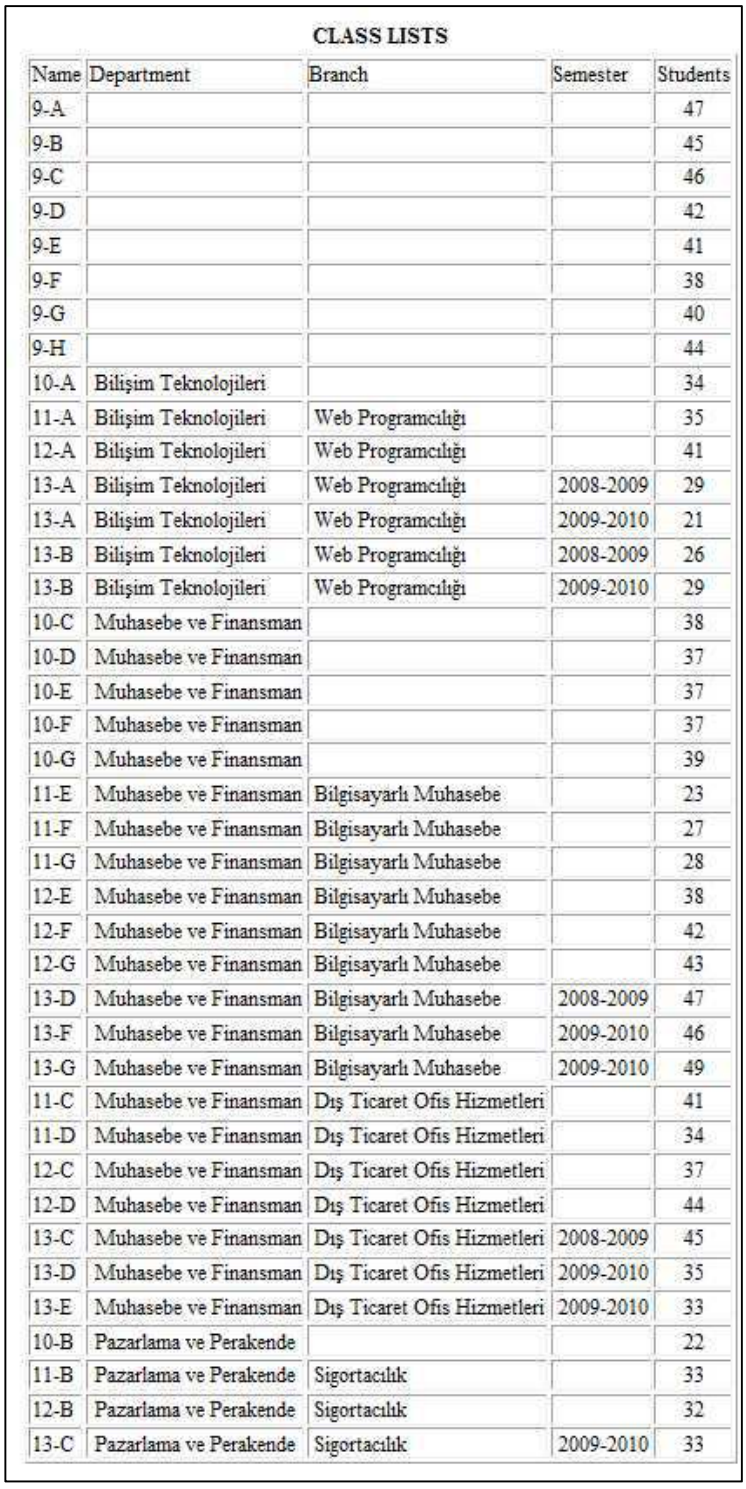
Figure 6. Menu items of WBDSS

As shown in Figure 6, the submenus of WBDSS are "Student", "Class", "Course", "Semester" and "School-Department-Branch". All of these menus have their sub menu

items in order to prepare an easy usage and user friendly design for the managers (potential users of the system).

In the student submenu, the user can add students to the system by entering his/her name, student number and can state his/her class individually or multiply. In the "Multiple" sub menu item, the school manager is allowed to add students as one class, as it has been saved to system previously. Firstly, the user is asked how many students s/he wants to add, then a form with student number and name-surname textboxes are created by the system to fill. To delete students, in related submenu item page, the user is asked to choose the class of the student first. After choosing the classroom, the user is allowed to select students by checking checkbox form objects from the chosen class list. Lastly, when the user clicks on the button which called "Delete Students", a JavaScript message appears on the screen and asks to be sure to delete. If the user clicks "Yes", students whose checkboxes are checked, are deleted from the system, not only from the "student" table but also, from all related tables. In "Add Student Course Grade" page, first of all, the user is asked to enter the student number of the one whose course grades are intended to be input. Since there would be more than one student with same student number (graduated ones and current students), all students' names are listed to be chosen by the user. Then, the manager chooses the intended student and clicks the "Create Form" button and the form will appear for the selected student. In this form, all the courses of the student are listed with textbox objects, in which possible pre-added grades of the students are written. Therefore, the user can see and change the scores of the student. "Add 10th Course Grades" menu is designed for the systems validation purposes and is optional. If the manager enters the current course grades of the students in the last semester by the same method in "Add Course Grades" menu,

s/he can compare the results of the system (estimated grades) to the real ones. Finally, as shown in Figure 7, the user can see student numbers of the classes in every semester in the "Student Numbers" page.



CLASS LISTS

Name	Department	Branch	Semester	Students
9-A				47
9-B				45
9-C				46
9-D				42
9-E				41
9-F				38
9-G				40
9-H				44
10-A	Bilişim Teknolojileri			34
11-A	Bilişim Teknolojileri	Web Programcılığı		35
12-A	Bilişim Teknolojileri	Web Programcılığı		41
13-A	Bilişim Teknolojileri	Web Programcılığı	2008-2009	29
13-A	Bilişim Teknolojileri	Web Programcılığı	2009-2010	21
13-B	Bilişim Teknolojileri	Web Programcılığı	2008-2009	26
13-B	Bilişim Teknolojileri	Web Programcılığı	2009-2010	29
10-C	Muhasebe ve Finansman			38
10-D	Muhasebe ve Finansman			37
10-E	Muhasebe ve Finansman			37
10-F	Muhasebe ve Finansman			37
10-G	Muhasebe ve Finansman			39
11-E	Muhasebe ve Finansman	Bilgisayarlı Muhasebe		23
11-F	Muhasebe ve Finansman	Bilgisayarlı Muhasebe		27
11-G	Muhasebe ve Finansman	Bilgisayarlı Muhasebe		28
12-E	Muhasebe ve Finansman	Bilgisayarlı Muhasebe		38
12-F	Muhasebe ve Finansman	Bilgisayarlı Muhasebe		42
12-G	Muhasebe ve Finansman	Bilgisayarlı Muhasebe		43
13-D	Muhasebe ve Finansman	Bilgisayarlı Muhasebe	2008-2009	47
13-F	Muhasebe ve Finansman	Bilgisayarlı Muhasebe	2009-2010	46
13-G	Muhasebe ve Finansman	Bilgisayarlı Muhasebe	2009-2010	49
11-C	Muhasebe ve Finansman	Dış Ticaret Ofis Hizmetleri		41
11-D	Muhasebe ve Finansman	Dış Ticaret Ofis Hizmetleri		34
12-C	Muhasebe ve Finansman	Dış Ticaret Ofis Hizmetleri		37
12-D	Muhasebe ve Finansman	Dış Ticaret Ofis Hizmetleri		44
13-C	Muhasebe ve Finansman	Dış Ticaret Ofis Hizmetleri	2008-2009	45
13-D	Muhasebe ve Finansman	Dış Ticaret Ofis Hizmetleri	2009-2010	35
13-E	Muhasebe ve Finansman	Dış Ticaret Ofis Hizmetleri	2009-2010	33
10-B	Pazarlama ve Perakende			22
11-B	Pazarlama ve Perakende	Sigortacılık		33
12-B	Pazarlama ve Perakende	Sigortacılık		32
13-C	Pazarlama ve Perakende	Sigortacılık	2009-2010	33

Figure 7. Student number submenu item page of WBDSS

Secondly, there is “Class” sub menu for class and section operations. In “Add Class” sub menu item, the school manager can add classes with their grades, names, departments, and graduate semesters as shown in Figure 8. In “Class List” page, the user can access the class student lists of the system by selecting the class from a dropdown menu form object. Same as “Add Multiple Student Course Grades” page, in “Add Class Course Grades” page, the user is allowed to enter course grades of students in an individual class. But before those operations, the main item of class menu should be opened, which is “State Class Courses”. In this page, the manager decides and enters the elective and must courses of the classes. By the help of this entrance, system learns and propagates regression algorithms to the appropriate courses.

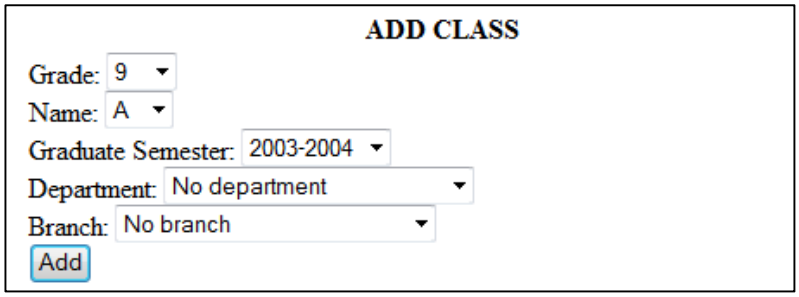


Figure 8. Add class submenu item page of WBDSS

In the third submenu which is called “Course”, there are two simple pages. Firstly, in “Add Course Page”, the user can add course to the system. But throughout this process, the user should offer grade, code and department of the course being added, because there are departmental and elective courses, also each course should have one grade, such as 9, 10 etc. Again, in “Course List Page” is an informative page, like “Student Numbers” page, which lists the courses of chosen grade by the user.

In the purpose of stating semesters, which the system will deal with later, “Semester” sub menu is designed for the school managers. In this menu, the user of WBDSS can add, drop or update semesters for the educational data mining operations.

Lastly, there is a "School-Department-Branch" submenu, which is prepared for related operations on those subjects. First of all, since there would be more than one school in an individual building such as Anatolian and Regular, there are school adding-dropping and updating pages. Also, this system is designed for vocational high schools, due to this fact, there are department and branch pages. In vocational high schools, students choose departments when passing to 10th grade, and also, at the end of the 10th grade they are asked to choose branches. Although WBDSS is designed only for department selection process of vocational high school students, system and relational database of it are designed in a developable form for branch selection operations. Due to these facts, there are branch related pages, as in Figure 9.

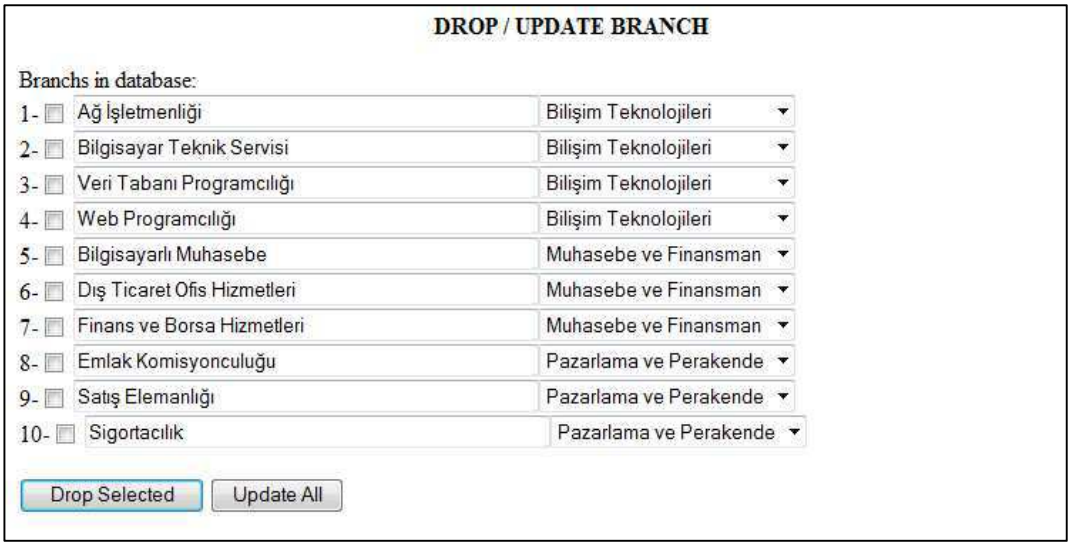


Figure 9. Drop-Update branch submenu item page of WBDSS

Application Layer

As shown in Figure 4, the main structure of the system in application server was applied onto an Apache Web Server for "PHP" applications and modules. In order to try and execute system easily, the windows form of Apache Server "XAMPP for Windows 1.8.1" was installed and used. But, system is ready to use on a Linux Server with its full

of PHP and MYSQL format. In Application Layer, there are nine main data mining operations executed. The flowchart in Figure 10 shows this programming processes clearly. The detailed information will be given in Educational Data Mining Operations of WBDSS part of this study report.

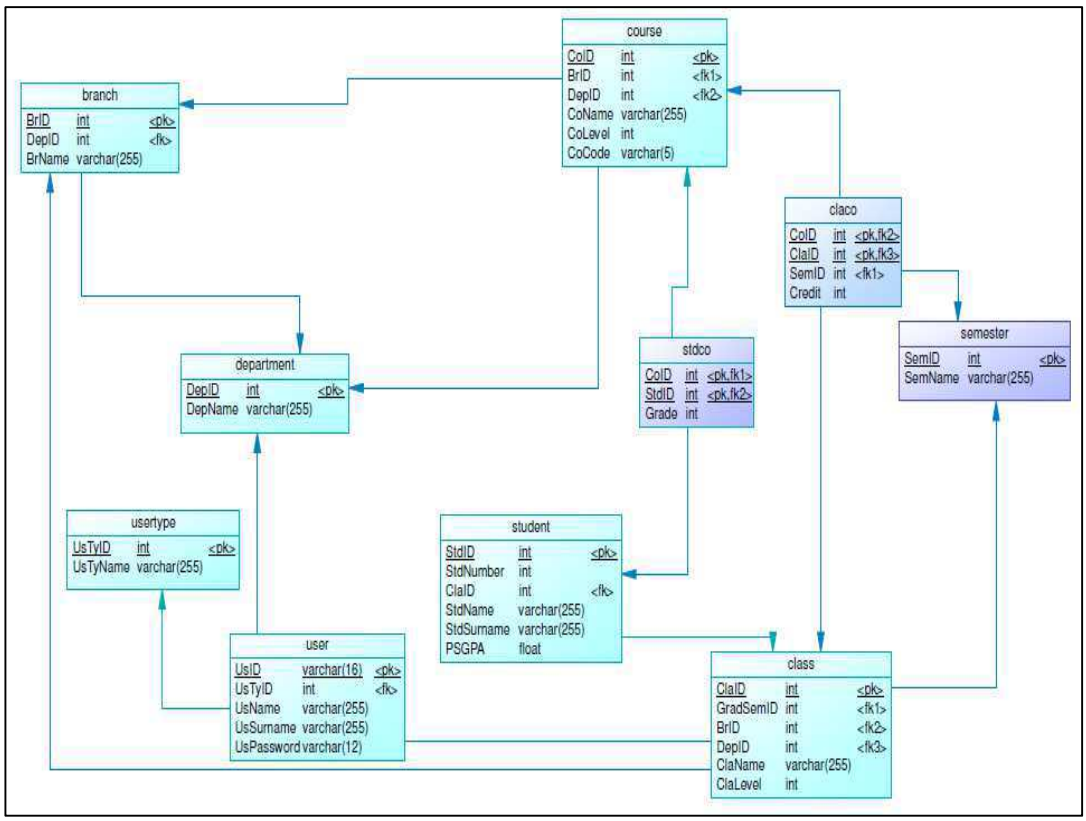


Figure 10. Main tables of relational database of WBDSS

Data Access Layer & Relational Database

Since the Apache Web Server and the PHP programming language is used in this research, the Data Access Layer is designed in phpMyAdmin 3.5.2.2 platform. The version of the platform deals with PHP 5 version and some codes for connecting and accessing database written in this format. For instance, in the action methods of form objects, instead of using $PHP_SELF alone, the true format of the code is used as;

<form action="$_SERVER[php_self]">

In addition to these, a relational database is used in WBDSS shown in Figure 10. There are eight main tables called “Branch”, “Course”, “Department”, “UserType”, “Student”, “User”, “Class” and “Semester” in the system. Also, there are two relational tables named as “stdco” (for representing student-course relationship) and “claco” (for representing class-course relationship).

