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The Predictive Degree of Anatolian High School 11th Grade Science Students' Mathematics, Physics, Chemistry, Geometry and Biology Academic Achievements on Their University Entrance Examination Quantitative Scores

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ABSTRACT

In this research, it is aimed to reveal the predictive degree of Anatolian High School 11th Grade Science students' mathematics, physics, chemistry, geometry, and biology academic achievements on their University Entrance Examination scores. The descriptive research has a subjects consisted of 858 science class students from nine different Anatolian High Schools. In the research, University Entrance Examination quantitative scores of students in 2007 and their 2006-2007 academic achievement points for mathematics, physics, chemistry, geometry and biology are used as the data set. As a result of the research, it was found that students' academic grades for mathematics, physics, chemistry, and geometry are significant predictors in explaining their University Entrance Examination quantitative success. Their academic achievement in biology, however, is not a significant predictor in explaining their University Entrance Examination quantitative success.

Key Words: University Entrance Examination, Academic Achievement, Mathematics, Physics, Geometry, Chemistry, Biology.

Anadolu Lisesi On Birinci Sınıf Fen Bölümü Öğrencilerinin Matematik, Fizik, Kimya, Geometri ve Biyoloji Akademik Başarı Puanlarının ÖSS Say-2 Puanını Yordama Derecesi

ÖZET

Bu araştırmada, Anadolu liselerinin on birinci sınıf fen bölümü öğrencilerinin matematik, fizik, kimya, geometri ve biyoloji akademik başarı puanlarının ÖSS SAY-2 puanını yordama derecesi ortaya konmaya çalışılmıştır. İlişkisel tarama türünde olan araştırmanın çalışma grubunu, dokuz Anadolu lisesinin fen bölümünde okuyan toplam 858 fen bölümü öğrencisi oluşturmaktadır. Araştırmada veri olarak, öğrencilerin 2007 ÖSS SAY-2 puanları ile 2006-2007 öğretim yılında matematik, geometri, fizik, kimya, biyoloji başarılarını gösteren yıl sonu not ortalamaları kullanılmıştır. Araştırma sonucunda, öğrencilerin matematik, geometri, fizik, kimya başarılarının ÖSS SAY-2 başarısını açıklamada anlamlı yordayıcısı olduğu ortaya çıkmıştır. Biyoloji başarısının ise ÖSS SAY-2 başarısını açıklamada anlamlı yordayıcı olmadığı belirlenmiştir.

Anahtar Sözcükler: ÖSS, Akdemik Başarı, Matematik, Fizik, Geometri, Kimya, Biyoloji.

INTRODUCTION

In various levels of education in Turkey, there are central proficiency tests for selecting and placing the students who plan to continue their education at the further levels. These tests are generally held for selecting students and they aim to assess the student's success, ability and readiness for the next level. Most of these tests are held by the Center of Student Selection and Placement (ÖSYM) and the others are held by the Ministry of Education. One of these tests is the University Entrance Examination (ÖSS) held by the Center of Student Selection and Placement (MEB, 2002). The University Entrance Examination is the test to declare the success after a long period of education.

A short history of the Student Selection Test

The number of youngsters who wish to have a degree at higher education has been increasing in relation to the increasing importance of education in Turkey. However, limited quota of universities for students does not allow every candidate to be placed at a tertiary level program. In the

Republic Period, till 1960s many universities had accepted all the applicants, as the high school graduates were not more than the university quotas. After that, together with facing the demands more than the quotas, university faculties had started selecting students in some ways such as selecting them during the enrollment period when they already had enough students, accepting students according to their graduation areas like science or literature, or ranking the students according to their secondary education grades. When these methods were not enough to meet the demand, each faculty started to give entrance tests according to their own targets. However, tests given by different faculties conflicted with each other in terms of time and place and started to create problems for the students. Because of that reason, the inter-universities committee decided to give the tests from one center and established the Center of Student Selection and Placement in 1974 in order to place the candidates on the criterion of their highest possibility to succeed (ÖSYM, 2002). The selection and placement of students was carried out by this center until 1981. In 1981, the Center of Student Selection and Placement became a sub-institution of the Council of Higher Education (ÖSYM, 2006).

