

PREDICTING HIGH SCHOOL STUDENTS' ACADEMIC
ACHIEVEMENT IN INTERNATIONAL AND NATIONAL PROGRAMS
BASED ON ADMISSION EXAMINATION: A CASE STUDY FROM
TURKEY

A MASTER'S THESIS

BY

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THE PROGRAM OF CURRICULUM AND INSTRUCTION
İHSAN DOĞRAMACI BILKENT UNIVERSITY
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PREDICTING HIGH SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT
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ADMISSION EXAMINATION: A CASE STUDY FROM TURKEY

The Graduate School of Education
of
İhsan Doğramacı Bilkent University

by

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GRADUATE SCHOOL OF EDUCATION

Predicting High School Students' Academic Achievement in
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Case Study from Turkey.

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May 2020

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ABSTRACT

Predicting High School Students' Academic Achievement in
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Case Study from Turkey.

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M.A. in Curriculum and Instruction
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Predicting students' future academic performance is an important discussion in the world of education that began to gain importance more than fifty years ago. Predictions of academic performance is of paramount importance in selecting the most appropriate students. Schools use admission criterion to select students to attend their programs. In this study, relationships between student's admission and exit performance were examined in a laboratory high school context. The school uses a two-stage high school admission exam. The first step consists of written tests of Turkish Language, mathematics, science, English and a non-verbal reasoning questionnaire, whereas the second stage includes essay writing in Turkish, and interviews about art, music, English, and Turkish. Students' exit performance is defined by the following scores: (i) IGCSE results in Turkish, English language, English literature, physics, chemistry, biology and mathematics, (ii) IB DP component results in Turkish, English, physics, chemistry, biology and mathematics, (iii) first stage of Turkish university entrance examination results (iv) high school cumulative grade point average. Results indicated that different components of the admission system predict students' exit performance criteria differently.

Keywords: Admission examination, academic achievement prediction, IB DP, IGCSE

ÖZET

Lise Öğrencilerinin Okul Alım Sınavına Göre Ulusal ve Uluslararası Program ve Sınavlardaki Akademik Başarılarının Yordanması. Türkiye’den Bir Vaka İncelemesi

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Öğrencilerin gelecekteki akademik performanslarını tahmin etme konusundaki tartışmalar, eğitim dünyasında uzun yıllardır devam etmektedir. Akademik başarının kestirilmesi okullara en uygun öğrencilerin seçilmesi açısından büyük önem taşımaktadır. Okullar programlarına öğrenci seçmek için öğrenci kabul kriterlerini kullanırlar. Bu çalışmada, bir laboratuvar lisesi öğrencilerinin lise giriş ve çıkış performansı arasındaki ilişkiler incelenmiştir. Çalışmada örnek olarak kullanılan laboratuvar lisesinin lise giriş sınavları iki aşamadan oluşmaktadır. Öğrenci alım sınavının ilk aşamasında Türkçe, matematik, fen bilimleri, İngilizce ve sözel olmayan muhakeme sınavlarından oluşurken, ikinci aşama Türkçe kompozisyon ve sanat, müzik, sınavlarından oluşmaktadır. Öğrencilerin çıkış performansları aşağıdaki puanlarla tanımlanmıştır: (i) Türkçe, İngiliz dili, İngiliz edebiyatı, fizik, kimya, biyoloji ve matematik sınav sonuçlarının oluşturduğu IGCSE toplam puanı (ii) Türkçe, İngilizce, fizik, kimya, biyoloji ve matematik derslerinden gelen toplam puanın oluşturduğu toplam IBDP puanı, (iii) üniversite giriş sınavı birinci basamak sınav sonuçları ve (iv) lise kümülatif not ortalaması. Çalışma sonuçları giriş sınavı bileşenlerin çıkış puanlarını farklı şekillerde açıkladığını ortaya koymuştur.

Anahtar Kelimeler: Lise öğrenci alım sınavı, akademik başarı yordanması, IBDP, IGCSE.

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CHAPTER 1: INTRODUCTION

Introduction

In the current education world, institutions are paying special attention to the use of a wide variety of data to make data driven educational decisions about students' academic performance (Datnow & Hubbard, 2015). In conjunction with this, an analysis of data at institution level has become a popular strategy for several purposes such as improving teaching and learning and decision making. Institutions need to be aware of how to use data the most effectively for making right decisions for student recruitment. According to the “data driven decision-making theory”, as stated by Gill, Borden, and Hallgren (2014), institutions should follow three different steps to support assessment process. The first step is to collect high-quality data, the second step is to analyze the collected data, and the third step is to make decisions to inform teaching and learning.