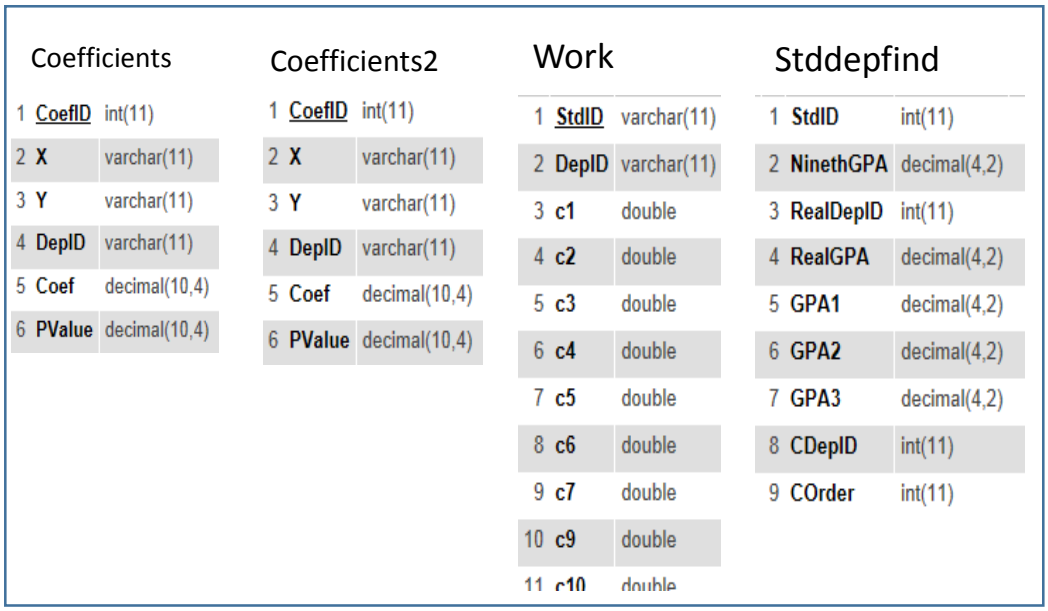


Figure 11. Triggered tables of relational database of WBDSS

Additionally, as it is explained in Data Mining Operations part, briefly, there will be some tables needed by the system in order to store data executed by data mining modules. These tables are shown in Figure 11 as “Coefficients”, “Coefficients2”, “Work” and “StdDepFind”. “Work” table is made for storage of students’ course values before regression operation. This table is designed by the system during the analysis part, while all data can be accessed from three main tables of the database. This type of combination is chosen for fast operation purposes. “Coefficients” table is designed for storing Coefficient and PValue values of courses after first regression process. As it will be explained in Data Mining Operations part, there are two regression operations in the system for related courses. The “Coefficient2” table is prepared for the results of

second regression progress. Lastly, "StdDepFind" table is made by the system at the end of the regression process in order to store best departments found for the student and the order of these departments.

Educational Data Mining and Knowledge Discovery Sequences of WBDSS

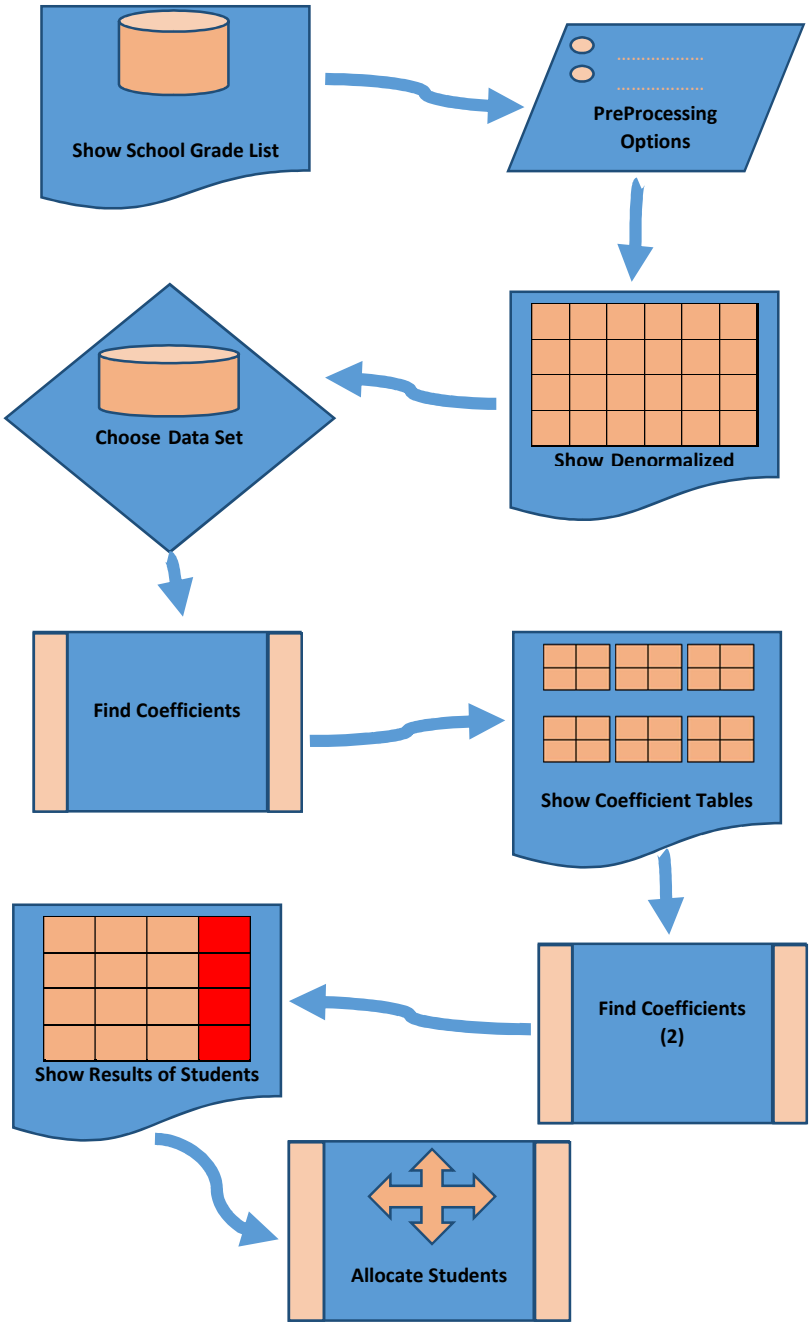


Figure 12. Data mining operations' flowchart of WBDSS

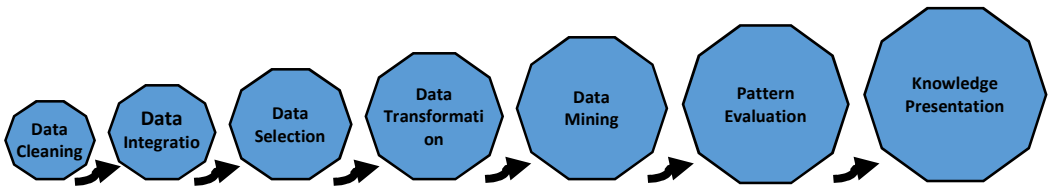


Figure 13. Knowledge discovery sequences (Adapted from Han, 2006)

WBDSS is designed with the aim of preparing a decision support system to allocate students to the best departments for them individually in the school by the help of their 9th year grades. Briefly, what the system does is simply shown in Figure 12. The operations of the WBDSS alternatively resembles the operations of knowledge discovery operations which are illustrated by Han (2006). Those knowledge discovery iterative steps are drawn in Figure 13. Also, as shown in Figure 14, all the operations of WBDSS are represented by a menu item of Analysis submenu in the main user page of WBDSS. Although the educational data mining and knowledge discovery operations of WBDSS word in a sequential way, the user can access all of them in any step. So that, this non-sequential access method would be accepted as more and more practical for the user to manage all the process iteratively.

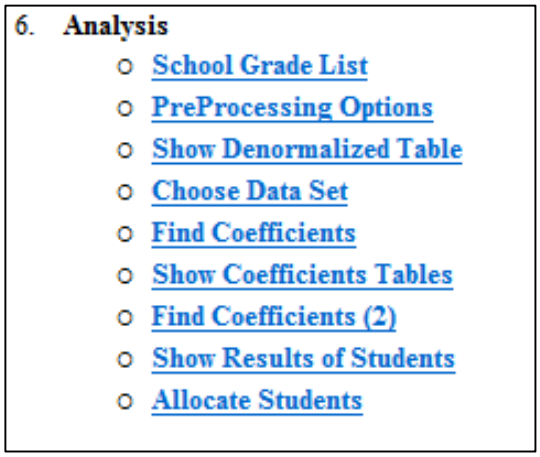


Figure 14. Analysis menu items of WBDSS

First of all WBDSS shows the user (manager) all the grade list of the school in one table for the last check before the analysis operations. As it is a well-known fact that %60 of a

data mining process consists of preprocessing. Therefore, is should not be forgotten that pure, clear, reduced and transformed data is the most important part of WBDSS. In the first step of the process, the manager is allowed to check all the grades of students in the system as a whole, and re-edit them before the start although there is a data cleaning phase next.

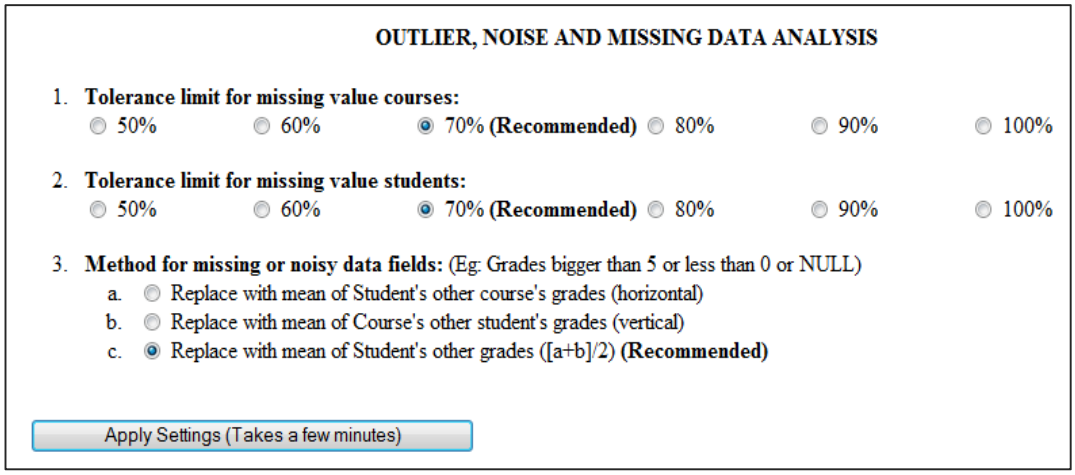


Figure 15. Outlier, noise and missing data analysis choice page of WBDSS

Secondly, as shown in Figure 15, the user is asked to choose data cleaning features for noisy and redundant data. If there are some grades of students saved in the database as not between 0-5 or NULL, system asks the user how to cope with this problem. There are three options for this problem.

a) Replace with mean of student's other courses' grades (horizontal)

b) Replace with mean of course's other students' grades (vertical)

c) Replace with mean of the choices above (a+b)/2

The last choice is recommended to the user for best mean operation. In this third choice, system calculates the sum of all other students' grades of the missing value course and the sum off all other courses' grades of the missing value student. Then, system finds the average of this two mean values and saves the new value into this missing value cell. (Figure 16)

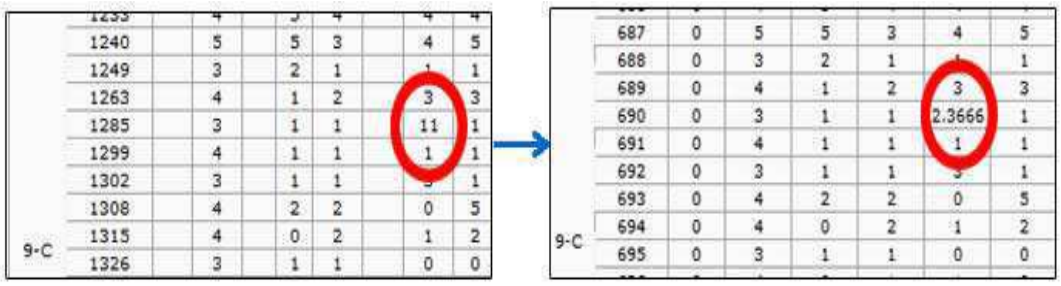


Figure 16. Data cleaning and transforming operation example in WBDSS

There would be some courses which would be old for current year and have grades of old students only. Or, there would be some cells which the user did not input grades of students because of some reasons. In other words, if we consider a table which consist of courses in the columns and students in the rows; and there would be some columns in which only some students' rows have values in their cells. Those courses should be stated as redundant because they do not have enough grades for data mining operations. WBDSS asks the user the tolerance limit for the omitting courses with less than given percentage values. This operation can be done in horizontal way for omitting the missing value students, too. Therefore, system asks the user the limitation percentages for omitting students and courses as shown in Figure 15.

After selecting the percentages of those tolerance limits and the data cleaning operation method, WBDSS executes the given orders by the user. In order to contribute the speed of data mining operation, while there is a relational normalized database with relevant tables, a "work" table is created by the system for found values of chosen students and courses. This "work" table is shown to the user with courses in the columns and students in the rows. From now on, WBDSS uses this table for data mining operations, in order to behave faster.

As the fourth step of whole process (Figure 12), WBDSS asks for the user to choose the data set for data mining. Since there are two type of student allocation in

vocational high schools, which can be called "allocating to departments in 9th to 10th year passing" and "allocating to branches of departments in 10th to 11th year", the user is allowed to choose data mining data set. Although this study is generally focused on departmental allocation, as the future research topic, this part of the WBDSS is inserted to the system operation tree passively. (Figure 17)

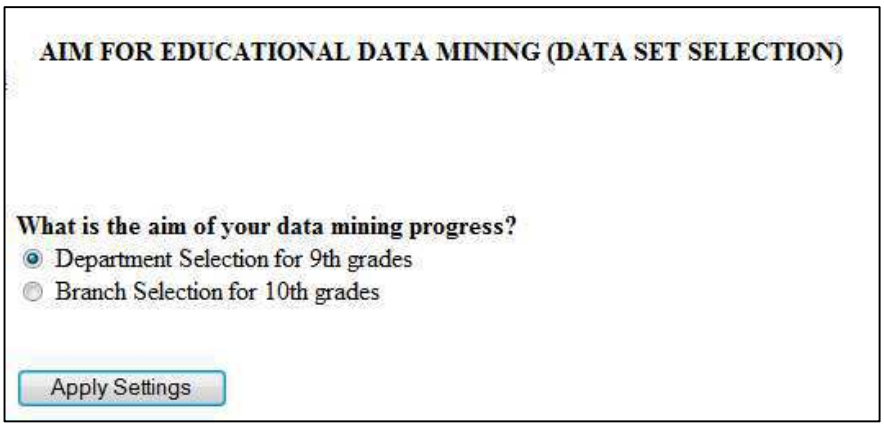
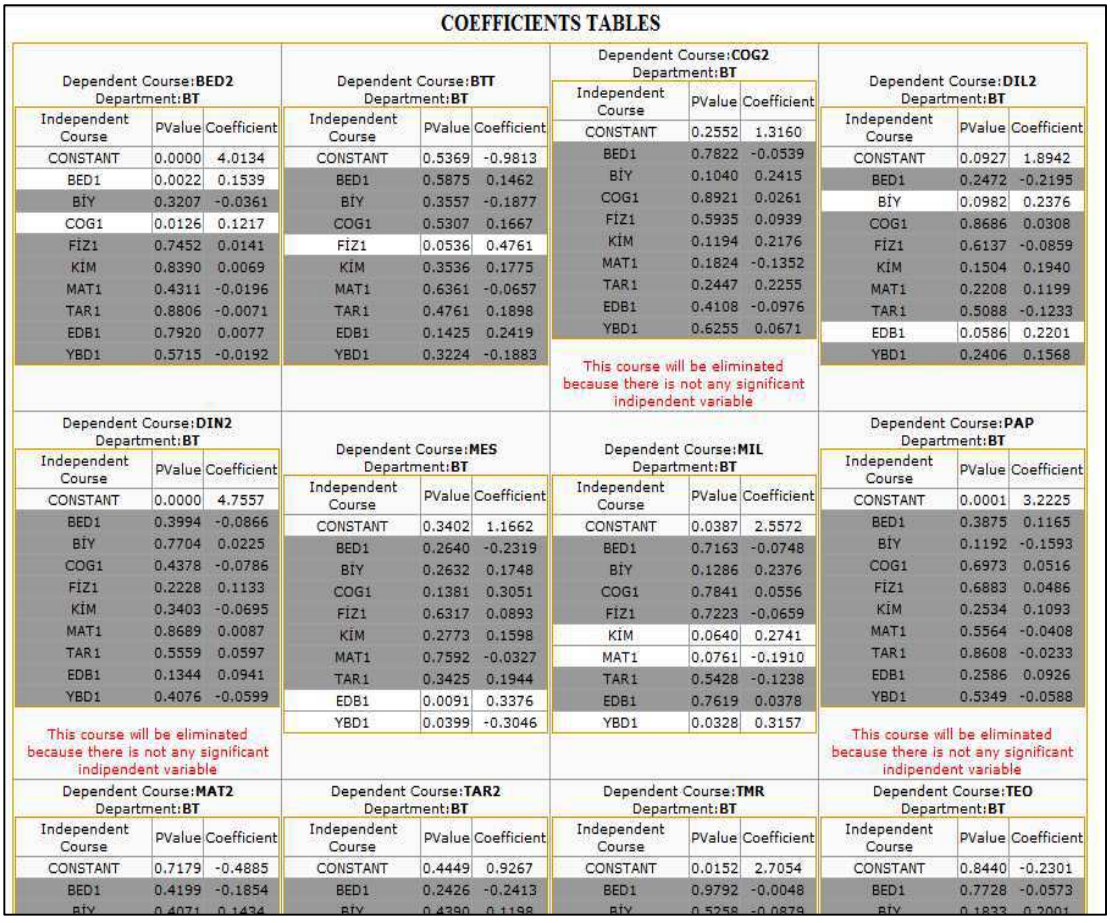


Figure 17. Data set selection page of WBDSS

After these data integration and data selection options of knowledge discovery sequences, data transformation phase comes according to Han (2006). As it is already mentioned, all the grades of students are included to the system in the same form which is over 5. Additionally, a strict data clearing and integration operation is executed at the beginning of all. Then, it can be assumed that there is no need to produce a data transformation step. If all the data types and formats of variables were not in the same style in the system, this step would be irresistible. However, all independent variables of the data mining algorithm are in the same format. Because of those facts, the data transformation methods are omitted.