Student Selection and Placement Tests for University Entrance (ÖSS and ÖYS) were held on the same day with two sessions, one in the morning and the other one in the afternoon in 1974 and 1975. Between 1976 and 1980, however, it was held on the same day in one session. After 1981, it became a two-phase test. The first phase, the Student Selection Test, was held in April and the other phase, the Student Placement Test, was held in June (ÖSYM, 2006).

After 1974, candidates' preferences for higher education programs were also collected and they were placed in accordance with their preferences and their scores on the test. After 1987, candidates' secondary education graduation grades were collected and these grades were added into the final score on the test with various weighted averages under the name of High School Achievement Point. After 1987, the candidates who focus on specific issues in their preferences were given the right to answer the relevant part of the test and not to answer the other parts. In 1999, the second phase of the test was canceled and the test became a one-phase test under the name of Student Selection Test. In the same year, it was decided to multiply the High School Achievement Point by a higher coefficient in the process of selecting the students and placing them in the related programs (ÖSYM, 2006).

In 1999, there were not any alterations in the application of University Entrance Examination other than the change in High School

Achievement Point (OBP), and the questions of the test were not beyond the basic education curriculum. By a change brought in 2006, the test continued to be one-phased but while some of topics were preserved as they were, some other topics were broadened to a level covering all the high school education curriculum (ÖSYM, 2006).

As the target of selection tests is to select the ones who have a higher probability to be successful at next levels (education, work, etc.), one of the important features of this test is the validity of prediction.

The level of realizing this aim is generally assessed through looking at the student's performance in university or at work. By considering the features of University Entrance Examination, it can be seen that together with some basic features it is an exam assessing the students' knowledge brought from earlier levels.

The University Entrance Examination (ÖSS) is prepared by ÖSYM, held once in a year in one session for students to authorize entrance into higher education from the high school. The test consists of parts aiming to assess some higher mental processes like the student's ability to understand, interpret, generalize, predict, categorize, set relations and evaluate.

Prior Knowledge

Throughout the recent years, many educational psychologists researched into the factors that mostly affect a student's success and they have emphasized the importance of prior knowledge in learning. The differences in the quality of prior knowledge is the key factor of the differences between achievement (Hailikari et al., 2007, p.320-321). At the same time, prior knowledge is one of the cognitive factors affecting the students' achievement. Prior knowledge is the knowledge, abilities and talents that the students bring to the learning environment before the academic process (Dochy et al., 1999, p.115).

According to knowledge processing theories, prior knowledge affects learning. In order to learn the new knowledge correctly in the learning process, it is necessary to know the relationship between prior knowledge and knowledge and how to use the prior knowledge in this process. Thus, prior knowledge is brought from the long term memory and the correct connections can be set with the new knowledge (Ormrod, 2003, p.211).

Looking through the literature, one can come across much research about prior knowledge. The persons who have more pre-knowledge than others in specific subjects tend to understand and remember new knowledge