Assessment and data analysis can be applied for different purposes in educational decision making in school context. For example, internal school assessment mainly aims to measure a student's academic performance for taking necessary actions for teaching and learning. The immediate purpose of internal school assessment is to inform students about their learning and improve the quality of learning that students gain in schools and school systems (Sanders & Horn, 1998). In addition, internal school assessment provides valuable data for teachers to look at their teaching and make modifications where needed (Datnow & Hubbard, 2015). On the other hand, external school assessment such as Subject Academic Test (SAT), Advance Placement (AP), International General Certificate of Secondary Education (IGCSE) and

International Baccalaureate Diploma Program (IBDP) provides important data for educational institutions which would like to recruit students for their institutions. An important purpose of assessing students learning by external assessment is to determine on the students' academic potential, assess their skills in terms of appropriateness for a specific educational program, and eventually admit them to an institution where different kinds of educational programs are implemented (Wiggins, 1993). Student assessment can be made by variety of tools such as questionnaires, multiple choice tests, short answer tests, interviews, essays, rating scales etc. (Yates & Johnston, 2018).

As Bydžovská (2013, p. 306) stated, “prediction of a student's academic achievement is a common approach among education institutions for a variety of reasons such as identification of weak students, modification of instruction and finally providing constructive feedback to the students”. Among them at institutional level is admission procedures. Institutions strive to choose students who have the highest potential for requirements of their educational programs. Admitted students are expected to show high performance on exit scores of the programs. Looking at the issue from institutional perspective, using reliable instruments for student admission is crucial in order to make a valid decision about the admission of students. Looking at the issue from a student perspective, the results of assessment procedures often influence how a student views himself/herself compared to the other students who take the same assessment material and the results of these assessments influence the student's plan for future educational stages. Also, fairness of the admission is of importance. Stakeholders should have no question about the fairness for the procedures implemented. There are different aspects of admission system such as validity,

reliability and fairness, what is particularly important for students, parents, and school administrations to know to what extent students' current academic performance predict their performance in future academic settings (Piontek, 2008). For this reason, the purpose of the present study is to examine how admission procedures of a high school in Turkey predict students' academic achievement defined using both national/international performance indicators. Although there are different factors related with students' current performance such as ability, learning approaches, and personal habits that can be important at any educational level, entry performance at high school level is important predictor of students' academic performance for future educational programs (Lockshin & Zamkov, 2009; Mccoach, 2002).

Background

There are different high stakes tests throughout the world such as Subject Academic Test (SAT), Academic Collage Testing (ACT), Advance Placement (AP), and A Level. Similarly, as of 2020, there are two main exams in Turkey. University entrance examination (TYT) for students who want to pursue university education and high school entrance examination (LGS) for students who would like to study in selective high schools. Both tests intend to gauge the student's skills and knowledge aims to select students who has higher potential of becoming successful at future educational stages. In other words, both tests try to predict students' future education performance. AP is a test which is widely accepted by the United States colleges and universities for admission purposes. College admission offices evaluate the quality of high schools by looking at the factsheets that students' performance in AP (Shaw, Marini, & Mattern, 2012). They examined the relationship between AP scores and students' performance in the first year of college. The results showed a positive correlation between a

student's AP scores and their first-year grade point average. The study also compared the high school cumulative grade point average and college first year grade point average. There is also a positive correlation between these two variables. These results reveal that both AP examinations and high school cumulative grade point average can predict ability of academic achievement in college.

Atkinson and Geiser (2009) claim that although high school grades of students are seen as less reliable than standardized tests in predicting students' academic achievement at university or college, high school grades outperform standardized tests in predicting academic performance in tertiary education. It is still true that the assessment standards differ from one school to another, no matter the type of school, the grade point average in high school has been proven to be the best predictor of academic achievement in college.

Nowadays, students may have different types of outcome scores. A student applying to a higher education institution may be required not to only provide diploma scores, but also scores from national and/or international education programs such as IGCSE and IB. This particular research focuses on an admission examination of a Laboratory High School located in Eastern Anatolia which implements two international (International General Certificate of Secondary Education and International Baccalaureate Diploma Program) programs and one national (Ministry of National Education) program.

The laboratory school concept was brought to Turkey in 2006. Thus, it is a relatively new concept in the Turkish educational system. The laboratory schools are established

under governance of a university and expected to collaborate with universities to provide highly effective teacher training. The purpose of the laboratory schools is to provide a high-quality education in international standards. The schools also follow national curricula (Wilcox-Herzog & McLaren, 2012).

Problem

Discussions about predicting students' future academic performance is a hot topic in education world and reach out more than fifty years ago. The main aim of assessing students' academic achievement is to make informed decisions on students' academic journey in future educational steps (Koretz, Yu, Mbekeani, Langi, Dhaliwal & Braslow, 2016; Sanders & Horn, 1998).

College Admission Testing (ACT) aims to assess students' learning in college and help making predictions about the student's future academic achievement. In order to analyze predictive validity of different college admission tests, Koretz et al. (2016) investigated different college admission tests and how these tests predicted students' academic achievement in future educational steps. The researchers examined the differences between states' summative test and college admission test with regards to their ability to predict students' academic performance in college. The results show that neither replacing states' summative test with a college admission test nor administering a prediction model on top of the admission test provides a reliable data for predicting students' university first year grade point average.