The next three sub menu items of Analysis part of WBDSS are about data mining exactly. In addition, in these three steps pattern evaluation sequences of knowledge discovery is embedded.

At first, "Find Coefficients" operation is executed by the system for all chosen courses of "work" table of database. The simple linear regression method of data mining is used in this operation. The 9th year courses' grades of students are chosen as the independent variables of regression algorithm. And, by the help of this independent variables, a regression equation is tried to be found for 10th grade courses in each department iteratively. Also, the PValues of those equations are found simultaneously for significance determination. Since this operation is highly mathematical, it takes approximately 10 minutes for only one equation creation process. Totally, this is the most time consuming process of all knowledge discovery progress and it takes approximately 6 hours at all.



COEFFICIENTS TABLES

Dependent Course:**BED2** Department:**BT**

Independent Course	PValue	Coefficient
CONSTANT	0.0000	4.0134
BED1	0.0022	0.1539
BİY	0.3207	-0.0361
COG1	0.0126	0.1217
FİZ1	0.7452	0.0141
KİM	0.8390	0.0069
MAT1	0.4311	-0.0196
TAR1	0.8806	-0.0071
EDB1	0.7920	0.0077
YBD1	0.5715	-0.0192

Dependent Course:**BTT** Department:**BT**

Independent Course	PValue	Coefficient
CONSTANT	0.5369	-0.9813
BED1	0.5875	0.1462
BİY	0.3557	-0.1877
COG1	0.5307	0.1667
FİZ1	0.0536	0.4761
KİM	0.3536	0.1775
MAT1	0.6361	-0.0657
TAR1	0.4761	0.1898
EDB1	0.1425	0.2419
YBD1	0.3224	-0.1883

Dependent Course:**COG2** Department:**BT**

Independent Course	PValue	Coefficient
CONSTANT	0.2552	1.3160
BED1	0.7822	-0.0539
BİY	0.1040	0.2415
COG1	0.8921	0.0261
FİZ1	0.5935	0.0939
KİM	0.1194	0.2176
MAT1	0.1824	-0.1352
TAR1	0.2447	0.2255
EDB1	0.4108	-0.0976
YBD1	0.6255	0.0671

This course will be eliminated because there is not any significant indipendent variable

Dependent Course:**DIL2** Department:**BT**

Independent Course	PValue	Coefficient
CONSTANT	0.0927	1.8942
BED1	0.2472	-0.2195
BİY	0.0982	0.2376
COG1	0.8686	0.0308
FİZ1	0.6137	-0.0859
KİM	0.1504	0.1940
MAT1	0.2208	0.1199
TAR1	0.5088	-0.1233
EDB1	0.0586	0.2201
YBD1	0.2406	0.1568

Dependent Course:**DIN2** Department:**BT**

Independent Course	PValue	Coefficient
CONSTANT	0.0000	4.7557
BED1	0.3994	-0.0866
BİY	0.7704	0.0225
COG1	0.4378	-0.0786
FİZ1	0.2228	0.1133
KİM	0.3403	-0.0695
MAT1	0.8689	0.0087
TAR1	0.5559	0.0597
EDB1	0.1344	0.0941
YBD1	0.4076	-0.0599

This course will be eliminated because there is not any significant indipendent variable

Dependent Course:**MES** Department:**BT**

Independent Course	PValue	Coefficient
CONSTANT	0.3402	1.1662
BED1	0.2640	-0.2319
BİY	0.2632	0.1748
COG1	0.1381	0.3051
FİZ1	0.6317	0.0893
KİM	0.2773	0.1598
MAT1	0.7592	-0.0327
TAR1	0.3425	0.1944
EDB1	0.0091	0.3376
YBD1	0.0399	-0.3046

Dependent Course:**MIL** Department:**BT**

Independent Course	PValue	Coefficient
CONSTANT	0.0387	2.5572
BED1	0.7163	-0.0748
BİY	0.1286	0.2376
COG1	0.7841	0.0556
FİZ1	0.7223	-0.0659
KİM	0.0640	0.2741
MAT1	0.0761	-0.1910
TAR1	0.5428	-0.1238
EDB1	0.7619	0.0378
YBD1	0.0328	0.3157

Dependent Course:**PAP** Department:**BT**

Independent Course	PValue	Coefficient
CONSTANT	0.0001	3.2225
BED1	0.3875	0.1165
BİY	0.1192	-0.1593
COG1	0.6973	0.0516
FİZ1	0.6883	0.0486
KİM	0.2534	0.1093
MAT1	0.5564	-0.0408
TAR1	0.8608	-0.0233
EDB1	0.2586	0.0926
YBD1	0.5349	-0.0588

This course will be eliminated because there is not any significant indipendent variable

Dependent Course:**MAT2** Department:**BT**

Independent Course	PValue	Coefficient
CONSTANT	0.7179	-0.4885
BED1	0.4199	-0.1854
BİY	0.4071	0.1434

Dependent Course:**TAR2** Department:**BT**

Independent Course	PValue	Coefficient
CONSTANT	0.4449	0.9267
BED1	0.2426	-0.2413
BİY	0.4390	0.1198

Dependent Course:**TMR** Department:**BT**

Independent Course	PValue	Coefficient
CONSTANT	0.0152	2.7054
BED1	0.9792	-0.0048
BİY	0.5258	-0.0879

Dependent Course:**TEO** Department:**BT**

Independent Course	PValue	Coefficient
CONSTANT	0.8440	-0.2301
BED1	0.7728	-0.0573
BİY	0.1833	0.2001

Figure 18. Show coefficients table page of WBDSS

Afterwards, the next page appears with coefficient tables. In this tables all dependent courses of 10th year course grades are listed with significant predictors (Figure 18). In this part, there appears some courses in red color, which will be omitted by the system because they do not have any significant predictor 9th grade course. In other words, when all PValues are checked as being insignificant for a dependent course, this course is signed as "omitted" for the allocation progress. And the results of the operation are stored in a triggered table in the database called "coefficient". (Figure 11) Additionally, the independent courses (9th grade predictors) which have higher PValues (insignificant) are also omitted for related dependent course. This means an independent variable course would be predictor for a dependent course while it is not for another one. Because of this fact, there are some eliminated and selected independent variable courses for the system, another regression progress is needed.

Therefore, WBDSS executes another simple linear regression with the chosen dependent and independent courses again. This process is called as "Find Coefficients 2" page by the system. After this regression operation, the results are saved into the triggered table named as "Coefficient2". (Figure 11) In this table, there are X, Y, DepID, Coef and PValue attributes. Those attributes refer to the independent courses id (X) and dependent courses id (Y) from "course" table. There is DepId column because the regression is designed for departmental allocation. In order for a dependent course could be taken in more than one department, the related equation should be created in accordance with this department. When WBDSS tries to operate regression for this type of dependent course, chosen data set is taken from the students of related department.

For instance, Mathematics is given in all departments of the school in 10th grade. Then, WBDSS creates 3 types of the Math equation for every department. In this process, system uses each department's predictor (old) students' grades for related department Math equation calculation. Thus, there appears more than one equation for non-departmental courses' dependent variables. This process can be seen simply in Figure 19. In this figure, there are repetitions of dependent course names with different department codes in parentheses.

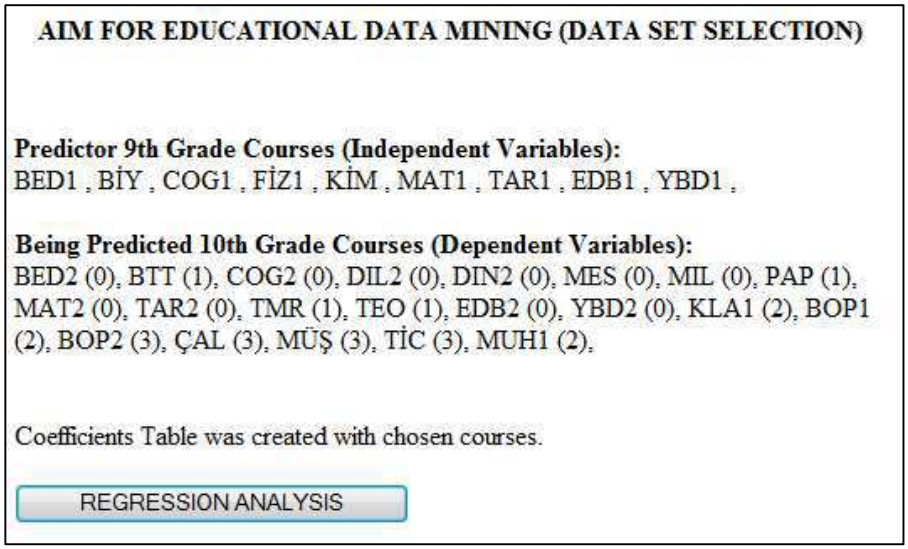
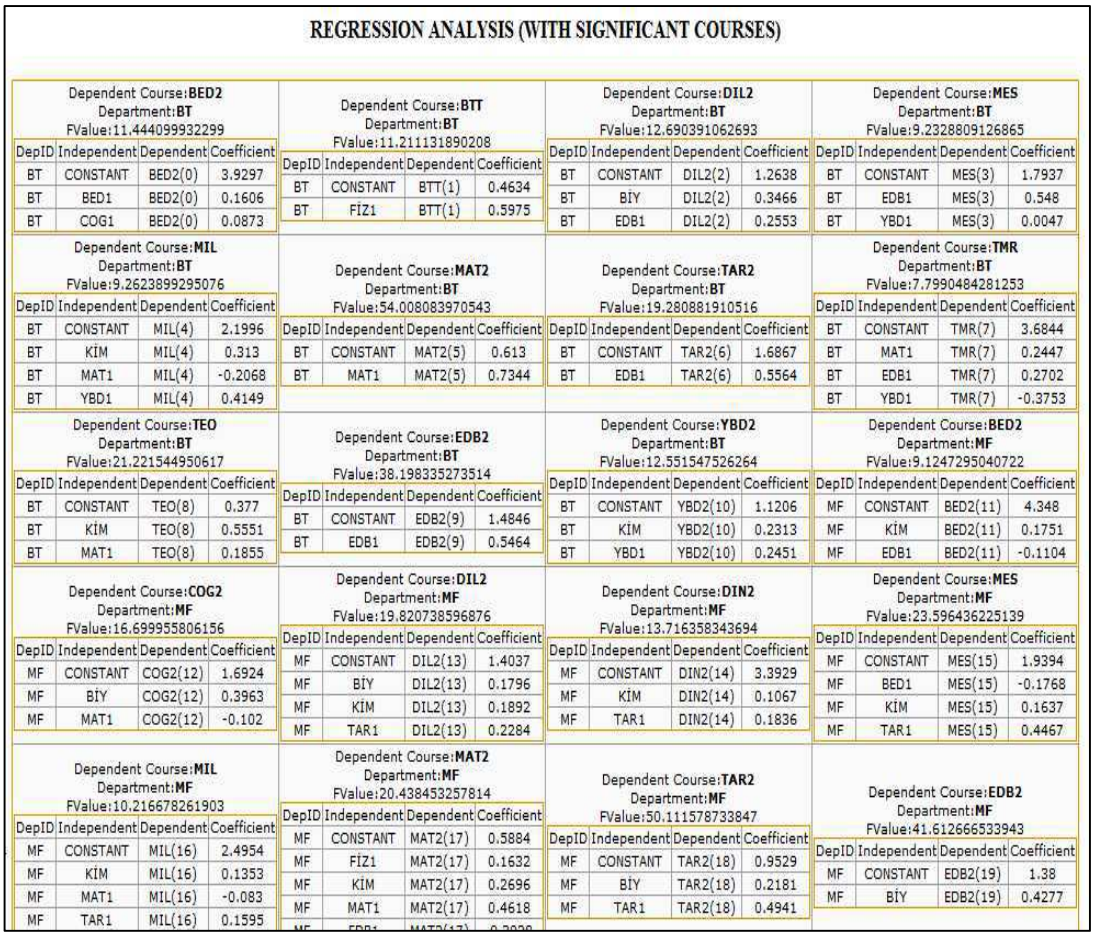


Figure 19. Dependent and independent courses list of WBDSS

As a result, a second coefficient table with significant variables and selected (non-omitted) courses is drawn to the user. (Figure 20) In this page, all the significant predictor courses, dependent courses, coefficients, constants, department IDs and FValues are listed.

After the regression algorithms, the current year students' departmental course grades would be found by the help of coefficients calculated by the system. "Show Results of Students Page" is designed for these results. (Figure 21)



REGRESSION ANALYSIS (WITH SIGNIFICANT COURSES)

Dependent Course:**BED2** Department:**BT** FValue:11.444099932299

DepID	Independent	Dependent	Coefficient
BT	CONSTANT	BED2(0)	3.9297
BT	BED1	BED2(0)	0.1606
BT	COG1	BED2(0)	0.0873

Dependent Course:**BTT** Department:**BT** FValue:11.211131890208

DepID	Independent	Dependent	Coefficient
BT	CONSTANT	BTT(1)	0.4634
BT	FİZ1	BTT(1)	0.5975

Dependent Course:**DIL2** Department:**BT** FValue:12.690391062693

DepID	Independent	Dependent	Coefficient
BT	CONSTANT	DIL2(2)	1.2638
BT	BİY	DIL2(2)	0.3466
BT	EDB1	DIL2(2)	0.2553

Dependent Course:**MES** Department:**BT** FValue:9.2328809126865

DepID	Independent	Dependent	Coefficient
BT	CONSTANT	MES(3)	1.7937
BT	EDB1	MES(3)	0.548
BT	YBD1	MES(3)	0.0047

Dependent Course:**MIL** Department:**BT** FValue:9.2623899295076

DepID	Independent	Dependent	Coefficient
BT	CONSTANT	MIL(4)	2.1996
BT	KİM	MIL(4)	0.313
BT	MAT1	MIL(4)	-0.2068
BT	YBD1	MIL(4)	0.4149

Dependent Course:**MAT2** Department:**BT** FValue:54.008083970543

DepID	Independent	Dependent	Coefficient
BT	CONSTANT	MAT2(5)	0.613
BT	MAT1	MAT2(5)	0.7344

Dependent Course:**TAR2** Department:**BT** FValue:19.280881910516

DepID	Independent	Dependent	Coefficient
BT	CONSTANT	TAR2(6)	1.6867
BT	EDB1	TAR2(6)	0.5564

Dependent Course:**TMR** Department:**BT** FValue:7.7990484281253

DepID	Independent	Dependent	Coefficient
BT	CONSTANT	TMR(7)	3.6844
BT	MAT1	TMR(7)	0.2447
BT	EDB1	TMR(7)	0.2702
BT	YBD1	TMR(7)	-0.3753

Dependent Course:**TEO** Department:**BT** FValue:21.221544950617

DepID	Independent	Dependent	Coefficient
BT	CONSTANT	TEO(8)	0.377
BT	KİM	TEO(8)	0.5551
BT	MAT1	TEO(8)	0.1855

Dependent Course:**EDB2** Department:**BT** FValue:38.198335273514

DepID	Independent	Dependent	Coefficient
BT	CONSTANT	EDB2(9)	1.4846
BT	EDB1	EDB2(9)	0.5464

Dependent Course:**YBD2** Department:**BT** FValue:12.551547526264

DepID	Independent	Dependent	Coefficient
BT	CONSTANT	YBD2(10)	1.1206
BT	KİM	YBD2(10)	0.2313
BT	YBD1	YBD2(10)	0.2451

Dependent Course:**BED2** Department:**MF** FValue:9.1247295040722

DepID	Independent	Dependent	Coefficient
MF	CONSTANT	BED2(11)	4.348
MF	KİM	BED2(11)	0.1751
MF	EDB1	BED2(11)	-0.1104