better than those with less prior knowledge (Thompson and Zamboanga, 2004, quoting from 780 Schneider, Presley, 1997) and, together with this, it has been seen that prior knowledge in some areas enhances the student's achievement and learning. Çalışır et al. (2007) researched the effect of prior knowledge level in understanding the text, scanning the text and perception control. Sufficient prior knowledge helped the subjects to understand and interpret the structure of the text. It has been found out that the prior knowledge widely affects the acquisition of new knowledge (Thompson and Zamboanga, 2003; Muller et al., 2008; Hambrick et al., 2008), and the prior knowledge has an effect on abilities of mathematics and physics (Hudson and Rottmann, 1980). Setidisho (1996) states that advanced mathematics has direct effects on the achievement in mathematics and science courses (quoted by Olatoye, 2007, p.48). Mathematics plays a large role on every level of physics, there is a meaningful relationship between achievement in mathematics and physics (Ackerson, 1965; Friend, 1985 quoted by Güzel, 2004, p.51; Rutter, 1994, p.8-12), ability in mathematics and spatial mathematics affects the high school students' achievement in physics (Delialioğlu and Aşkar 1999), and one of the reasons of failure in the science course is failure in the mathematics course (Sulak, 1992). In the research done at different levels of education from primary to tertiary, it has been found out that prior knowledge affects students' achievement in a positive way (Thompson and Zamboanga, 2004, p.780).

As it is stated by Pressley et al. (1990, p.28) the organizer knowledge directs students to the new topic and helps them acquire the new knowledge correctly. During the education process, the active organizers simplify the understanding and storing of the knowledge. Moreover, organizers affect learning positively.

Introductory cognitive behaviors directly affect future learning. Introductory cognitive behaviors as a precondition to learning should be set before the new unit's learning-teaching activities start in order to make students understand future behaviors easily and make those behaviors attainable. After setting those introductory behaviors, it is necessary to find out if the students have acquired those behaviors beforehand. This should be assessed through the reliable and valid assessment devices (introductory cognitive behavior test). Moreover, it is necessary to start the new unit only after determining the precondition relations with the target behavior of the unit, defining those necessary preconditions for learning and then completing the missing behaviors necessary to learn (Thompson and Zamboanga, 2004, p.780).

Prior knowledge plays a very active role in every level from perception to acquisition (Roschelle, 1995, p.13). Theoretically, it is impossible for students to learn a new subject at a desirable level if they do not have the preconditions (prior knowledge and abilities) necessary to understand the subject. In the case of not having those necessary preconditions, no other stimuli like an effort, award, or an educational service can enable the students to acquire the subject to a desirable extent. Thus, the preconditions or introductory cognitive behaviors are the only bridge between the learners and the acquisition of the subject and they should not be underestimated for students' learning (Bloom, 1995, p.40-41).

Moreover, many researches have been concerned about University Entrance Examination, which assesses the prior knowledge and many abilities of students who are about to enter higher education from high school. Karaman (2001) in his research analyzed the relationship between University Entrance Examination scores and the high school achievement criteria. It has been found out that the high school achievement criteria validate University Entrance Examination achievements. When the students are divided into Science, Turkish-Mathematics and Social Sciences, it has been found out that a meaningful relationship exists between those categories and the University Entrance Examination scores for each of them. Özdoğan (1988) found out that there is a significant correlation between the 11th grade high school students' achievement in psychology course and their ÖYS (Student Placement Exam) scores for Turkish-Mathematics. Kırbaç (2004), in his research found out that there is a close relationship between the physics scores attained in trial tests of private courses and the real University Entrance Examination scores for Physics. Doğan (1999), examined the relationship between trial tests of private courses and University Entrance Examinations; and he analyzed the prediction potential of trial tests of private courses. As a result he found out that trial tests have a high validity to predict the scores for University Entrance Examinations. Demirok (1990), in his research found out a close relationship between the students' high school achievements and ÖYS scores on Turkish-Mathematics, Turkish-Social Sciences and Social Sciences when he analyzed their academic achievement in high school and after that university together with their University Entrance Examinations scores. Yağcı (1999), in his research found a significant difference between University Entrance Examination scores and regular high school students' perception of control focus and motivation level. Gültekin (2006) determined that high school achievement validates University Entrance Examination achievement independently of the program. Gelbal (1989) found out in his research that in

the trial tests for the Student Selection Test given by the Association of Private Courses, subtest for verbal and quantitative parts validate the same versions of University Entrance Examination. Sak (1999) analyzed the relationship between the general abilities and scores attained in ÖYS (held until 1998) and the academic achievement in the first year of university. He found out a meaningful relationship between the General Ability Test scores and ÖYS scores. ÖYS scores validate the academic achievement of those students.