On the other hand, Ateşkan, Onur, Sagun, Sands, and Çorlu (2014) investigated the alignment of IBDP and national high school curriculum in Turkey and how these two different programs prepare the students for higher education. University entrance

scores of IBDP graduates and non-IBDP graduates have been compared to see if there is a difference in academic achievement of these two groups of students at the university level. Results revealed that although non-IBDP graduates have a higher performance in university entrance examination, IBDP graduates tend to have a better grade point average than non-IBDP graduates at the university. University entrance examination performance of students seemed to have a lower prediction ability on the academic achievement of the students at the university. On the contrary, IBDP graduates were more successful than non-IBDP graduates at the university.

Generally, exit scores are limited with the scores gained at the end of high school. A student's diploma score is the principal exit score. Thus, relational studies are limited by nature due to the lack of variety in exit scores. This is the typical case in Turkey, as well. Students get a diploma score at the end of high school. Those who take university entrance examinations also have another set of scores. In Turkey, to be defined as a high-school graduate, a successful completion of the national curriculum is a must. International programs such as IGCSE and IBDP can also be completed but their completion does not allow a high score degree.

Graduation conditions are different for students who are studying in laboratory schools in Turkey. The laboratory schools are the only schools which are required to implement national and international programs at the same time. Students must successfully complete both national and international programs to get a high school degree. This specific requirement attributes an important meaning to the admission examination of the school. Therefore, the students who enroll in laboratory schools in Turkey must have a strong academic foundation in order to endure the demanding

academic program. Therefore, the school admission examination plays a vital role in assessing the necessary skills which students need in order to be successful in both the national and international examinations. However, the ability of the laboratory schools' admission examination to assess the required skills of the national and international university exams has not been investigated. The laboratory schools in Turkey accept a considerable number of students every year through these admission examinations without knowing to what extent the exam result assists the school in accepting students who will be able to follow the provided challenging programs. This leads to a gap in the literature. Examination of the relationship between entry and exit performance of students can also be made by using a limited number of variables. However, students in laboratory school follow two international programs (IGCSE and IBDP) and ministry of national education (MoNE) program. Therefore, predictive validity of laboratory school admission systems may be assessed using both national and international performance variables to get a complete picture of the relationship between entry and exit performance of students.

Purpose

In laboratory schools in Turkey, students need to follow two international programs and one national program. All the programs implemented in the school have equal value. The students are required to complete the International Baccalaureate Diploma Program successfully to be eligible to receive the Ministry of National Education high school diploma.

The purpose of this study is to investigate the predictability of a Turkish laboratory high school admission examination. Specifically, the study will investigate to what extent standardized and unstandardized components of the admission examination of

a laboratory high school predicts academic achievement of students in IGCSE, IBDP, TYT and high school cumulative grade point average.

Research questions

Main research question: To what extent do the components of a laboratory high school admission exam predict students' academic achievement in international/national high school exit examinations and programs?

- a) To what extent do the components of a laboratory high school admission exam predict students' academic achievement in the International General Certificate of Secondary Examinations?
- b) To what extent do the components of a laboratory high school admission exam predict students' academic achievement in the International Baccalaureate Diploma Program?
- c) To what extent does the components of a laboratory high school admission exam predict students' academic achievement in the Ministry of Education National Program?
- d) To what extent do the components of a laboratory high school admission exam predict students' academic achievement in first stage university entrance examination?

Significance

This study will investigate performance admission examination components to predict students exit performance in a laboratory high school in Turkey. Admission process is vital for the school because it expects students to follow multiple programs at the same time and maintain a high academic performance in all of them. The results of this study

will indicate whether the school needs to revise the admission examination so as to assess more accurately the required skills of the students who are accepted to attend the school.

This study will also demonstrate to other schools and educators which properties of an admission examination allow educators to make predictions about the academic achievement of students on national and international examinations. Furthermore, the study will also be a value for the laboratory schools' administrators to critically look at their admission examinations and make necessary amendments to it. Making amendments will increase the quality of admissions examinations and eventually assist the school in selecting the most suitable students for its programs.

Definition of key terms

International Baccalaureate Diploma Program (IBDP): An International Diploma Program is recognized by the most reputable universities in the world. The program is designed for the students aged 16 to 18 (IBO, 2017). DP program is implemented in grades 11 and 12 in high schools in Turkey.

International General Certificate of Secondary Education (IGCSE): An international certificate program created by Cambridge University for international students aged 14 to 16 (CIE, 2017).

Laboratory schools: The schools which have connections with universities' teacher education departments. These schools aim to conduct educational research and make contributions to literature (Wilcox-Herzog & McLaren, 2012).

Ministry of Education National Program: Turkish National Education Program designed for high school students aged 14 to 18 (MoNE, 2017).

CHAPTER 2: REVIEW OF RELATED LITERATURE

Introduction

Chapter 1 provided an overview of the study. In chapter 1, background for the study, research questions, problem and significance were given. Chapter 1 also gave some brief information about the importance of assessment, how it plays a vital role in education, how educational assessments guide institutions, administrators, teachers, parents, and students in making important decisions on teaching and learning.