Dependent Course:**COG2** Department:**MF** FValue:16.699955806156

DepID	Independent	Dependent	Coefficient
MF	CONSTANT	COG2(12)	1.6924
MF	BİY	COG2(12)	0.3963
MF	MAT1	COG2(12)	-0.102

Dependent Course:**DIL2** Department:**MF** FValue:19.820738596876

DepID	Independent	Dependent	Coefficient
MF	CONSTANT	DIL2(13)	1.4037
MF	BİY	DIL2(13)	0.1796
MF	KİM	DIL2(13)	0.1892
MF	TAR1	DIL2(13)	0.2284

Dependent Course:**DIN2** Department:**MF** FValue:13.716358343694

DepID	Independent	Dependent	Coefficient
MF	CONSTANT	DIN2(14)	3.3929
MF	KİM	DIN2(14)	0.1067
MF	TAR1	DIN2(14)	0.1836

Dependent Course:**MES** Department:**MF** FValue:23.596436225139

DepID	Independent	Dependent	Coefficient
MF	CONSTANT	MES(15)	1.9394
MF	BED1	MES(15)	-0.1768
MF	KİM	MES(15)	0.1637
MF	TAR1	MES(15)	0.4467

Dependent Course:**MIL** Department:**MF** FValue:10.216678261903

DepID	Independent	Dependent	Coefficient
MF	CONSTANT	MIL(16)	2.4954
MF	KİM	MIL(16)	0.1353
MF	MAT1	MIL(16)	-0.083
MF	TAR1	MIL(16)	0.1595

Dependent Course:**MAT2** Department:**MF** FValue:20.438453257814

DepID	Independent	Dependent	Coefficient
MF	CONSTANT	MAT2(17)	0.5884
MF	FİZ1	MAT2(17)	0.1632
MF	KİM	MAT2(17)	0.2696
MF	MAT1	MAT2(17)	0.4618

Dependent Course:**TAR2** Department:**MF** FValue:50.111578733847

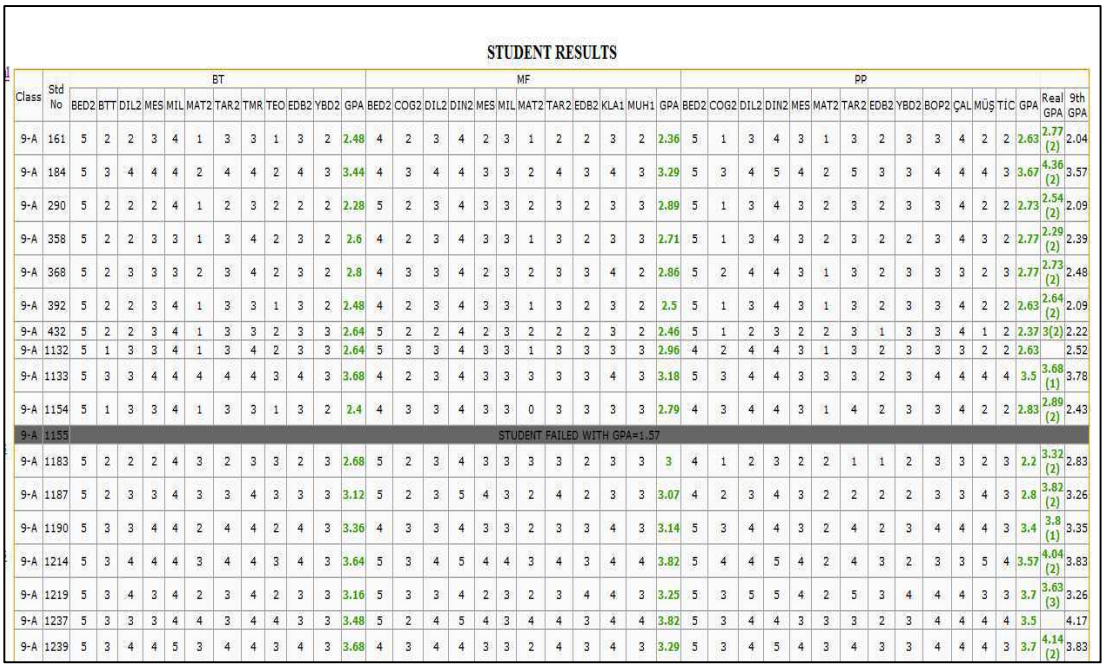
DepID	Independent	Dependent	Coefficient
MF	CONSTANT	TAR2(18)	0.9529
MF	BİY	TAR2(18)	0.2181
MF	TAR1	TAR2(18)	0.4941

Dependent Course:**EDB2** Department:**MF** FValue:41.612666533943

DepID	Independent	Dependent	Coefficient
MF	CONSTANT	EDB2(19)	1.38
MF	BİY	EDB2(19)	0.4277

Figure 20. Second show coefficient tables page of WBDSS

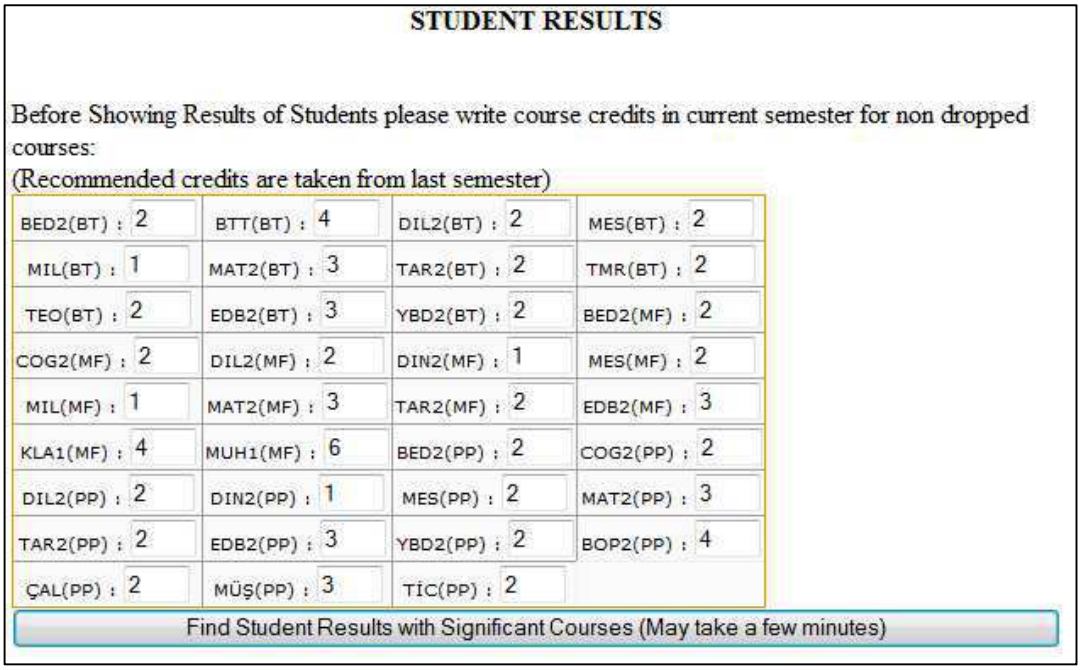
But, before this page appears a form is drawn by the system for stating the current year course credits. Since the credits of the courses can be changed by school for every year, this table is prepared for finding current year students' GPAs with regression equation coefficient resultant course grades of 10th year (Figure 22). In this form, the last year credits are listed in textboxes as a recommendation for the users.



STUDENT RESULTS

Class	Std No	BT												MF												PP															
		BED2	BTT	DIL2	MES	MIL	MAT2	TAR2	TMR	TEO	EDB2	YBD2	GPA	BED2	COG2	DIL2	DIN2	MES	MIL	MAT2	TAR2	EDB2	KLA1	MUH1	GPA	BED2	COG2	DIL2	DIN2	MES	MAT2	TAR2	EDB2	YBD2	BOP2	ÇAL	MÜŞ	TİC	GPA	Real GPA	9th GPA
9-A	161	5	2	2	3	4	1	3	3	1	3	2	2.48	4	2	3	4	2	3	1	2	2	3	2	2.36	5	1	3	4	3	1	3	2	3	3	4	2	2	2.63	2.77 (2)	2.04
9-A	184	5	3	4	4	4	2	4	4	2	4	3	3.44	4	3	4	4	3	3	2	4	3	4	3	3.29	5	3	4	5	4	2	5	3	3	4	4	4	3	3.67	4.36 (2)	3.57
9-A	290	5	2	2	2	4	1	2	3	2	2	2	2.28	5	2	3	4	3	3	2	3	2	3	3	2.89	5	1	3	4	3	2	3	2	3	3	4	2	2	2.73	2.54 (2)	2.09
9-A	358	5	2	2	3	3	1	3	4	2	3	2	2.6	4	2	3	4	3	3	1	3	2	3	3	2.71	5	1	3	4	3	2	3	2	2	3	4	3	2	2.77	2.29 (2)	2.39
9-A	368	5	2	3	3	3	2	3	4	2	3	2	2.8	4	3	3	4	2	3	2	3	3	4	2	2.86	5	2	4	4	3	1	3	2	3	3	3	2	3	2.77	2.73 (2)	2.48
9-A	392	5	2	2	3	4	1	3	3	1	3	2	2.48	4	2	3	4	3	3	1	3	2	3	2	2.5	5	1	3	4	3	1	3	2	3	3	4	2	2	2.63	2.64 (2)	2.09
9-A	432	5	2	2	3	4	1	3	3	2	3	3	2.64	5	2	2	4	2	3	2	2	2	3	2	2.46	5	1	2	3	2	2	3	1	3	3	4	1	2	2.37	3(2)	2.22
9-A	1132	5	1	3	3	4	1	3	4	2	3	3	2.64	5	3	3	4	3	3	1	3	3	3	3	2.96	4	2	4	4	3	1	3	2	3	3	3	2	2	2.63		2.52
9-A	1133	5	3	3	4	4	4	4	4	3	4	3	3.68	4	2	3	4	3	3	3	3	3	4	3	3.18	5	3	4	4	3	3	3	2	3	4	4	4	4	3.5	3.68 (1)	3.78
9-A	1154	5	1	3	3	4	1	3	3	1	3	2	2.4	4	3	3	4	3	3	0	3	3	3	3	2.79	4	3	4	4	3	1	4	2	3	3	4	2	2	2.83	2.89 (2)	2.43
9-A	1155	STUDENT FAILED WITH GPA=1.57																																							
9-A	1183	5	2	2	2	4	3	2	3	3	2	3	2.68	5	2	3	4	3	3	3	3	2	3	3	3	4	1	2	3	2	2	1	1	2	3	3	2	3	2.2	3.32 (2)	2.83
9-A	1187	5	2	3	3	4	3	3	4	3	3	3	3.12	5	2	3	5	4	3	2	4	2	3	3	3.07	4	2	3	4	3	2	2	2	3	3	4	3	2.8	3.82 (2)	3.26
9-A	1190	5	3	3	4	4	2	4	4	2	4	3	3.36	4	3	3	4	3	3	2	3	3	4	3	3.14	5	3	4	4	3	2	4	2	3	4	4	4	3	3.4	3.8 (1)	3.35
9-A	1214	5	3	4	4	4	3	4	4	3	4	3	3.64	5	3	4	5	4	4	3	4	3	4	4	3.82	5	4	4	5	4	2	4	3	2	3	3	5	4	3.57	4.04 (2)	3.83
9-A	1219	5	3	4	3	4	2	3	4	2	3	3	3.16	5	3	3	4	2	3	2	3	4	4	3	3.25	5	3	5	5	4	2	5	3	4	4	4	3	3	3.7	3.63 (3)	3.26
9-A	1237	5	3	3	3	4	4	3	4	4	3	3	3.48	5	2	4	5	4	3	4	4	3	4	4	3.82	5	3	4	4	3	3	3	2	3	4	4	4	4	3.5		4.17
9-A	1239	5	3	4	4	5	3	4	4	3	4	3	3.68	4	3	4	4	3	3	2	4	3	4	3	3.29	5	3	4	5	4	3	4	3	3	4	4	4	3	3.7	4.14 (2)	3.83

Figure 21. Show results of students page of WBDSS



STUDENT RESULTS

Before Showing Results of Students please write course credits in current semester for non dropped courses:
(Recommended credits are taken from last semester)

BED2(BT) : 2	BTT(BT) : 4	DIL2(BT) : 2	MES(BT) : 2
MIL(BT) : 1	MAT2(BT) : 3	TAR2(BT) : 2	TMR(BT) : 2
TEO(BT) : 2	EDB2(BT) : 3	YBD2(BT) : 2	BED2(MF) : 2
COG2(MF) : 2	DIL2(MF) : 2	DIN2(MF) : 1	MES(MF) : 2
MIL(MF) : 1	MAT2(MF) : 3	TAR2(MF) : 2	EDB2(MF) : 3
KLA1(MF) : 4	MUH1(MF) : 6	BED2(PP) : 2	COG2(PP) : 2
DIL2(PP) : 2	DIN2(PP) : 1	MES(PP) : 2	MAT2(PP) : 3
TAR2(PP) : 2	EDB2(PP) : 3	YBD2(PP) : 2	BOP2(PP) : 4
ÇAL(PP) : 2	MÜŞ(PP) : 3	TİC(PP) : 2	

Find Student Results with Significant Courses (May take a few minutes)

Figure 22. Current year course credits page of WBDSS

In addition to the predicted grade list of students in Figure 21, the failed students are listed. Those failed students will be eliminated by the system for allocation progress. The failure degree is 2.00 over 5.00 stated by legal policies of Ministry of National Education. But, in this manner, there should be an important explanation about failure

calculation operation. WBDSS does not look at significant independent variables for calculating 9th grade GPA and for stating failed students. Adversely, WBDSS executes this algorithm with all 9th year courses grades of students with related credits.

Additionally, in the results table real departments of the students are listed with real GPAs in that department if they are stated in the "Add Student 10th Course Grades" page.

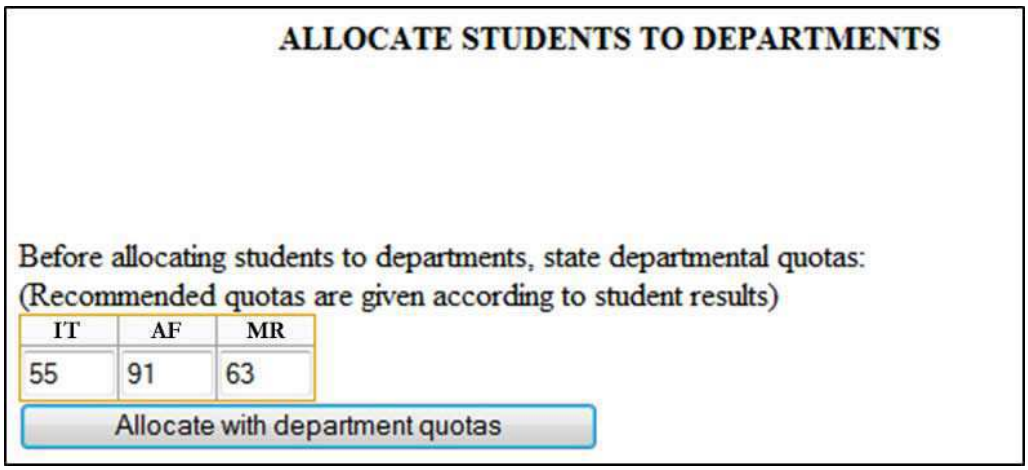
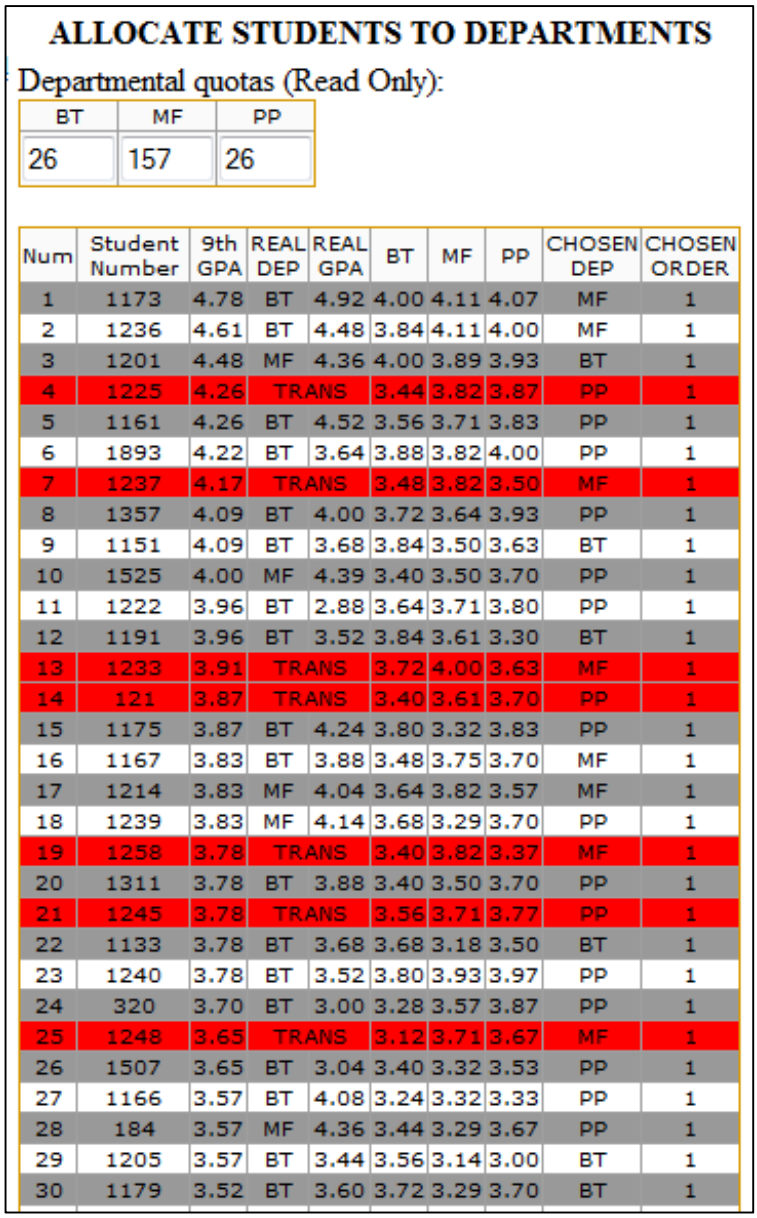


Figure 23. State departmental quotas page of WBDSS

As the last step of knowledge discovery progress, Allocate Students page may represent the Knowledge Presentation sequence. In this page, firstly, the user is asked the departmental quotas of the school. System can know the total student number and the departments of the school, but the departmental quotas of the current year should be given by the user to the system. The form shown in Figure 23 is designed for this stating quotas purpose. At the same time, in this form recommendations for quotas are given to the user which are estimated for best allocation. In other words, the recommended quotas in this form are stated as if all the students are allocated to the best GPA department individually. But in reality this is impossible because of physical conditions, number of teachers in each department etc. Also, since the total number of students that have continued on to the 10th grade is known by the system, the total number is

fixed by a JavaScript code by the system. In this form, the last textbox is a read-only textbox whose value is found by subtracting the sum of all other textboxes from total student number. So that, the total number of students was not be exceeded by the user when stating the departmental quotas.