In the present research, the prediction degree of students at math, physics, chemistry, geometry and biology grades as a sign for their prior knowledge on University Entrance Examination quantitative scores has been analyzed.

The research problem

What is the prediction degree of Mathematics, Physics, Chemistry, Geometry, and Biology grades of Anatolian High School 11th Grade Science Class Students to their University Entrance Examination quantitative scores?

METHOD

The Subjects

The subjects of the research consisted of a total of 858 (372 female and 486 male) science class students from Kağıthane Anadolu Lisesi, Şişli Anadolu Lisesi, Nişantaşı Anadolu Lisesi, Adnan Menderes Anadolu Lisesi, Maltepe Anadolu Lisesi, Ahmet Keleşoğlu Anadolu Lisesi, Maltepe Anadolu Lisesi, Çağrıbey Anadolu Lisesi, Mustafa Saffet Anadolu Lisesi nine Anatolian High schools.

Data Collection Instruments

In this research the data is the final grades for the courses related to University Entrance Examination quantitative in the term of 2006-2007 and the scores in 2007 University Entrance Examination quantitative. To gain the scores in 2007 University Entrance Examination quantitative, students' scores in that exam were collected, and to gain the final grades for mathematics, geometry, physics, chemistry and biology the final grades of students, an average score for the whole term, were collected. Students' academic achievement scores and their University Entrance Examination quantitative points were obtained from the principals of Anatolian High Schools.

The structure of the questions in the first part of the test largely depends on interpretation, analytical thinking, power of judgment, and logic. On the other hand the structure of the questions in the second part depends on knowledge and academic abilities (Kültür Dersaneleri, 2007, 9-10). 2007 University Entrance Examination was a test of two sections. In the first section, questions were about common courses: Turkish Language Test [Tür], Social Sciences-1 Test [Sos-1], Mathematics-1 Test [Mat-1], Science-1 Test [Fen-1]. In the second section of the test specific questions for each program took place: Literature-Social Sciences Test [Ed-Sos], Social Sciences -2 Test [Sos-2], Mathematics-2 Test [Mat-2] and Science -2 Test [Fen-2] (ÖSYS Guidebook, 2007, p.9-10).

2007 University Entrance Examination covers all the topics of high school curriculum and consisted of 8 parts, each having 30 questions. The first 4 parts of the exam cover the common subjects of high school first year curriculum with 120 questions and all the candidates are supposed to answer those questions. The other 4 parts are program-specific covering high school second and third year curricula and the candidates are supposed to answer 60 questions related to their own program (Fen Bilimleri Merkezi, 2007).

In University Entrance Examination, the part related to this research is the quantitative section of University Entrance Examination, and it is consisted of math, physics, chemistry, geometry and biology questions. The score for quantitative-2 obtained from this part is very important to enter a university program. This score is calculated using the scores for the first part of the exam and the scores of Mathematics-2 and Science-2, the scores on mathematics and science being very important in all of them (Kültür Dersaneleri, 2007, 11).

FINDINGS

In this research, the aim is to find out the predictive degree of Anatolian High School 11th Grade Science students' mathematics, physics, chemistry, geometry, and biology academic achievement on their University Entrance Examination scores.

To answer this question, first of all some calculation has been done to find range, medium, maximum and minimum values and standard deviation. The quantitative values are shown on Table 1.

In order to make a regression analysis, the necessary prediction is independent variables correlates linear with dependent variable University Entrance Examination quantitative achievement. Thus, before the regression

analysis, Pearson correlation analysis has been applied in order to determine the relationship between dependent and independent variables. The result of this analysis is shown on Table 2.