The purpose of this study was to investigate how a laboratory high school's admission examination predicts academic achievement of students based on their national/international exit performances. To this end, relationships between scores of the admission examination and exit performances were analyzed.

In this chapter the related research findings from the literature are reviewed. Specifically, in the first section of this chapter, the review will be focused on the prediction of academic achievement by different admission examinations and systems. In the second section, the review will be focused on the prediction of academic achievement based on factors different than course grades variables. Finally, the third section will be focused on the laboratory schools concept.

There is a wide range of research on the prediction of academic achievement of students based on entry criteria. However, most of the studies are at higher education level such as predicting students first year grade point averages based on the university entrance examination results (Cliffordson, 2008; Geiser & Santelices, 2007; Olani,

2009; Vulperhorst, Lutz, Kleijn, & Tartwijk, 2018). The research is very limited for the prediction of academic achievement from the results of the admission exams high school entry/exit level. Moreover, the literature is limited in predicting students' academic achievement based on the admission examination of laboratory high schools.

Different admission examinations and systems

Recruiting students to higher education institutions with a selective system is commonly used throughout the world. Due to limited capacity and the need to recruit most appropriate students for their programs, the higher education institutions are forced to administer a selection process. Throughout selection process institutions administer different procedures which take into considerations criteria such as academic exams, previous cumulative grade point averages interviews, and letter of recommendations (Chari & Potvin, 2019).

Admission procedures are especially used in transition to higher education. Different higher education institutions around the world administer a variety of procedures for recruiting their students in a valid and reliable manner. Most of the universities prefer a merit-based approach which comprises of basing their decisions on prior academic achievement parameters such as high school grade point average and a respected admission examination (Pitman, 2016).

In this regard, higher education institutions mostly use internationally recognized tests such as Scholastic Assessment Test Advanced Placement and American College Testing as one of the components in their student selection systems. The performance

of students on these exams indicate a strong relationship with students' performance in higher education (Pitman, 2016). Addition to these internationally recognized tests, many states in the USA have their own high school achievement tests. Some colleges and universities rely on the results of these high school achievement tests in order to evaluate applicants. Furthermore, some universities and colleges consider high school cumulative grade point average as one of the variables in their admission criteria. There are a number of academic studies in the literature regarding high school cumulative grade point average as one of the variables for deciding on students' future academic achievement. Studies show that high school cumulative grade point average can be considered as the best way for predicting students' academic achievement in future educational stages (Cliffordson, 2008; Geiser & Santelices, 2007; Olani, 2009).

There have been, however, debates on the predictive validity of admission examinations on the longer-term performance such as the cumulative grade point average at the end of university or college. One of the earlier studies contributed to this debate, Wilson (1983) examined a number of studies which focused on correlations between high school cumulative grade point average and SAT scores of those who graduated from high school between 1930 and 1980 to university (CGPA) and university graduation success. The results show that individual variables, SAT scores and high school cumulative grade point average of the participant students, made a satisfactory prediction of long-term measures such as graduation and CGPA. Further, combination of SAT scores and high school cumulative grade point average ensured a stronger predictor than only SAT scores or high school cumulative grade point average (Burton & Ramist, 2001; Wilson, 1983).

Similarly, Atkinson and Geiser (2009) made a significant contribution to the literature by discussing the role of college admission testing. They strongly supported the idea of shifting from college scholastic aptitude testing to curriculum based academic achievement testing. They claim that academic achievement in college admission tests such as SAT and ACT are causally related to socio-economic and financial status of the students. Therefore, instead of measuring a student's general ability or reasoning skills, they supported the idea of assessing a student's academic knowledge that students gain in subjects that they study throughout their high school career. However, they found a strong relationship between students' performance in the SAT writing test with first year grade point average in college. They also emphasize the predictive value of high school cumulative grade point average. Their finding clearly shows that high school cumulative grade point average is a more reliable prediction tool for college academic achievement.

The main aim of all these admission examinations and systems is to recruit students who can successfully complete the requirements of the higher education programs. Therefore, an admission examination or system should have a strong prediction ability of students' academic achievement at tertiary education (Cimetta, D'Agostino, & Levin, 2010). In line with the above-mentioned research, Vulperhorst, Lutz, Kleijn, & Tartwijk (2018) investigated the effect of prior academic achievement to university first year grade point average. The study compared the predictive validity of high school core subjects and high school cumulative grade point average of both Dutch pre-university program (VWO) and International Baccalaureate Diploma Program (IBDP) for predicting academic achievement at the university. The results of the study show that while VWO graduates' high school cumulative grade point average predict

more variance in university first year cumulative grade point average and high school cumulative grade point average than the high school core subject grades. The picture is completely different for IBDP graduates. Core subject grades of IBDP graduates was found to be a more reliable predictor of future academic achievement than high school cumulative grade point average. The results also show that university first year grade point average is far the best predictor of university cumulative grade point average. Therefore, the study suggests that higher education institutions can use university first year grade point average as another parameter for maintaining students at higher education institutions.