After stating departmental quotas by the manager as the main user of the system, the last step of the WBDSS executes and students are allocated to the best possible departments according to the departmental quotas. This progress is done by WBDSS with a simple allocation procedure. Firstly, system lists students with their 9th grade GPAs in a descending order. Then, starting with the higher-GPA-student, system choses the each student's best department by choosing the higher calculated (predicted) departmental GPA. If the highest-GPA-department is not suitable for allocating (if its quota is full for the queued student), the next highest department is chosen iteratively. As a result of this procedure, some students may not be allocated to the highest-GPA-department which situation will be discussed in Evaluation of the System Chapter. As the result of this allocation progress, the last page of the analysis part of WBDSS appears as "Allocation of Students to Departments" page. (Figure 24) Some rows of the table are drawn in red color in this allocation table, because those students do not have any 10th year GPA and known as transferred students to another schools. Whether transferred or not, system predicts the best possible departments for every student and lists in the last table.



ALLOCATE STUDENTS TO DEPARTMENTS

Departmental quotas (Read Only):

BT	MF	PP
26	157	26

Num	Student Number	9th GPA	REAL DEP	REAL GPA	BT	MF	PP	CHOSEN DEP	CHOSEN ORDER
1	1173	4.78	BT	4.92	4.00	4.11	4.07	MF	1
2	1236	4.61	BT	4.48	3.84	4.11	4.00	MF	1
3	1201	4.48	MF	4.36	4.00	3.89	3.93	BT	1
4	1225	4.26	TRANS		3.44	3.82	3.87	PP	1
5	1161	4.26	BT	4.52	3.56	3.71	3.83	PP	1
6	1893	4.22	BT	3.64	3.88	3.82	4.00	PP	1
7	1237	4.17	TRANS		3.48	3.82	3.50	MF	1
8	1357	4.09	BT	4.00	3.72	3.64	3.93	PP	1
9	1151	4.09	BT	3.68	3.84	3.50	3.63	BT	1
10	1525	4.00	MF	4.39	3.40	3.50	3.70	PP	1
11	1222	3.96	BT	2.88	3.64	3.71	3.80	PP	1
12	1191	3.96	BT	3.52	3.84	3.61	3.30	BT	1
13	1233	3.91	TRANS		3.72	4.00	3.63	MF	1
14	121	3.87	TRANS		3.40	3.61	3.70	PP	1
15	1175	3.87	BT	4.24	3.80	3.32	3.83	PP	1
16	1167	3.83	BT	3.88	3.48	3.75	3.70	MF	1
17	1214	3.83	MF	4.04	3.64	3.82	3.57	MF	1
18	1239	3.83	MF	4.14	3.68	3.29	3.70	PP	1
19	1258	3.78	TRANS		3.40	3.82	3.37	MF	1
20	1311	3.78	BT	3.88	3.40	3.50	3.70	PP	1
21	1245	3.78	TRANS		3.56	3.71	3.77	PP	1
22	1133	3.78	BT	3.68	3.68	3.18	3.50	BT	1
23	1240	3.78	BT	3.52	3.80	3.93	3.97	PP	1
24	320	3.70	BT	3.00	3.28	3.57	3.87	PP	1
25	1248	3.65	TRANS		3.12	3.71	3.67	MF	1
26	1507	3.65	BT	3.04	3.40	3.32	3.53	PP	1
27	1166	3.57	BT	4.08	3.24	3.32	3.33	PP	1
28	184	3.57	MF	4.36	3.44	3.29	3.67	PP	1
29	1205	3.57	BT	3.44	3.56	3.14	3.00	BT	1
30	1179	3.52	BT	3.60	3.72	3.29	3.70	BT	1

Figure 24. Allocation of students page of WBDSS

As a conclusion of all the knowledge discovery sequences of WBDSS, the aim of developing this system is "predicting the 10th year departmental course grades of a vocational high school's students by the help of 9th year significant course grades". Firstly, system clears the data set from noisy and redundant data. Then, system tries to find coefficients of a regression equation in which the 10th grade courses are dependent variables and 9th grade ones are independent. In order to create a valuable equation,

system operates two regression algorithms. In the first regression, the Pvalues of coefficients are found and the insignificant independent variable courses are eliminated from the system. Then, the selected significant variables propagated in a second regression and the final equations are found. Afterwards, students' course grades are estimated by the system with regression equations. Lastly, by the help of predicted departmental GPAs and given departmental quotas, students are allocated to the possible best departments in a descending order process of 9th grade GPA.

CHAPTER 6

IMPLEMENTATION OF THE SYSTEM

WBDSS is designed as an educational data mining system in the purpose of students' departmental allocation progress knowledge discovery. It has been tested and evaluated with the data of a governmental vocational high school. The name of that school is Bahçelievler Vocational Trade High School (BVTHS). In order to validate the methodology generated for the system, course grades of over 1400 students from a 44-item course pool (approx. 25000 grades) have been used. In this chapter, the testing environment, training and test datasets, demographic information of students in test dataset gathered from an informative questionnaire (Appendix C), dependent and independent variable courses topics are covered respectively.

Testing Environment

Bahçelievler Vocational Trade High School (BVTHS) is a state vocational high school which is located in the middle of Bahçelievler district of Istanbul. It is also one of the crowded schools of the district. BVTHS was founded in 1995 with the aim of leading primary school graduates of the region to the vocational education. In its first education semester, there were only 400 students and 28 teachers. Nowadays, as the number of 2012-2013 education year, there are more than 1500 students enrolled actively and 62 teachers working in different technical and non-technical branches. The physical environment, except classes, of BVTHS was only a typewriter laboratory in 1995, on the other hand; now, there are 1 library, 1 closed sport hall, 1 medical rood and 6 computer laboratories.

Additionally, after the MEGEP, the departmental status of the school was changed progressively. A new and progressive department was opened in the school in 2005, called Information Technologies Department (IT), in addition to the Accounting Department. Also, since the structure of vocational education was changed by the project, Accounting Department was divided into two different departments as Accounting and Finance (AF) and Marketing and Retail (MR). In the 2012-2013 education year, there are 3 main departments in the school in which 4 different branches are situated (Table 7).

Table 7. Departments and Branches of BVTHS

Department	Branch
Accounting and Finance (AF)	Computerized Accounting (CA)
	Foreign Trade Office Services (FTOS)
Marketing and Retail (MR)	Insurance
Information Technologies (IT)	Web Programming (WP)

In addition to this information of BVTHS, there is another school situated as Anatolian Vocational Trade High School. This school is embedded as a second school of the education environment in 2005 with 50 students who enrolled with a country based entrance exam. But, there is only one department in Anatolian school which is IT, and also, students choose their department not with a departmental allocation system during 9th grade to 10th grade passing year, but with their country based high school entrance exam scores just after graduating from primary school. Therefore, the students of Anatolian high school of BVTHS are not included in both training and test datasets of WBDSS evaluation progress.

Training and Test Datasets

Training Dataset

According to Witten (2006), data mining can be defined as the process of discovering patterns in data. Also, those discovered patterns must be meaningful in that they lead to some advantages, and, the data is invariably present in substantial quantities. In this sense, the 2008-2009, 2009-2010, 2010-2011, 2011-2012 and 2012-2013 education year graduates of BVTHS are chosen as the training dataset of the system evaluation progress. Also, during the regression algorithm, the 10th grade courses of these students are chosen as the dependent variables while the 9th grade ones are independent.

As it can be found from Figure 7, there are 1478 students in the system in which 343 students are in the 9th grade and can be called as possible 2013-2014 graduates. These students' grades are chosen as test data set and will be explained briefly in the next topic.

The rest of the students set (1135) are selected as training data set and listed in Table 8 with their possible graduation years and departments.

Table 8. Student Numbers of BVTHS in Training Dataset with Possible Graduation Years and Departments

Grade	Graduation Year	Department			TOTAL
		IT	AF	MR	
10	2012-2013	34	188	22	244
11	2011-2012	35	153	33	221
12	2010-2011	41	204	32	277
13 (Graduated)	2009-2010	50	163	33	246
13 (Graduated)	2008-2009	55	92	-	147
GENERAL TOTAL					1135

As a second fact is that, unfortunately, the grades of students in both data sets are stored in the relational database in the form of over 5, because only this type of form is available in E-Okul. Although, the recent year students are included with their 100-based scores, the past year graduates are in 5-based form because of the fact that E-Okul was designed in this form in the first and second year of its usage in high schools.

Lastly, it should be stated that students in training data set are only the ones who did not fail in the related years of education. In other words, those students who failed in such a year of their high school education and repeated, are included to the system database with their last (past year) grades. In addition, the students who transferred from school to other ones are embedded to the system, only if they have 9th and 10th grade scores, namely, if they were not transferred just after 9th year.

Test Dataset

The test database of the evaluation progress of WBDSS consists of 343 students in 9th grade in 2010-2011 education year. Therefore, they are assumed as the possible 2013-2014 graduates of BVTHS. After calculating the 9th grade GPA of those students, 134 students are stated as "failed" because of a GPA below 2.00. These students are not allocated to the departments because of their repeat processes. Additionally, since there is an "Add Students 10th Course Grades" menu item in the system, the test dataset students who has not any current grade of 10th grade are accepted as transferred to other schools. But, WBDSS still allocate those students to best departments in order to guide them for the transferred schools. Then, as it is shown in Table 9, 209 students are allocated to departments whether they are transferred or not.

Table 9. Student Numbers of Test Dataset in WBDSS Evaluation Progress

Total Students applied to system		343
	Failed Students in 9th year (not allocated)	134
	Passed (Allocated) students	209
	Transferred Students (Who do not have current grade but estimated grades and allocated)	42
	Allocated Students at school	167

Dependent and Independent Variable Courses

In the main analysis part of WBDSS, a linear regression algorithm is executed among dependent and independent variable courses. The dependent variables are 10th grade courses, while the independent ones are 9th grade. But, before these double regression algorithms, as it is briefly explained in the design and development chapter, there are some preprocessing steps which are about data cleaning, integration and selection sequences of knowledge discover.

After choosing data set from the choices of "Departmental Allocation" and "Branch Allocation", system automatically finds the dependent and independent variables from the courses table of relation database. Since all the courses of the table are not relevant for data mining applications because of tolerance limits, some courses were eliminated first. Then, independent variable course are found as follows;

- Physical Education 1 (BED1)
- Biology (BIY)
- Geography 1 (COG1)
- Physics 1 (FIZ1)
- Chemistry (KIM)
- Mathematics 1 (MAT1)

- History 1 (TAR1)
- Literature 1 (EDB1)
- Foreign Language 1 (YBD1)

In addition to these, the courses listed in Table 10 are dependent course of 10th grade.

Table 10. Dependent Variable Courses with Their Departments

Independent Variable Course	Department
Physical Education 2 (BED2)	All
Mathematics 2 (MAT2)	All
Geography 2 (COG2)	All
Turkish Language 2 (DIL2)	All
Religion and Ethics Science 2 (DIN2)	All
Professional Development (MES)	All
National Security (MIL)	All
History 2 (TAR2)	All
Foreign Language 2 (YBD2)	All
Literature 2 (EDB2)	All
Technical and Professional Drawing (TMR)	IT
Basic Electronics and Measurement (TEO)	IT
Fundamentals of Information Technologies (BTT)	IT
Package Programs (PAP)	IT
Office Programs (BOP1)	AF
Keyboard Writing (KLA)	AF
Accounting 1 (MUH1)	AF
Customer Relationships (MUS)	MR
Commercial Accountings (TIC)	MR
Office Programs (BOP2)	MR
Working Life (CAL)	MR

As it is discussed in Chapter 5, WBDSS executes two linear regression algorithms, one of which is done for finding significant independent courses according to PValues and

the other is for finding coefficients with only those significant courses. In this phase, the courses which are not technical (has no department) in the dependent course list are executed 3 times in linear regression for all of the departments. After the first regression, some dependent variables are eliminated because of having no significant independent variables. Those courses are the followings;

- COG2 for IT department
- DIN2 for IT department
- PAP for IT department
- YBD2 for AF department
- BOP1 for AF department
- MIL for MR department

Therefore, second regression algorithm is executed by the system and results are listed as shown in Table 11.

Table 11. Dependent & Independent Variables with Deps, Coefficients and F Values

Dependent Course: BED2 Department: IT FValue:11.4441		Dependent Course: TMR Department: IT FValue:7.799		Dependent Course:DIL2 Department: IT FValue:12.6904		Dependent Course: MES Department: IT FValue:9.2329	
Independent	Coeff	Independent	Coeff	Independent	Coeff	Independent	Coeff
CONSTANT	3.9297	CONSTANT	3.6844	CONSTANT	1.2638	CONSTANT	1.7937
BED1	0.1606	MAT1	0.2447	BİY	0.3466	EDB1	0.548
COG1	0.0873	EDB1	0.2702	EDB1	0.2553	YBD1	0.0047
		YBD1	-0.3753				
Dependent Course: BTT Department: IT FValue:11.2111		Dependent Course: MAT2 Department: IT FValue:54.0081		Dependent Course:TAR2 Department: IT FValue:19.2809		Dependent Course: EDB2 Department: IT FValue:38.1983	
Independent	Coeff	Independent	Coeff	Independent	Coeff	Independent	Coeff
CONSTANT	0.4634	CONSTANT	0.613	CONSTANT	1.6867	CONSTANT	1.4846
FİZ1	0.5975	MAT1	0.7344	EDB1	0.5564	EDB1	0.5464
Dependent Course: TEO Department: IT FValue:21.2215		Dependent Course: MIL Department: IT FValue:9.2624		Dependent Course: YBD2 Department: IT FValue:12.5515		Dependent Course: BED2 Department: AF FValue:9.1247	
Independent	Coeff	Independent	Coeff	Independent	Coeff	Independent	Coeff
CONSTANT	0.377	CONSTANT	2.1996	CONSTANT	1.1206	CONSTANT	4.348
KİM	0.5551	KİM	0.313	KİM	0.2313	KİM	0.1751
MAT1	0.1855	MAT1	-0.2068	YBD1	0.2451	EDB1	-0.1104
		YBD1	0.4149				

Dependent Course: COG2
Department: AF
FValue:16.7

Independent	Coeff
CONSTANT	1.6924
BİY	0.3963
MAT1	-0.102

Dependent Course:DIL2
Department: AF
FValue:19.8207

Independent	Coeff
CONSTANT	1.4037
BİY	0.1796
KİM	0.1892
TAR1	0.2284

Dependent Course: DIN2
Department: AF
FValue:13.7164

Independent	Coeff
CONSTANT	3.3929
KİM	0.1067
TAR1	0.1836

Dependent Course: MES
Department: AF
FValue:23.5964

Independent	Coeff
CONSTANT	1.9394
BED1	-0.1768
KİM	0.1637
TAR1	0.4467

Dependent Course: MIL
Department: AF
FValue:10.2167

Independent	Coeff
CONSTANT	2.4954
KİM	0.1353
MAT1	-0.083
TAR1	0.1595

Dependent Course: MAT2
Department: AF
FValue:20.4385

Independent	Coeff
CONSTANT	0.5884
FİZ1	0.1632
KİM	0.2696
MAT1	0.4618
EDB1	-0.3028