Table 1: Range, Medium, Maximum and Minimum, Standard Error and Standard Deviation of Students' 2006-2007 Academic Year Mathematics, Physics, Chemistry, Geometry, and Biology Achievement Points and 2007 University Entrance Examination Quantitative Scores

	N	Rang	Minimum	Maximum	X-Value	X-SE	SD
Mathematics	858	73.00	26.00	99.00	70.49	.57	16.55
Geometry	858	74.00	26.00	100.00	75.31	.49	14.50
Physics	858	76.00	23.00	99.00	69.50	.50	14.62
Chemistry	858	72.00	26.00	98.00	72.86	.48	14.01
Biology	858	63.00	35.00	98.00	72.98	.44	12.81
University Entrance Examination Quantitative Scores	858	125.27	250.45	375.72	319.38	.91	26.68

Table 2: The Result of Correlation Analysis between Students' Mathematics, Physics, Chemistry, Geometry, and Biology Achievement Points and their University Entrance Examination Quantitative Scores

	Math.	Geo.	Phys.	Chem.	Bio.	Unv.E.E.Q
Mathematics P.K.	1.00	.67**	.72**	.65**	.62**	.73**
p		.00	.00	.00	.00	.00
Geometry P.K.	.67**	1.00	.55**	.46**	.53**	.60**
p	.00	.00	.00	.00	.00	.00
Physics P. K.	.72**	.55**	1.00	.69**	.67**	.71**
P	.00	.00	.00	.00	.00	.00
Chemistry	.65**	.46**	.69**	1.00	.71**	.65**
P	.00	.00	.00	.00	.00	.00
Biology	.62**	.53**	.67**	.71**	1.00	.59**
P	.00	.00	.00	.00	.00	.00
Unv.E.E.Q PK.	.73**	.60**	.71**	.65**	.59**	1.00
p	.00	.00	.00	.00	.00	.00
N	858	858	858	858	858	858

** significant in the case of $p < 0.01$

After analyzing the relationship between dependent and independent variables, a positive relationship has been found out between students' math, physics, chemistry, geometry and biology grades and their University Entrance Examination quantitative scores in the case of $p<0.01$. The regression analysis of the validity of students' math, physics, chemistry, geometry and biology grades to their University Entrance Examination quantitative scores is shown on Table 3.

Table 3: The Results of Regression Analysis of Prediction Degree of Students' Mathematics, Physics, Chemistry, Geometry, and Biology Achievement Points to their University Entrance Examination Quantitative Scores

	Standard Points		Standardized		
Model	B	SE	β	T	p
Stable	202.40	3.63		55.82	.00**
Mathematics	.50	.06	.31	8.73	.00**
Geometry	.27	.05	.15	5.05	.00**
Physics	.51	.06	.28	8.20	.00**
Chemistry	.34	.06	.18	5.46	.00**
Biology	.01	.07	.01	.21	.84

Dependent variable: Unv.E.E.Q. R^2 =0.63 F=294.41

** significant in the case of $p<0.01$

The regression analysis can be seen in table 3. Observing the validity of mathematics, geometry, physics, chemistry and biology grades of students in total to their University Entrance Examination quantitative scores and seeing R^2 =0.63, one can tell prediction is high and the prediction degree is F=294.41, which is significant in the case of $p<0.01$. Looking at the prediction degree of each course to University Entrance Examination quantitative scores, mathematics academic achievement point ($t=8.73$, $p<0.01$), geometry academic achievement point ($t=5.05$, $p<0.01$), physics academic achievement point ($t=8.20$, $p<0.01$), chemistry academic achievement point ($t=5.46$, $p<0.01$), it is seen that they can meaningfully predict the quantitative part of University Entrance Examination. Biology academic achievement point ($t=0.21$, $p>0.01$), on the other hand, does not validate University Entrance Examination quantitative score.