Takele (2017) conducted a predictive validity study which investigated the predictive power of combination of variables with a student's academic performance in college. The study analyzed to what extent college entrance assessment, high school leaving certificate and high school grade point average predicted a student's college academic achievement in Ethiopia. The results of the study show that even though a combination of three variables makes the strongest prediction, high school grade point average accounts the most to the prediction by almost 31 per cent.

Looking at the admission examinations or systems in Turkey context, Turkish education system has two different important examinations namely LGS and Turkish University entrance examination (YKS). The former is taken at the end of Grade 8, while the later examination is taken at the end of Grade 12. LGS results are used to place students in high schools. On other hand, YKS scores are used to place students into higher education programs.

Bahar (2013) examined the relationship between TEOG scores and university admission examination scores for three different school types in Turkey, namely, Anatolian High Schools, Science High Schools and Anatolian Teacher Training High Schools. The exam results of 34.479 students from 570 schools were analyzed. The standardized sub scores of Turkish, mathematics, social sciences and natural sciences of TEOG and YKS differed in mean scores in each of the three different school types. The highest mean difference in relationship was observed between the YKS and TEOG in Mathematics in the Anatolia High School (i.e., 23.7), which shows that the students in this type of school improved their score in mathematics from the high school exams to the university entrance exams. Improvement in the score of mathematics was also observed in the other two types of schools. In the Anatolian teacher training high schools, the mean score difference in mathematics was 19.5 and in Science High Schools, it was 17.1. On the other hand, in social sciences students' scores in the university entrance exams were lower compared to the high school exams. This finding shows that students' scores in social sciences were dropped. Despite that Bahar (2013) did not check to what extent YKS scores were predicted by TEOG scores, the above differences show that probably the results of the Turkish high school qualification examination are not high predictors of the results of the Turkish University entrance examination.

Alternatively, Karakaya (2011) investigated whether high school cumulative grade point average and Turkish University entrance examination results predict students' first year GPA at university. A total of 691 students from 5 Turkish teacher education departments participated in the study. The results of correlational analysis suggest a moderate degree of relationship between students' high school cumulative grade point

average, University entrance examination and university first year cumulative grade point average.

Kontaş and Özpolat (2017) investigated the predictive validity of middle school internal examinations to the Turkish high school entrance examination. The purpose of the study was to compare students' grade 8 results in internal school examinations in six different subject areas (i.e., Turkish, mathematics, science, English, religion, and history) and compare the relationships between subjects' school assessment and TEOG scores. Internal school examination results of 1035 students from 7 different middle schools used in the study and linear regression analysis was administered for the analysis. The results of the study indicate that exam scores of Turkish, and science and technology lessons have higher predictive validity of the TEOG examination results compared to Social Studies and Religion courses. The results also suggest that all of the middle school internal school subject examinations strongly correlated to the TEOG examination results. The correlation was higher in Turkish and Science lessons while lower in Religion and Revolution History.

Similar to the previous research, Kingston and Anderson (2013) conducted a research study in the USA with a sample of more than 2000 students from 20 different high schools. The purpose of the researchers was to compare the results of math and reading scores of the students gained in community college and compared these scores with state assessment math and reading scores acquired from Center for Educational Testing and Evaluation (KSA) in Kansas University. The results show that KSA scores in reading moderately correlated with first year English course scores in college. On the other hand, KSA Math scores are strongly correlated with a college algebra course.

The study highlights that state assessment tests can be as predictive as the other commercial assessments such as SAT or ACT.

On the other hand, several studies investigated the predictive validity of standardized tests, such as SAT and ACT, by comparing test results and university first year grade point averages. Relatively few of the researches focused on longer term and compared college admission tests and university cumulative grade point average which covered a four/five -year time frame. Geiser and Maria (2007) investigated whether the long-term performance of students in college can be predicted by high school cumulative grade point average. The researchers examined different predictive-validity studies and came through to reveal that high school cumulative grade point average is significantly superior than standardized tests in predicting college academic achievement. Although students make intensive preparation for standardized tests, it is very clear that standardized tests are the reflection of three to four sit in examinations. Whereas, high school cumulative grade point average provides more reliable data for academic success since students are repeatedly assessed throughout high school which provides a more reliable assessment data for making predictions on a student's future academic achievement.

Similar to Wilson (1983), Burton and Ramist (2001) published a report on the predictive validity of SAT and cumulative grade point average in college. The report focusses on long-term measures of predictive validity in admission examinations or systems rather than short term measures such as predicting first year grade point average in college based on admission examination or system. Long-term measures such as CGPA, graduation, leadership and postgraduate income. The report using the

SAT scores and high school grade point average of more than 17,000 students graduated between 1980 and mid-1990s summarizes studies investigating the predictive validity of SAT and high school grade point average for university graduation. The study reviewed eight studies which examined the predictive validity of SAT and high school cumulative grade point average of the students who graduated from high school from 1980s to mid-1990s. The report indicates that a moderate correlation between SAT and university graduation. The strongest correlation was found between the combination of SAT and high school cumulative grade point average with university graduation.