Dependent Course: TAR2
Department: AF
FValue:50.1116

Independent	Coeff
CONSTANT	0.9529
BİY	0.2181
TAR1	0.4941

Dependent Course: EDB2
Department: AF
FValue:41.6127

Independent	Coeff
CONSTANT	1.38
BİY	0.4277

Dependent Course:KLA1
Department: AF
FValue:4.6103

Independent	Coeff
CONSTANT	3.0165
BİY	0.1008
FİZ1	0.0905

Dependent Course:MUH1
Department: AF
FValue:25.4413

Independent	Coeff
CONSTANT	1.1495
KİM	0.2546
TAR1	0.3155

Dependent Course:BED2
Department: MR
FValue:10.1187

Independent	Coeff
CONSTANT	3.5646
BED1	0.2391
FİZ1	0.1708
YBD1	-0.1721

Dependent Course: COG2
Department: MR
FValue:12.7447

Independent	Coeff
CONSTANT	-0.9193
BİY	0.4071
COG1	0.5306
EDB1	0.2591

Dependent Course:DIL2
Department: MR
FValue:23.2016

Independent	Coeff
CONSTANT	1.8149
BİY	0.601

Dependent Course:DIN2
Department: MR
FValue:18.6029

Independent	Coeff
CONSTANT	2.9563
BİY	0.492

Dependent Course: MES
Department: MR
FValue:14.9101

Independent	Coeff
CONSTANT	1.4849
BİY	0.5595

Dependent Course: MAT2
Department: MR
FValue:12.1318

Independent	Coeff
CONSTANT	-2.3163
BED1	0.69
MAT1	0.4649

Dependent Course:TAR2
Department: MR
FValue:10.4462

Independent	Coeff
CONSTANT	-1.7629
BED1	0.6699
BİY	0.4582
MAT1	-0.3132
EDB1	0.4275

Dependent Course:EDB2
Department: MR
FValue:21.8493

Independent	Coeff
CONSTANT	0.928
BİY	0.5095

Dependent Course: YBD2
Department: MR
FValue:4.3261

Independent	Coeff
CONSTANT	1.4887
BED1	0.3296
BİY	0.2562
TAR1	-0.2898

Dependent Course: BOP2
Department: MR
FValue:6.181

Independent	Coeff
CONSTANT	1.2356
BED1	0.3896
MAT1	0.2052

Dependent Course: ÇAL
Department: MR
FValue:6.2671

Independent	Coeff
CONSTANT	0.8813
BED1	0.5327

Dependent Course: MÜŞ
Department: MR
FValue:13.9307

Independent	Coeff
CONSTANT	-0.4338
FİZ1	0.2869
TAR1	0.4757
EDB1	0.375

Dependent Course: TİC
Department: MR
FValue:19.578

Independent	Coeff
CONSTANT	0.9736
FİZ1	0.6108

Afterwards, the course credits are determined in the evaluation progress as shown in Figure 22 in the previous chapter. Then, the students' course grades of 10th grade in each department are found. Lastly, by the help of those estimated course grades students departmental 10th grade GPAs are found for finding best departments orderly.

CHAPTER 7

EVALUATION OF THE SYSTEM

Analysis Results

As it is shown in Table 9, there are 209 students are satisfactory in 9th grade in test dataset of the system. Forty two members of this set are transferred and 167 are not. In other words, we know the current grades of these 167 students and have chance to see their characteristics by applying a questionnaire. (Appendix C)

In terms of student numbers in the school, 26 students for IT, 157 students for AF and 26 students for MF departments are chosen in the "Allocate Students to Departments" page. (Figure 25) This values are gathered from the management office of the school for current education year.

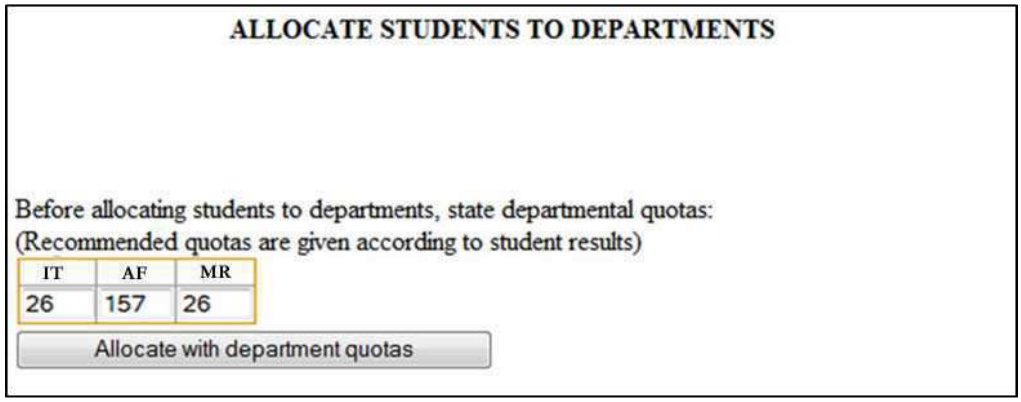


Figure 25. Departmental quotas of BVTHS

After the regression algorithm execution by WBDSS, the results appear with best departments (Appendix E). If there was a chance to state departmental quotas as 55 for IT, 91 for AF and 63 for MR; that would be best for the allocation. In other words, students could be placed to the best GPA estimated departments in that situation. But, since the physical conditions and numbers of teachers are not available for these quotas, 26-157-26 values are given to the system. (Figure 25) Then, as a result of these input values, some students could not be allocated to the first (greatest GPA) departments.

Table 12. Cross-Tabulation Analysis of Chosen Departments and Transferred Students

Chosen Department	Information Technologies (IT)	Accounting and Finance (AF)	Marketing and Retail (MR)	Total
Trans	4	34	4	42
Non-Trans	22	123	22	167
Total	26	157	26	209

As it is shown in Table 12, there are some students in all departments who are transferred. Those 42 students are guided by the system about their best department choices though they are transferred to other schools.

Table 13. Number of Students in Departments Compared to Real Departments

Chosen Department	Information Technologies (IT)		Accounting and Finance (AF)		Marketing and Retail (MR)	
	Real = IT	Real <> IT	Real = AF	Real <> AF	Real = MR	Real <> MR
Students (Non-Trans)	8	14	97	26	1	21
Percentages in Departmental Quotas	36.36	63.64	78.86	21.14	4.55	95.45

Then, another comparison matrix is discussed in Table 13. In this table, the number of students in departments compared to the real departments are shown. By the help of this table, it can be concluded that students in AF department (as real department) are mostly in their departments according to the results of WBDSS (78.86 %). But, IT and MR departments' students are not in their best departments. This result brings to mind new questions: "What is the difference between IT and AF or MR and AF?" and "What is the similarity of IT and MR?". When the 9th grade and 10th grade total average of GPAs in these departments are compared, these differences and similarities can be found. IT department is the hardest and the most popular department of the school. Then, in the current allocation system, most of the hard working students intend to

study in this department. This fact is resulted from the analysis of 9th grade GPA average of IT students (3.54). Accordingly, MR department is the least popular department of BVTHS. Then, this department is generally chosen on the last order by the students in department selection form (Appendix A). This department seen as a part of AF and students who does not have chance to enroll AF chose this department (Table 9). Additionally, when we look at the average GPA of those students, it is calculated as 2.58. This result can be summarized that the highest and lowest GPA students do not attend to choose the real best departments, they tend to choose what is popular (IT) or what is a must to be enrolled in (MR). In other words, hard-working students choose IT because of its popularity without any consideration on its convenience, also, lowest score students are forced to be enrolled MR department because of its unpopularity (Hypothesis 3).

Table 14. Number of Students in terms of GPA and Real-Chosen Comparison

	Real = Chosen	Real <> Chosen
Students who are better than estimated (Real GPA > Estimated GPA)	46	30
Students who are worse than calculated (Real GPA < Estimated GPA)	60	31
TOTAL	106	61

Another discussion point is about real versus chosen department and current versus estimated GPAs. Table 14 shows the cross-tabulation analysis result of these discussion points. As it can be clearly seen on the table that number of the students are in nearly half and half distributed in terms of current versus estimated scores, whether the real department is equal to chosen department. Then, we can simply validate the effect of WBDSS's GPA calculation. This half distribution (especially in real > chosen part) can

mean a confidence in the calculation methodology of WBDSS. But, it should be examined by a scientific method.

Table 15. Paired Sample Statistics of Real GPA and Estimated GPA

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Real GPA	3.0733	167	0.63444	0.04909
	Estimated GPA	2.9996	167	0.37707	0.02918

Table 16. Paired Sample Test Results of Real GPA and Estimated GPA

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	90% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Real GPA Estimated GPA	0.07365	0.54125	0.04188	0.00437	0.14293	1.759	166	0.081

Therefore, an Analysis of Variance (ANOVA) method is applied to the estimated and current GPAs of 10th grade. Since the sample (student groups) of both GPAs are same (test data set students), Paired Sample T-Test is applied for this analysis. Table 15 shows the Paired Sample Statistics of this analysis. Also, as it seen in Table 16 that the calculated GPAs' of students by WBDSS is in 90% confidence interval with a 0.081 significance value (Hypothesis 1).

Table 17. Increase Percentage of Students GPA in terms of Current-Chosen Comparison

	Current = Chosen	Current <> Chosen
Average of 9th GPA	2.62	3.24
Average of (Current)10th GPA	2.95	3.29
Increase Rate	12.60 %	1.54 %

Furthermore, another analysis is done about GPA increases of students from 9th grade to 10th grade (Table 17). Students who are placed to the real departments by the system

improved their GPAs in the ratio of 12.60 %, while the others increase only 1.54 %. In addition to these, this table shows that the students who are not placed in their real departments by WBDSS, has higher average of 9th and 10th grade GPAs. This is proof of the discussion about Table 13 above (Hypothesis 4).

Table 18. Results of 10th Grade Failed Students

Student Number	9th GPA	Real Dep.	Real GPA	Chosen Dep. GPA	IT	AF	MR	Chosen Dep.	Chosen Order
153	2.70	IT	1.84	2.71	2.92	2.71	2.67	IT	2
1421	2.52	MR	1.70	2.71	2.80	2.71	2.43	AF	2
143	2.22	AF	1.64	2.43	2.56	2.43	2.60	AF	3
1246	2.04	AF	1.64	2.54	2.56	2.54	2.43	AF	2

Moreover, when we look at the results table of 10th grade failed students (Table 18), which consists of only 4 students, it can be simply seen that 3 failed students are not in their best departments, although two of them (Number 143 and 1246) are placed in same departments in third and second orders. And, the number 153 is in the best department but failed indeed. However, if we focus on this student's special position at school, it can be found that the student had 2 disciplinary punishments during 10^{th} education year. And, these punishments made him omitted for this analysis. As a result, it can be concluded that the students, who failed in 10th grade with lower GPAs than 2.00 by a legal policy, could not have been allocated to their best departments. If we apply this analysis to the students who have GPAs lower than 2.50, again, we can collect the information that only 8 of those 25 students are in their best departments with the ratio of 7.54 % (8 over 106 best department students). On the other hand, other 17

lower GPA ones are in different departments with the ratio of 27.86 % (17 over 61 different department students) (Hypothesis 2 and 4)

Lastly, since the students who are not in best departments in real life could not be examined in a countable way, an observable comparison analysis is designed. In this analysis, students with similar or same 9th grade GPAs are grouped to be compared. There appeared 17 groups with different numbers of students in. And, the observations result that in 13 groups of those 17, students (total 55) who have placed to the same department with the system, have greater 10th year real GPAs than those who do not. Besides, only in 4 groups, students (total 15), who were not allocated to the same department by WBDSS have bigger 10th GPAs than the ones who have. This observation simply concludes that nearly 4 times of students who are in their best departments according to WBDSS, have bigger GPAs than the ones who are not, while they have same GPAs in 9th grade. In other words, if two students have same 9th grade GPA, the one who is in the best department according to WBDSS has the possibility rate of 78.57% (55/70) to have higher GPA at the end of the 10th grade (Hypothesis 2).

To sum up, WBDSS is acceptable and scientifically proven with a 90% confidence interval with a significance value of 0.081 on calculating 10th grade GPAs over all 167 students. Also, frequencies and descriptive cross-tabulation statistics shows that students in the best departments according to the results of WBDSS increase their GPAs much more than the others. And, students who are not in best departments are more close to failure in 10th grade than the others. Lastly, a group-wise comparison between the ones who have same 9th grade GPAs show that allocating to best departments cause a more GPA on 10th grade in the ration of 78.57 %.

Limitations & Future Study Recommendations

WBDSS, as a futuristic but young system, has some limitations because of limited data access of E-Okul. Those limitations, possible solutions and recommendations for the future studies are explained briefly in this section.

First of all, the students embedded into the system from earliest education years have the course scores not over 100 but over 5. It is strongly believed in the area of educational data mining that the more specific and vary data means the more patterns available for discovery. Therefore, it would be better to include scores of students in the form of over 100. Also, separating the scores into two semesters would create new patterns to be discovered by data mining algorithms. In other words, the score of each course would be divided into two scores if it was available from E-Okul, and this would double the number of independent variable courses.

Secondly, the most time consuming part of the system is data input progress at the beginning of the knowledge discovery sequences. Due to this fact, this system would be combined into E-Okul as an analysis and allocation module. Then, the data input process would be eliminated, although data input process must be done once and the data can be used for the future researches and allocations of the school during the next years allocations. In this manner, the combination of E-Okul and WBDSS could be three times more efficient in terms of time and effort.

As the third fact, directly related to the first and second limitations of WBDSS, the system does not have enough differentiated independent variables for training issues. In order to create a well-designed knowledge discovery model, there should be as much more variables as possible. And, those variables must be in different forms to enlarge the scales and reduce the error rates. However, there is only 9th grade course

scores in this system because of data access limitations. On the other hand, the data of students listed below may improve the quality of educational data mining model of WBDSS by varying the factors and reducing the error rates to the acceptable minimal values. According to the "Department Satisfaction Surveys" of Akkaya (2006) and Kütük (2007) those possible independent variables are:

- Attendance rates of students
- Number of disciplinary punishments in related grades and the types of these punishments.
- Family income
- Number of brothers and sisters in the school and their departments
- Education levels of parents and resemblance of their occupation and students department
- Number and type of awards and certificates in related grades

These data can be gathered from E-Okul database but with an access limit. For instance, a manager can access to the referred data of just the current year students. However, the data of both training and test data set should be stored to the system for educational data mining. So that, these independent variables could not be included to the system in evaluation progress. On the other hand, this limitation could be coped with easily by a combination of E-Okul and WBDSS. In this sense, the structure of data mining methodology in WBDSS should obviously be redesigned because of different types of these variables. There may be a computation in which decision tree and regression methods are used together.

Lastly, WBDSS has a technical limitation in its methodology period. While there are many methods for countable variables in educational data mining literature, only

regression model could be used in the system. It is believed that there would be more than one option and also these options can be compared or combined for best results by the system. Briefly, neural networks or decision tree methods can be included into the system at all. However, this embedding wish could not be taken into consideration because of technical limitations of web based design. As it is explained in Chapter 5, the duration of regression algorithm is approximately 6 hours for an individual school, due to web based application server capability, the number of iterations and deepness of recursive functions. But, again in the ideal form, "combination of E-Okul and WBDSS", WBDSS can be executed as a local application of main web based education module of Turkey. Therefore, WBDSS would simply work more stable and with much more complex features of data mining.

To sum up, WBDSS, as an educational data mining system, has some limitations because of bureaucratic data access procedures and controls. On the other hand, it is strongly believed that WBDSS could be a part of Main Education Management Information System of Ministry of Education (E-Okul). Then, all the limitations of the WBDSS would disappear automatically.

CHAPTER 8

CONCLUSION

This study discusses the problem of departmental allocation progress of vocational high school students. A web based multi-criteria decision support system (WBDSS) is designed to find relations between the 9th and 10th grade courses of the school in a departmental group wise method with simple linear regression educational data mining algorithm. In the educational data mining process, the general Knowledge Discovery Sequences are adapted to the system. Firstly, data cleaning and integration phases are done for pure and appropriate datasets. Then, since the data sets consist of same type of data (grades over 5) data transformation step is omitted. Afterwards, possible 10th grade GPAs of students are calculated by the help of grades of previous education years' students with linear regression algorithm as data mining step. Lastly, as the step of pattern evaluation, WBDSS allocates students to the best appropriate departments in terms of school's current year department quotas.