DISCUSSION, CONCLUSION and RECOMMENDATIONS

In this study, prediction degree of high school academic success in mathematics, geometry, physics, chemistry and biology courses to explain success in University Entrance Examination quantitative points is investigated. The results of statistical analysis support meaningful prediction degree for academic success in mathematics, geometry, physics, chemistry courses to explain success in University Entrance Examination quantitative points. However, academic success in biology course does not present meaningful prediction degree value to explain success in University Entrance Examination quantitative points.

University Entrance Examination quantitative points are calculated according to the student's grades achieved throughout the high school education in the area of natural sciences plus the points received from the National Student Election Exam which is entered after completing the high school education. From this perspective, it can be assumed that academic success in mathematics, geometry, physics, chemistry and biology courses may present itself as a predictor of success in the quantitative part of University Entrance Examination.

Recent research has shown that having prior knowledge on certain fields of study affects students' future learning and success positively (Dochy et al., 1999). It is revealed that prior knowledge is significant on skills and abilities in physics and mathematics (Hudson and Rottmann, 1980), as well as being effective on learning new topics and directly supporting the learning of new information (Thompson and Zamboanga, 2003; Muller et al., 2008; Hambrick et al., 2008). Ersoy (1989) showed that students' success in mathematics in the high school education is positively predictive of the success of students' first semester university education. Moreover, Hailikari et al. (2007) point out that having pre-knowledge on different interests are positively effective on the academic success of students. In his study, Karaman (2001) investigated the relationship between success in high school grades and University Entrance Examination points. He pointed that success in high school academic grades predicts University Entrance Examination success. He also found a meaningful relationship between high school academic success and University Entrance Examination success regardless of the category differences in the high school such as Natural Sciences, Turkish-Mathematics and Social Sciences, comprising high school education in Turkey. Özdogan (1988) discovered that among courses taken in the last year of high school education, only success in the psychology course for the students of Turkish-Mathematics class has a relatively meaningful relationship with success in ÖYS points. In his study,

Kirbac (2004) found out that success in physics in the private trial exams has close relationship with the success in the ÖSS physics points. When Demirok (1990) investigated the relationship between success of university students in their university life and their previous success in ÖSS and ÖYS points as well as their academic success in high school or equivalent education, he found a significant relationship between students' academic success in high school grades from different classes and success in TM (Turkish Language, Mathematics), TS (Turkish Language - Social Sciences) and S (Social Sciences) points received in ÖYS examination. Gültekin (2006) explored high school academic success regardless of classes predictive in ÖSS success.

When studies on exams done abroad equivalent to University Entrance Examination are considered, Burnstein (2002) observed that undergraduate GPA, department, gender, professional experience, GMAT's total, verbal, science points explained %24 of the success in MBA programs. In his study, Dooney (1999) researched the prediction validity of IELTS to be accepted as a signifier of the future academic success. He concluded that IELTS success does not provide a precise proof for holding predictive validity for academic success even though language skills are one of the most important factors that contribute to academic success. Tross, Harper, Osher and Kneidinger (2000) found a strong relationship between college Grade Point Average (GPA) and scholastic aptitude test scores (SAT). Yet significant relationship is found between college GPA and high-school GPA.

Here, Geometry grade predicts University Entrance Examination quantitative points in lower degrees than math, physics and chemistry grades. This may result from the lack of students' geometry knowledge at an adequate level. In his research, Parlak (2007) found out that National Education program of Biology course is consistent with the University Entrance Examination test questions and students fail to get successful grades in biology courses. The aim of education and teaching should be providing knowledge for students by means of certain programs about a particular topic as well as giving related ability, habits and values about that topic and changing the previous habits if needed. Lack of using visual materials in laboratories in biology courses, lower levels of student participation, teaching the course only verbally and thus leading students to rote learning can be named as some for the reasons behind the failure of biology course prediction degree to University Entrance Examination points. It is expected that the more pre-knowledge is provided for students at such a level that rote learning dissolves, the higher rates of targeted success among students can be achieved.

Research done by high schools like this contributes to control the consistency between high school program and Student Selection (ÖSS) tests for higher education.

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