In the context of student admission in education institutions, variables are very limited in predicting students' future performance. The best predictor is considered to be the combination of admission testing and high school cumulative grade point average in predicting college academic success which is limited to explain 25 to 30 percent of the dependent variable. This means that 70 to 75 percent remains unexplained (Geiser & Maria, 2007). This should not be surprising since there are many other factors which affect a student's performance at the college such as socioeconomic status, environment, academic engagement etc. For some reasons, educator's ability to predict academic achievement impedes and some test characteristics are considered more critical in designing admission tests such as,

- “being criterion-based rather than norm-referenced,
- being useful for diagnostic ability than ranking students in within percentage scales,
- beside predicting students 'future academic achievement, it should provide reliable, information on student's current academic achievement,

- being based on the curricula which is intended to be assessed so students should feel that the best preparation for the test is mastering the curriculum which is intended to be assessed” (Geiser & Maria, 2007, p. 26-27).

Using high stakes examinations and previous cumulative grade point average to predict future academic achievement, problem-solving abilities and reading comprehension is vital for maintaining a high academic achievement especially at elementary school level (Björn, Aunola, & Nurmi, 2016). They investigated how text comprehension skills in elementary school predicts mathematics achievement in secondary school in Finnish school context. This longitudinal study focused on students’ text comprehension skills in elementary school level and compared these results with the mathematical achievement in the secondary school. The results prove that text comprehension is a strong predictor of mathematics problem solving skills in secondary school. The results also investigated the gender differences in text fluency and text comprehension. The study reveals that girls outperformed boys in text fluency and text comprehension in grade 4. Another study demonstrates that there is a strong relationship between reading comprehension and mathematics achievement in elementary school level (Koponen, Aunola, Ahonen, & Nurmi, 2007).

Finally, Corlu (2014) conducted a study on the relationship between a student’s IGCSE scores and IBDP scores. He found a strong relationship between students’ IGCSE performance and IBDP performance. The study found that the relationship is stronger between IGCSE science and IBDP science than IGCSE math and IBDP math. The study also found that even though IGCSE science courses provided a good preparation for IBDP science subjects, students must be given more opportunities to handle scientific experiments in the IGCSE program since IBDP science courses require

students to conduct a variety of experiments in order to ensure a stronger handle of the subject matter.

Finally, some institutions use letters of recommendation as one of the criteria in their admission procedure. Letters of recommendations are considered as important informative tool for collecting valuable information about students' strengths and weaknesses (Bowman & Bastedo, 2017; Chari & Potvin, 2016).

This section reviewed the studies which mainly focused on predicting academic achievement based on different admission examinations and systems. On the other hand, admission examinations and systems are not the only way for predicting future academic achievement.

Factors different than test performance

Mckenzie and Schweitzer (2001) reported that while previous academic achievement is the best predictor of future academic achievement, there are also other factors such as self-efficacy, socio economic status which are also valid parameters in predicting academic achievement. Therefore, the next section will focus on factors different from high school cumulative grade point average, admission examinations and systems that can predict academic achievement.

Most of the predictive validity studies focus on achievement-related entry and exit variables. However, there are several studies that have investigated factors other than achievement. In the literature, there are a number of studies of other factors which are considered to be important parameters in predicting academic achievement of students.

Namely, socio-economic status and parental expectations are considered as important predictors of students' academic achievement. Understanding the relationship between such variables and students' future performance has an important educational value. For example, Long and Pang (2016) investigated the effect of these two factors on adolescents' mathematics and problem-solving achievement. Confirmatory factor analysis was used to measure the relation of three components socio economic status namely, family wealth, home educational resources, and parental education. The study reveals that there is a direct relationship between the three components of socio-economic status and parental expectations and student achievement. The study revealed that there is a statistically significant correlation between two components of socio-economic status, parental education and home educational resources, as well as parental expectations on students' problem-solving skills and mathematics achievement. Therefore, students with parents who are well educated, who can provide their children with the educational materials at home as well as with high academic achievement expectations are more likely to perform better in mathematics and problem solving.

Several studies examined cognitive style and problem-solving abilities of students to predict academic achievement. Badru (2015) worked on a group of participants from five different public junior schools in Nigeria. The purpose of the study was to examine the prediction of academic success of secondary school students in mathematics using their cognitive style. The results show that there is no statistically significant relationship between students' cognitive style and problem-solving abilities. When cognitive style and problem-solving abilities are considered together, they strongly predict students' academic achievement in mathematics. Ahiakwo (1991) also found

that cognitive style of the students does not predict problem solving achievement of students.

There are several other non-cognitive abilities which have considerable effect on students' academic achievement such as motivation, self-efficacy, and emotional health (Rothstein, Jacobsen, & Wilder, 2008). Heckman and Rubinstein (2001) identified non-cognitive skills of students as a valid predictor of students short- and long-term academic achievement. Makransky, Havmose, Vang, Andersen and Nielsen (2017) investigated predictive validity of admission testing and multiple mini interviews in undergraduate students. The study included 422 psychology students studied in Denmark universities between 2010 and 2013. The study investigated that adding multiple mini interviews to the admission procedure would decrease the dropout rates as well as increase the academic achievement of the students. The results reveal that students who are admitted with multiple mini interview systems are less likely to drop out of university at the end of first year. The results also show that these students outperform their peers who are admitted to university by their high school grade point averages in courses which requires self-efficacy and components of critical thinking.