The system has been implemented on a 1478 student-database which is divided into two groups (one consists of the previous years' students and the other consists of current year's students) in Bahçelievler Vocation Trade High School (BVTHS) in İstanbul. There are 3 departments in this school which are Information Technologies (IT), Accounting and Finance (AF) and Marketing and Retail (MR). Training set consists of 1135 students from 5 previous education years and test set consists of 343 transferred and non-transferred students of 9th grade. Those 209 of those 343 students are passed to the 10th grade while the others are stated as repeat in terms of their lower GPAs. Also, 42 successful students are transferred to other schools and remaining 167 ones are investigated by a questionnaire. The results of questionnaire show that 59.77 % of the

students do not have any information about the vocational high schools before they enrolled to school. Additionally, students chose their department mostly (60.5 %) for a valid job by their own accord but do not have enough information or guidance.

At the end of the double regression algorithms, one of which is done for finding significant independent variable and the other is applied to the significant ones to get coefficients; 9 independent 9th grade courses are related, significantly, to the 11 technical and 10 non-technical courses of 10th grade.

After the allocation to the departments iteratively by the help of the regression algorithm, the results are discussed briefly. First of all, numbers allocated department students are compared to real departments. The results show that 36.36 % of 22 students in IT department allocated to the IT department same as real. This percentage is 78.86 in AF and 4.55 in MR departments. Then, the similarities and differences of the departments were discussed and found that IT is the most and MR is the least popular departments of the school. Secondly, it was found that the calculation algorithm in the WBDSS is in 90 % confidence interval with a significance value of 0.081. Also, the increase rate of GPAs from 9th to 10th grades in test dataset is 8 times more than the ones who are in their best department in real life. In addition, the failure students in 10th grade are found in the different departments than the ones WBDSS found. Lastly, a group wise research on the same 9th grade GPA students shows that student placement to the best departments found by the WBDSS cause more GPA than the others in 10th grade with a percentage of 78.75.

As the limitations of the system, the grades in the database are chosen to be stored in the form of over 5 due to the fact that the previous year graduates grades are available only in this form. Also, the regression algorithm step of the system takes a lot

of time because it is applied in a web server. Another limitation is that system does not have enough types of independent variables. Lastly, the single method of educational data mining of the system would be improved for better solutions. As a result of these limitations, a combination of E-Okul and WBDSS systems is highly recommended to solve those data access, application time, data and method limitation problems, totally.

To sum up, this developmental research is aimed to conduct a Web Based Decision Support System for Departmental Selection Process of Vocational High Schools. The system uses main knowledge discovery sequences with simple linear regression algorithm of educational data mining. The evaluation results of the system conclude that it is in 90% confident interval on calculation, but it can be improved by a combination with E-Okul.

APPENDIXES

A. EVALUATION OF STUDENT SELECTION AND PLACEMENT FORM

EK-2

ÖĞRENCİ TERCİHLERİNİ DEĞERLENDİRME VE YERLEŞTİRME FORMU

ÖĞRENCİ BİLGİLERİ			
Kimlik ve Okul Bilgileri 9. Sınıf		**İlköğretim Bilgileri:**	
T.C. Kimlik No		Mezun Olduğu Okul	
Adı Soyadı			
Okul No			
Kayıtlı Olduğu Okul		İlköğretim Diploma Puanı	
9. Sınıf Yıl Sonu Başarı Puanı			

TERCİH BİLDİRİM FORMU VE DEĞERLENDİRME TABLOSU

Sıra No	Tercih Edilen		9. Sınıf Yılsonu Başarı Puanı x 0,60	İlköğretim diploma puanı x 0,40	Alana Yerleştirme Puanı
	Alan Adı	Okul Adı	(A)	(B)	C = A + B
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					

Tercihler tarafımızdan yapılmıştır.				**Görülmüştür**	
Öğrencinin Adı Soyadı:		Velinin Adı Soyadı:		**Müdür Yardımcısının** Adı Soyadı:	
İmza		İmza		İmza	

Not: Bu Form 2 adet düzenlenecek, müdür yardımcısı tarafından imzalandıktan sonra bir örneği öğrenci veya velisine verilecektir.

B. DESCRIPTIONS ABOUT PLACEMENT TO THE VOCATIONAL SCHOOLS

TEKNİK LİSE VE ALANA GEÇİŞLER İLE İLGİLİ AÇIKLAMALAR

1. Teknik liselere ve alana geçiş yapacak öğrencilerin velileri, e-Okul sisteminde yayımlanacak alanlar ve okulları gösteren listelerden yararlanarak tercihlerini belirleyecek Form Dilekçenin ilgili bölümlerini yazarak **3 Ağustos 2012** tarihinden itibaren öğrencinin kayıtlı olduğu okul müdürlüğüne teslim edeceklerdir.
2. Sınıf tekrarı durumuna düşenler hariç, 2011-2012 öğretim yılında 9'uncu sınıfta öğrenim gören tüm öğrenciler alan tercihi yapacaktır.
3. Alan Tercih Formunda en fazla 15 tercih yapılabilecek ve tercihler, sisteme okul müdürlüğünce işlenecektir.
4. Öğrencilerin sağlık durumlarının, öğrenim görmek istedikleri mesleğin öğrenimine elverişli olması gerekir. Okul müdürlüklerince, gerektiğinde, öğrencinin sağlık durumunun yerleştirildiği alanda öğrenim görmesine elverişli olup olmadığının raporla belgelendirilmesi istenebilecektir.
5. Alana Yerleştirme Puanı, öğrencinin 9'uncu sınıf yıl sonu başarı puanının % 60'ı ile ilköğretim diploma puanının % 40'ı toplanarak hesaplanacaktır.
6. Öğrenci tercihleri, ilgili okul müdürlüklerince belirlenen kontenjanlar ve Alana Yerleştirme Puanı çerçevesinde puan üstünlüğüne göre e-Okul sistemi üzerinden gerçekleştirilecektir.
7. Yerleştirme sonunda açık kontenjanı bulunan alan ve okullar e-Okul sisteminde duyurulacaktır.
8. Başvuru süresi içinde alan tercihi yapamayan öğrenciler ile tercih ettikleri herhangi bir alana yerleştirilemeyen öğrenciler, okul müdürlüklerince açık kontenjanı bulunan bir alana, Alana Yerleştirme Puanları göz önünde bulundurularak yerleştirilecektir.
9. Tercih başvurusu ve tercih değişikliği, teknik liseler için **16 Ağustos 2012**, alana geçişler için ise **27 Ağustos 2012** tarihine kadar yapılabilecektir.
10. Yerleştirme sonuçları teknik liselerde **17 Ağustos 2012**, alana geçişlerde ise **28 Ağustos 2012** tarihlerinde açıklanacaktır.
11. Tercihleri doğrultusunda teknik liseye yerleştirilen öğrencilerin velileri **22-27 Ağustos 2012** tarihleri arasında öğrencinin yerleştirildiği okul müdürlüğünde e-Okul sistemi üzerinden okula devam edeceğine ilişkin onay işlemi yaptıracaktır. Bu onay işlemini yaptıran öğrencilerin varsa meslek liseleri için alana geçiş tercihleri iptal olacaktır. Bu onay işlemini yaptırmayan öğrenciler, meslek liseleri için daha önce alan tercihi yapmamışlar ise **27 Ağustos 2012** tarihi mesai bitimine kadar alan tercihi yapabileceklerdir.
12. Tercihleri doğrultusunda alana yerleştirilen öğrencilerin velileri **29 Ağustos-5 Eylül 2012** tarihleri arasında öğrencinin yerleştirildiği okul müdürlüğünde e-Okul sistemi üzerinden alana devam edeceğine ilişkin onay işlemi yaptıracaktır. Bu onay işlemini yaptırmayan öğrenciler, Alana Yerleştirme Puanları göz önünde bulundurularak **6-14 Eylül 2012** tarihleri arasında, 9'uncu sınıfı okuduğu okulda açık kontenjanı bulunan bir alana okul müdürlüklerince yerleştirilecektir.
13. Tercih listesini doldurmadan önce öğrencinin, mesleki rehberlik amacıyla hazırlanan Mesleki Bilgi Sistemi portalına (http://mbs.meb.gov.tr) girerek mesleki gelişim, kendini tanımaya destek olabilecek ölçme araçları, eğitim ve iş piyasasına ilişkin bilgi ve kaynakları incelemesi, gerçek ilgi ve yeteneklerine ilişkin bilgi edinmesinde yarar görülmektedir.
14. Teknik liselerin 10'uncu sınıflarında boş kalan kontenjanlara şartları tutan öğrencilerin kayıtları **27 Ağustos-14 Eylül 2012** tarihleri arasında okul müdürlüklerince yapılacaktır.
15. Mesleki ve Teknik Eğitim Yönetmeliği'nin 52'nci maddesine göre; anne ve/veya babasına ait çalışır durumda bir iş yeri olup anne veya baba mesleği ile ilgili alana kayıt yaptırmak isteyenler kontenjana bakılmaksızın **6-14 Eylül 2012** tarihleri arasında kayıt yaptırabileceklerdir.

C. STUDENT QUESTIONAIRE

Dear Bahçelievler Vocational Trade High School Students
This questionnaire is intended to contribute to the research of "A Web Based Multi-Criteria Decision Support System for Department Selection Process of Vocational High School Students".
Please read and answer all the questions for the reality of the research.
Your responses are very important to the research results and valuable part of this scientific research. Data to be obtained will be evaluated totally and will not be used anywhere else.
Thanks for your interest in answering questions and being a part of this research.

Mustafa COŞKUN
Information Technologies Teacher
Boğaziçi University Institution of Social Sciences
Student of Management Information Systems Department

1. Your Department
   ( ) Accounting and Finance
   ( ) Marketing and Retail
   ( ) Information Technologies

2. Your Gender
   ( ) Male ( ) Female

3. Which high school did you want to choose when you graduated from primary school? (Please select only one choice)
   ( ) I had no idea
   ( ) Vocational High School
   ( ) Anatolian High School
   ( ) Science High School
   ( ) Social Sciences High School
   ( ) Other: ……

4. If you had chance, which department would you choose except for your department?
   (Please select only one choice)
   ( ) Accounting and Finance
   ( ) Marketing and Retail
   ( ) Information Technologies

5. Were you disciplinary punished in 9th grade period in high school?
   ( ) Yes ( ) No

6. Were you disciplinary punished in 10th grade period in high school?
   ( ) Yes ( ) No

7. Have you got any information about the department you study?
   ( ) Yes ( ) No

8. Why did you choose this department? (You can select more than one choice)
   ( ) There is no reason
   ( ) To have a valid job
   ( ) There are many alternative university choices entered with additional points
   ( ) To continue my family profession
   ( ) Because it is easier to graduate
   ( ) Because my close friends are in / choose this department
   ( ) Because my teachers recommended it
   ( ) Because I did not want to study at the university
   ( ) Other: ……

9. Who influenced you to choose this department? (You can select more than one choice)
   ( ) My family
   ( ) My friends
   ( ) Acquaintance (Family Friends)
   ( ) My teachers
   ( ) Counseling Service
   ( ) Graduates of this department
   ( ) My own accord
   ( ) My grades are just enough for this department
   ( ) Other: …….

10. Do you want to do this profession in the future?
    ( ) Yes ( ) No

ÖĞRENCİ ANKET FORMU

Sevgili Bahçelievler Ticaret Meslek Lisesi Öğrencileri
Bu anket "Meslek Liselerinde Bölüm Seçimi için Web-Tabanlı Çok Kriterli Karar Destek Sistemi" araştırmasına katkı sağlamak amacıyla hazırlanmıştır. Araştırmanın gerçekliği açısından lütfen bütün soruları okuyunuz ve mutlaka her soruyu yanıtlayınız. Araştırma sonuçlarına ulaşmada siz kıymetli öğrencilerimizin verecekleri cevaplar önem taşımakta ve bilimsel araştırmanın önemli bir boyutunu oluşturmaktadır. Elde edilecek veriler toplu olarak değerlendirilecek ve araştırma dışında hiçbir yerde kullanılmayacaktır.
Soruları cevaplarken gösterdiğiniz ilgi ve yardımlarınız için şimdiden teşekkür eder, başarılar dilerim.

Mustafa COŞKUN
Bilişim Teknolojileri Öğretmeni
Boğaziçi Üniversitesi Sosyal Bilimler Enstitüsü
Yönetim Bilişim Sistemleri Bölümü Yüksek Lisans Öğrencisi

1. Bölümünüz
   ( ) Muhasebe ve Finansman
   ( ) Pazarlama Perakende
   ( ) Bilişim Teknolojileri

2. Cinsiyetiniz
   ( ) Bay ( ) Bayan

3. İlköğretimi bitirdiğinizde hangi bölüme girmek isterdiniz. (Lütfen tek seçenek işaretleyiniz)
   ( ) Bir Fikrim yoktu
   ( ) Meslek Lisesi
   ( ) Anadolu Lisesi
   ( ) Fen Lisesi
   ( ) Sosyal Bilimler Lisesi

   ( ) Diğer: ……

4. Seçme şansınız olsaydı bölümünüz (alanınız) dışında hangi alana gitmek isterdiniz?
   (Lütfen tek seçenek işaretleyiniz)
   ( ) Muhasebe ve Finansman
   ( ) Pazarlama Perakende
   ( ) Bilişim Teknolojileri

5. 9. Sınıfta herhangi bir disiplin cezası aldınız mı?
   ( ) Evet ( ) Hayır

6. 10. Sınıfta herhangi bir disiplin cezası aldınız mı?
   ( ) Evet ( ) Hayır

7. Okumakta olduğunuz bölümle ilgili daha önceden bilginiz var mıydı?
   ( ) Evet ( ) Hayır

8. Okuduğunuz bölümü (alanı) niçin seçtiniz? (Birden fazla seçenek seçebilirsiniz.)
   ( ) Herhangi bir nedeni yok
   ( ) Geçerli bir meslek sahibi olmak için
   ( ) Ek puanla girilen üniversite seçeneği daha fazla olduğu için
   ( ) Aile mesleğimi devam ettirmek için
   ( ) Bitirmesi daha kolay olduğu için
   ( ) Arkadaşlarım bu bölümde (alanda) olduğu / tercih ettiği için
   ( ) Öğretmenlerim tavsiye ettiği için
   ( ) Üniversiteye gitmek istemediğim için

   ( ) Diğer: …….

9. Bu bölümü seçmenizde kimler etkili oldu? (Birden fazla seçenek seçebilirsiniz.)
   ( ) Ailem
   ( ) Arkadaşlarım
   ( ) Aile çevrem (Dost ve Akrabalar)
   ( ) Öğretmenlerim
   ( ) Rehberlik Servisi
   ( ) Bu bölüm mezunu tanıdıklarım
   ( ) Kendi isteğimle
   ( ) Notlarım bu bölüme girmeye yetiyordu

   ( ) Diğer: …….

10. İleride bu mesleği yapmak istiyor musunuz?
    ( ) Evet ( ) Hayır

D. INTERVIEW QUESTIONS

Description: This interview is intended to contribute to the research of "A Web Based Multi-Criteria Decision Support System for Department Selection Process of Vocational High School Students". Please try to answer all the questions for the reality of the research. Your responses are very important to the research results and valuable part of this scientific research. Data to be obtained will be evaluated in a restricted way and will not be used anywhere else. Thanks for your interest in answering questions and being a part of this research.

1. What is your position in the school?	
2. What are your responsibilities on Department Selection Process of BVTHS?	
3. What are the main steps of this process in the school and when it is done?	
4. Do you face with difficulties on this process? What are they?	
5. What are your suggestions for improving this process?	
6. Do you think, a decision support system, which find relations between 9th grade courses and departmental courses and then suggests best departments for the students, would be helpful for this process?	
7. If you say “yes” to the Question-6, what kind of features would be added to that system?	

RÖPORTAJ SORULARI

Açıklama: Bu röportaj "Meslek Lisesi Öğrencilerinin Bölüm Seçim Süreci için Web Tabanlı Çok Kriterli Karar Destek Sistemi" araştırmasına katkıda bulunmak için tasarlanmıştır. Lütfen araştırmanın gerçekliği için tüm soruları yanıtlamaya çalışın. Sizin yanıtlarınız araştırma sonuçları için çok önemli ve bu bilimsel araştırmanın değerli bir parçasıdır. Elde edilecek veriler gizlilik ölçüsünde değerlendirilecek ve başka bir yerde kullanılmayacaktır. Soruları yanıtlarken gösterdiğiniz ilgi ve bu araştırmanın bir parçası olduğunuz için teşekkür ederiz.

1. Okuldaki pozisyonunuz / ünvanınız nedir?	
2. BTML'de bölüm seçim sürecindeki sorumluluklarınız nelerdir?	
3. Bu sürecin temel aşamaları nelerdir ve ne zaman gerçekleştirilirler?	
4. Bu süreçte zorluklarla karşılaşıyor musunuz? Bu zorluklar nelerdir?	
5. Bu süreci gelişrtimek için sizing görüşleriniz / tavsiyeleriniz nelerdir?	
6. Sizce, 9. Sınıf ders notları ve bölüm derslerinin notları arasında bir ilişiki bulan ve öğrencilere onlar için en iyi bölüm tavsiyesinde bulunan bir karar destek sistemi bu süreç için yararlı olur mu?	
7. Eğer 6. Soruya "evet" cavabı verdiyseniz, bu sisteme ne tür özellikler eklenebilir?	

E. STUDENT ESTIMATED GPAS AND ALLOCATION RESULTS

NUM	STD NO	9TH GPA	REAL DEP	REAL GPA OF 10TH GRADE	IT GPA	AF GPA	MR GPA	CHOSEN DEP.	CHOSEN ORDER
1	117	2.30	AF	3.11	2.68	2.89	2.80	AF	1
2	119	2.43	AF	3.54	2.68	2.82	2.63	AF	1
3	121	3.87	TRANS		3.40	3.61	3.70	MR	1
4	122	2.26	AF	3.00	2.60	2.21	1.97	AF	2
5	124	2.65	AF	2.43	2.92	2.86	2.90	AF	3
6	125	2.87	AF	2.57	3.08	2.89	3.03	AF	3
7	143	2.22	AF	1.64	2.56	2.43	2.60	AF	3
8	146	2.87	AF	2.46	3.04	2.86	2.97	IT	1
9	148	2.65	MR	2.57	2.84	2.86	2.77	AF	1
10	151	2.70	AF	2.81	2.84	2.89	2.87	AF	1
11	153	2.70	IT	1.84	2.92	2.71	2.67	AF	2
12	155	3.48	IT	2.72	3.40	3.25	3.33	IT	1
13	161	2.04	AF	2.77	2.48	2.36	2.63	AF	3
14	167	2.35	TRANS		2.76	2.39	2.33	AF	2
15	184	3.57	AF	4.36	3.44	3.29	3.67	MR	1
16	190	2.61	AF	2.54	2.80	3.21	2.87	AF	1
17	240	2.61	IT	2.59	2.64	2.29	2.63	AF	3
18	241	2.57	TRANS		2.68	3.07	2.50	AF	1
19	243	3.09	AF	2.29	3.28	3.32	2.90	AF	1
20	245	2.70	AF	3.14	2.72	3.11	3.07	AF	1
21	250	2.83	MR	3.61	2.84	2.82	2.67	AF	2
22	254	2.22	TRANS		2.56	2.71	2.43	AF	1
23	283	2.78	MR	2.30	3.16	3.04	2.87	AF	2
24	290	2.09	AF	2.54	2.28	2.89	2.73	AF	1
25	295	2.35	TRANS		2.64	2.75	2.80	AF	2
26	303	2.35	AF	2.25	2.84	2.79	2.50	AF	2
27	305	2.61	AF	3.32	2.56	3.32	2.97	AF	1
28	310	2.26	AF	2.25	2.28	2.54	2.80	AF	2
29	320	3.70	IT	3.00	3.28	3.57	3.87	MR	1
30	338	2.13	AF	2.96	2.64	2.43	2.70	AF	3
31	351	2.22	TRANS		2.48	2.71	2.73	AF	2
32	358	2.39	AF	2.29	2.60	2.71	2.77	AF	2
33	361	3.30	AF	2.50	3.36	3.25	3.27	IT	1

34	368	2.48	AF	2.73	2.80	2.86	2.77	AF	1
35	392	2.09	AF	2.64	2.48	2.50	2.63	AF	2
36	395	2.22	AF	2.00	2.56	3.00	2.20	AF	1
37	398	3.04	AF	3.21	2.92	3.43	3.13	AF	1
38	401	2.61	AF	2.68	2.80	2.96	2.73	AF	1
39	432	2.22	AF	3.00	2.64	2.46	2.37	AF	2
40	445	2.39	AF	3.04	2.44	2.89	2.87	AF	1
41	637	2.96	AF	3.21	3.04	2.89	2.80	IT	1
42	643	2.87	AF	3.36	3.36	3.00	3.33	AF	3
43	855	2.52	AF	3.00	2.68	2.36	2.50	AF	3
44	1118	2.57	AF	2.68	2.92	3.21	2.57	AF	1
45	1132	2.52	TRANS		2.64	2.96	2.63	AF	1
46	1133	3.78	IT	3.68	3.68	3.18	3.50	IT	1
47	1134	2.61	AF	2.64	2.76	2.46	2.50	AF	3
48	1135	3.00	AF	2.57	2.92	2.96	2.67	AF	1
49	1140	2.04	TRANS		2.32	2.71	2.33	AF	1
50	1141	2.17	TRANS		2.60	2.71	2.43	AF	1
51	1144	2.96	TRANS		2.76	3.11	2.90	AF	1
52	1146	2.78	AF	2.54	3.16	2.71	2.83	AF	3
53	1148	2.52	AF	2.54	2.76	2.82	2.87	AF	2
54	1149	2.91	MR	2.61	2.88	2.82	3.07	IT	2
55	1150	2.65	AF	2.61	2.36	3.39	2.73	AF	1
56	1151	4.09	IT	3.68	3.84	3.50	3.63	IT	1
57	1154	2.43	AF	2.89	2.40	2.79	2.83	AF	2
58	1157	2.61	AF	3.07	2.80	2.89	2.80	AF	1
59	1159	2.22	AF	2.50	2.40	2.71	2.67	AF	1
60	1161	4.26	IT	4.52	3.56	3.71	3.83	MR	1
61	1163	2.35	IT	2.62	2.48	2.79	2.63	AF	1
62	1164	2.13	TRANS		2.28	2.89	2.37	AF	1
63	1165	3.09	TRANS		2.72	3.54	3.13	AF	1
64	1166	3.57	IT	4.08	3.24	3.32	3.33	MR	1
65	1167	3.83	IT	3.88	3.48	3.75	3.70	AF	1
66	1168	3.39	IT	3.16	2.84	3.71	3.27	AF	1
67	1171	2.57	AF	2.79	2.80	3.04	2.60	AF	1
68	1173	4.78	IT	4.92	4.00	4.11	4.07	AF	1
69	1174	3.26	AF	3.39	3.36	2.89	3.23	IT	1
70	1175	3.87	IT	4.24	3.80	3.32	3.83	MR	1

71	1176	2.39	AF	2.71	2.64	2.75	2.77	AF	2
72	1177	2.70	TRANS		2.76	2.82	2.80	AF	1
73	1179	3.52	IT	3.60	3.72	3.29	3.70	IT	1
74	1180	2.61	AF	3.36	2.64	2.71	2.53	AF	1
75	1181	3.00	AF	3.18	2.92	3.36	2.90	AF	1
76	1183	2.83	AF	3.32	2.68	3.00	2.20	AF	1
77	1184	2.48	MR	3.48	2.84	3.07	2.70	AF	1
78	1185	2.48	AF	3.18	2.84	2.46	2.97	AF	3
79	1187	3.26	AF	3.82	3.12	3.07	2.80	IT	1
80	1190	3.35	IT	3.80	3.36	3.14	3.40	MR	1
81	1191	3.96	IT	3.52	3.84	3.61	3.30	IT	1
82	1192	2.70	IT	3.20	2.84	2.96	2.40	AF	1
83	1193	3.22	IT	3.52	3.20	3.11	3.67	MR	1
84	1196	2.13	AF	3.61	2.56	3.04	2.30	AF	1
85	1198	2.87	TRANS		3.00	3.14	3.17	AF	2
86	1201	4.48	AF	4.36	4.00	3.89	3.93	IT	1
87	1202	2.09	TRANS		2.16	3.11	2.77	AF	1
88	1203	2.35	AF	3.75	2.64	2.89	2.63	AF	1
89	1204	2.57	AF	3.33	2.56	3.11	2.97	AF	1
90	1205	3.57	IT	3.44	3.56	3.14	3.00	IT	1
91	1208	2.30	TRANS		2.48	2.64	2.77	AF	2
92	1209	2.04	AF	3.11	2.44	2.50	2.63	AF	2
93	1211	2.00	TRANS		2.28	2.79	2.63	AF	1
94	1212	3.22	AF	3.82	3.20	3.18	3.00	IT	1
95	1213	3.48	IT	3.72	3.12	3.21	3.60	MR	1
96	1214	3.83	AF	4.04	3.64	3.82	3.57	AF	1
97	1219	3.26	MR	3.63	3.16	3.25	3.70	MR	1
98	1222	3.96	IT	2.88	3.64	3.71	3.80	MR	1
99	1224	2.96	AF	3.96	3.08	3.14	3.03	AF	1
100	1225	4.26	TRANS		3.44	3.82	3.87	MR	1
101	1231	2.74	AF	2.82	2.92	2.86	2.97	AF	3
102	1233	3.91	TRANS		3.72	4.00	3.63	AF	1
103	1234	2.26	IT	2.84	2.12	2.79	2.10	AF	1
104	1236	4.61	IT	4.48	3.84	4.11	4.00	AF	1
105	1237	4.17	TRANS		3.48	3.82	3.50	AF	1
106	1238	2.87	AF	2.68	2.72	3.04	3.07	AF	2
107	1239	3.83	AF	4.14	3.68	3.29	3.70	MR	1

108	1240	3.78	IT	3.52	3.80	3.93	3.97	MR	1
109	1242	2.39	AF	2.71	2.36	3.07	2.87	AF	1
110	1243	3.17	AF	3.07	3.24	3.29	3.73	AF	2
111	1245	3.78	TRANS		3.56	3.71	3.77	MR	1
112	1246	2.04	AF	1.64	2.56	2.54	2.43	AF	2
113	1248	3.65	TRANS		3.12	3.71	3.67	AF	1
114	1253	2.74	AF	2.64	3.04	2.93	2.37	AF	2
115	1254	2.22	AF	2.64	2.20	2.79	2.57	AF	1
116	1256	3.22	AF	3.64	3.36	2.96	3.33	IT	1
117	1257	2.39	TRANS		2.80	2.54	2.57	AF	3
118	1258	3.78	TRANS		3.40	3.82	3.37	AF	1
119	1259	2.70	AF	3.32	2.84	3.07	3.10	AF	2
120	1260	2.00	AF	2.25	2.56	2.61	2.47	AF	1
121	1261	2.52	AF	3.64	2.56	2.71	2.93	AF	2
122	1263	2.61	AF	4.18	2.72	2.86	2.33	AF	1
123	1264	2.70	AF	3.18	2.92	3.07	2.63	AF	1
124	1275	2.57	AF	2.46	2.60	3.04	2.90	AF	1
125	1276	2.30	AF	2.57	2.56	2.71	2.33	AF	1
126	1282	3.17	IT	2.88	3.12	2.89	3.13	MR	1
127	1284	2.87	MR	3.70	2.92	3.14	3.50	AF	2
128	1285	2.78	AF	2.04	3.96	1.89	2.47	AF	3
129	1291	2.65	AF	3.48	2.92	3.00	2.70	AF	1
130	1304	2.48	AF	3.07	2.48	3.21	2.70	AF	1
131	1307	2.61	MR	2.90	2.84	2.93	2.77	AF	1
132	1308	2.91	MR	2.77	2.88	3.36	2.83	AF	1
133	1311	3.78	IT	3.88	3.40	3.50	3.70	MR	1
134	1320	3.04	TRANS		3.12	2.71	2.90	IT	1
135	1321	2.78	AF	2.86	2.84	3.21	2.93	AF	1
136	1322	2.43	AF	2.14	2.76	2.21	2.53	AF	3
137	1330	3.04	AF	3.21	3.08	3.32	2.83	AF	1
138	1332	3.26	TRANS		3.24	3.32	3.27	AF	1
139	1336	3.48	AF	3.68	3.20	3.32	3.33	MR	1
140	1337	2.96	MR	2.91	2.84	3.11	3.00	AF	1
141	1338	2.43	AF	2.25	2.64	2.75	2.73	AF	1
142	1342	2.13	AF	3.00	2.56	2.57	2.03	AF	1
143	1344	2.30	AF	2.75	2.64	2.39	2.43	AF	3
144	1346	3.26	IT	3.08	3.20	2.86	2.77	IT	1

145	1351	2.43	TRANS		2.64	3.00	2.87	AF	1
146	1352	2.65	AF	2.93	2.72	2.82	2.97	AF	2
147	1356	2.87	AF	3.71	2.92	2.89	2.33	IT	1
148	1357	4.09	IT	4.00	3.72	3.64	3.93	MR	1
149	1359	3.35	TRANS		3.08	3.68	3.37	AF	1
150	1363	2.87	MR	2.40	2.96	2.96	2.67	AF	1
151	1372	3.17	AF	2.68	3.16	3.25	3.67	MR	1
152	1374	3.30	AF	3.96	3.16	3.57	3.43	AF	1
153	1381	2.22	AF	2.86	2.56	2.36	2.73	AF	3
154	1382	2.52	MR	2.83	2.92	3.00	2.70	AF	1
155	1390	2.87	AF	3.29	2.88	3.29	3.10	AF	1
156	1392	2.65	AF	3.46	3.00	3.14	2.80	AF	1
157	1394	2.70	AF	4.71	2.76	2.89	2.33	AF	1
158	1401	2.43	AF	3.21	2.40	2.89	2.80	AF	1
159	1402	2.43	AF	2.79	3.04	2.93	2.13	AF	2
160	1406	2.22	TRANS		2.36	2.54	2.63	AF	2
161	1421	2.52	MR	1.70	2.80	2.71	2.43	AF	2
162	1426	2.74	AF	3.39	3.00	3.14	3.07	AF	1
163	1427	2.43	AF	2.57	2.76	2.75	1.80	AF	2
164	1437	2.26	TRANS		2.56	2.71	2.47	AF	1
165	1439	2.30	TRANS		2.64	2.61	2.37	AF	2
166	1447	2.30	AF	3.18	2.56	2.61	2.20	AF	1
167	1459	2.48	AF	2.75	2.64	2.86	2.97	AF	2
168	1467	2.17	TRANS		2.76	2.25	2.53	AF	3
169	1470	2.22	AF	3.00	2.80	2.36	2.50	AF	3
170	1474	2.61	AF	2.29	2.76	2.82	2.43	AF	1
171	1480	2.30	AF	2.68	2.56	2.96	2.57	AF	1
172	1486	3.48	IT	2.96	3.40	3.14	3.20	IT	1
173	1494	2.91	AF	2.25	3.04	3.00	3.07	IT	2
174	1500	2.48	TRANS		2.84	2.82	2.53	AF	2
175	1504	2.91	TRANS		3.12	2.89	3.17	IT	2
176	1507	3.65	IT	3.04	3.40	3.32	3.53	MR	1
177	1508	3.26	AF	3.29	3.36	3.29	3.57	MR	1
178	1512	2.26	AF	3.36	2.72	2.82	2.17	AF	1
179	1525	4.00	AF	4.39	3.40	3.50	3.70	MR	1
180	1531	2.35	TRANS		2.56	2.61	2.83	AF	2
181	1542	2.91	AF	2.43	3.08	2.89	3.10	IT	2

182	1544	3.04	MR	2.87	2.80	3.25	3.37	AF	2
183	1550	2.22	TRANS		2.76	2.46	2.43	AF	2
184	1558	2.61	AF	2.46	2.80	3.14	3.17	AF	2
185	1561	2.57	AF	3.68	3.04	2.82	2.87	AF	3
186	1565	2.91	TRANS		2.92	2.89	3.10	IT	2
187	1593	2.22	AF	2.07	2.64	2.75	2.47	AF	1
188	1604	2.65	AF	2.68	2.72	3.36	3.23	AF	1
189	1627	2.61	AF	3.14	2.64	3.04	3.10	AF	2
190	1753	2.30	AF	3.04	2.80	3.07	2.70	AF	1
191	1779	3.00	TRANS		2.84	3.21	2.80	AF	1
192	1784	3.17	AF	2.93	3.00	2.89	2.37	IT	1
193	1792	2.96	TRANS		3.00	2.89	2.83	IT	1
194	1800	2.96	AF	3.64	3.08	3.21	2.97	AF	1
195	1812	2.74	AF	2.25	3.08	3.00	2.97	AF	2
196	1820	2.87	TRANS		3.20	3.14	2.70	AF	2
197	1830	3.22	AF	4.18	3.28	3.29	3.67	MR	1
198	1866	2.17	AF	2.71	2.56	2.89	2.27	AF	1
199	1879	3.35	TRANS		3.20	3.14	3.33	MR	1
200	1880	2.04	AF	2.82	2.24	2.54	2.80	AF	2
201	1893	4.22	IT	3.64	3.88	3.82	4.00	MR	1
202	1898	2.35	AF	2.29	2.56	2.29	2.80	AF	3
203	1901	2.61	MR	2.67	2.80	2.89	2.80	AF	1
204	1902	2.96	IT	2.87	2.72	3.04	3.13	AF	2
205	1903	2.57	TRANS		2.72	3.07	2.60	AF	1
206	1907	2.61	AF	2.79	2.84	3.14	2.60	AF	1
207	1931	2.70	AF	3.93	3.20	2.36	2.97	AF	3
208	1936	2.65	MR	2.87	2.92	2.75	2.63	AF	2
209	1937	3.13	AF	4.36	3.36	2.82	3.23	IT	1

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