Social competence is considered to be an important predictor of academic achievement by many researchers. Social competence can be defined as "effective response of the individual to specific life situations" (Goldfried & d'Zurilla, 1973). Children with successful social skills such as being active among their peer group or being accepted by their peers tend to do academically better than children who are socially rejected (Feldhusen, Thurston, & Benning, 1970; Vosk, Forehand, Parker, & Rickard, 1982).

Wentzel (1991) reported a significant relationship between academic performance and three aspects of social competence namely, socially responsible behavior, sociometric status and self-regulatory process among 423 students who were 12 and 13 years old. The results of multiple regression analysis suggest that social competence of children is directly related to their academic achievement. Children who are considered responsible towards social issues and who are able to overcome interpersonal problems tend to gain higher grades than their peers.

Personality is also considered as a factor for predicting academic achievement of students. Ciorbea and Pasarica (2013) investigated the effect of personality in academic achievement for students between 22 and 28 years old. Sixty students took part in their study and the study measured Neuroticism, Extraversion, Psychoticism, and self-esteem of the participants by different methods and scales. The result of correlational study shows that neuroticism and psychoticism have a negative effect on students' academic achievement. While extraversion has a small effect on students' academic performance, self-esteem was found to have a significant effect on the academic performance of the students.

To conclude, this section focused on the factors different than admission examination and grade related variables in predicting students' future academic achievement. The review ascertains that variables other than high school cumulative grade point average, admission examination and grades are also important to be taken into consideration for recruiting students for selective high schools or universities.

Laboratory school concept

There are examples of prediction studies for different school types, there is not any research on admission examinations of laboratory schools in Turkey. Even though the laboratory school concept is a relatively new concept in Turkey's education system, it has a quite long history in North America. The roots of research schools go back to Dewey's (1896) laboratory school concept. Dewey's perception of school was that it should provide an environment which promotes inquiry and an optimal environment to administer experimental education (Provenzo, 1979). Initially these schools were established and supported by teacher education departments of universities to conduct academic research on child development, teaching, learning and social welfare in K-12 education (Cutler, Bersani, Hutchins, Bowne, Lash, Kroeger, ..., & Black, 2012). The concept also provides an opportunity to develop, evaluate and inform policies and practices. The schools implement rigorous educational programs which are recognized by the most popular universities throughout the world giving a wide range of opportunities to the students and teachers to learn and teach by the latest educational developments. Therefore, laboratory schools should be viewed as the places of discovery and production of knowledge. (McBride et al., 2012).

In conclusion, based on the studies reviewed in this chapter, it is obvious that there are a number of ways to predict a student's academic achievement. Although psychometric tests make strong predictions of students' achievement (Lenhard & Schröppel, 2014), there are other factors which are useful in predicting future academic achievement. Therefore, the literature suggests that since schooling systems are complex contexts in many countries and differ according to students' expectations, it is not feasible to depend on just one factor to make strong decisions on students' future academic journeys. Therefore, institutions should consider different models for

predicting future academic achievement as well as recruiting students for their selective programs.



CHAPTER 3: METHOD

Introduction

The purpose of this study is to examine the relationship between scores on the admission components of Turkish laboratory high school and exit performance defined by national and international criteria. In this chapter, first, research design is given. Secondly, context of the research is described. Thirdly, sampling is explained. Fourthly, instrumentation is explained in detail. Fifthly, method of data collection is mentioned. Finally, the method of data analysis is explained.

Research design

The current study is mainly correlational. Correlational design was used to collect and analyze data to define relationships among variables (Fraenkel, Wallen, & Hyun, 2012). The study investigates the relationship between students' performance in components of a laboratory school admission examination and their performance in exit examinations and programs.

To examine the predictive validity of the high school admission system, relational analyses were conducted through a series of hierarchical multiple linear regressions. Using blocks for different sets of variables allowed to examine predictive powers, providing a clear picture. Several components of the admission exam of the high school (standardized test and skill assessment material) were regressed on the exit performance of students (IGCSE, IBDP, TYT results as well as high school cumulative grade point average of participant students).

Context

The laboratory school concept was brought to Turkey in 2007 with an official law passing through the grand national assembly. Law #5526 defines the special attributes of the laboratory schools in Turkey. There are two laboratory schools in Turkey which are currently operated under a university's faculty of education. Students in these schools are required to implement an international program, decided by the faculty senate of the governing university, in grades 9 and 10. Failing any of these programs will result in either transferring to another school or failing to obtain a Ministry of National Education high school diploma. As of 2020, students are required to successfully complete IGCSE at that grade level. There are specific passing criteria in the school for IGCSE. Students are required to achieve a minimum score of "C" from each course they take in order to continue to attend the school in grade 11. Students are also required to complete the International Baccalaureate Diploma Program in grades 11 and 12 at that laboratory school. Students must earn an International Baccalaureate Diploma in order to receive a ministry of education high school diploma. Students also complete courses offered by MoNE at the same time to get a high school degree. Implementation of both national and international curricula makes this laboratory school a good case to study predictions of future performance using the admission test.

The laboratory high school, which is the focus in the study, is a K-12 school and was established in 2007 in eastern Anatolia as a school which awards scholarship with varying degrees based on students' performance in the admission examination. Students from middle school section of the school must take an admission examination to carry on to high school. High school also accepts students who complete middle

school in other middle schools throughout Turkey. These students also need to take the admission examination in order to be qualified to register for high school. The majority of students come from the eastern part of Turkey and reflect the socio-cultural aspects of the area. Most of the students come from families who work in the public sector, either in education or the local government offices. On the other hand, the faculty of the school consists of both Turkish and international staff members from different parts of the world such as USA, UK, Germany, India, South Africa, France, and Canada.

Participants

The sample consists of 191 students at different grade levels of the high school. The students in the sample took the admission examinations of the laboratory school in 2013, 2014, 2015 and 2016. The results have been shared by the school administration after going through an official permission process.

The sample included 112 (58.6%) females and 79 (41.4%) males. The grade level of the participated students was varying. Eighty-three (44%) graduated from high school. Forty students (21%) were in grade 11. Forty-six students (24%) were in grade 10. Twenty-two (11%) students, who were not included in the sample, left school at the end of grade 10 for various reasons. Since the students at different grade levels, distribution of the achievement indicator differs in the sample. Eighty-three students possessed IGCSE results, TYT results and high school cumulative grade point average, 47 students possessed IGCSE results, and three years of high school cumulative grade point average and 46 students possessed IGCSE results and two years of high school cumulative grade point average. Finally, 83 students possess IBDP results. Separate

regression analysis was calculated to predict a student's academic achievement in IBDP Turkish and Mathematics courses based on student's performance in the admission examination. In the Diploma Program, students can take courses either at a high level or standard level. The standard and higher-level students were not differentiated in the calculations since 79 out of 83 students took higher level mathematics courses and 78 out of 83 students took higher level Turkish courses. As for sampling strategy, purposive sampling was utilized. The school from which the participated students were coming was selected based upon its educational programs as well as its unique admission examination.

Instrumentation

The school administers its own admission examinations. The effectiveness of the admission examination in terms of identifying the most capable students plays a vital role since the implementation of three different academic programs is compulsory for all the students. The school was selected based upon its educational programs as well as its unique admission examination. The variables in this study came from different instruments:

- Admission examination total scores. Results of admission examination components in Turkish, science, mathematics, non-verbal reasoning (NVR), Turkish essay and interview,
- IGCSE total scores. Results in Turkish, English Language, English Literature, Physics, Chemistry, Biology and Mathematics. Addition to the IGCSE total scores, IGCSE Turkish and IGCSE Mathematics variables will be used as the exit performances. IGCSE Turkish and IGCSE Mathematics courses are

consistently taken by all the students. Turkish and mathematics components are given in the admission examination.

- IBDP total scores. Results of components in Turkish, English, Physics, Chemistry, Biology and Mathematics. Addition to the IBDP total scores, IBDP Turkish and IBDP mathematics variables will be used as exit performances. IBDP Turkish and IBDP mathematics courses are consistently taken by all the students. These two courses are also given in the admission examination.
- High school cumulative grade point average (HCGPA).
- First stage university entrance examination results (TYT).

The laboratory school admission examination

The admission examination of the school is administered in a two-stages. The first stage consists of academic components such as Turkish, mathematics, science, English tests and NVR test. Students are given tests of Turkish, mathematics, and science that include multiple-choice and short answer items in one session. Giving wrong answers for multiple choice questions does not affect the right answers. The study will be using the total scores for each component (total of multiple choice and short answer). Students are also given a non-verbal reasoning test which includes 50 multiple choice items. The second stage of the examination consists of Turkish essay writing, visual art, music, English interview and an interview conducted in Turkish. The admission examination was prepared by a private company from 2013 to 2014. After this time, the school decided to create its own examination using the teachers of the school's expertise by forming an admission examination committee. The committee consists of teachers of middle school science, physics, chemistry, biology, mathematics, Turkish

and English. Therefore, 2015 and 2016 examinations were prepared by the school admission examination committee. Turkish, mathematics, science and NVR components have been consistently used in all the years whereas English component has been added in later years and the structure of the English component has been changed several times. Results of the all the components are standardized and converted to 100. Maximum available point is 400 from the first stage (Turkish, science, math and NVR) and maximum available point is 200 from the second stage. Students are given a total grade based on their performances in the two-stage admission examination. Students earn percentages of scholarship based on their total points.

IGCSE courses and components

At the school, the IGCSE program is implemented in grades 9 and 10 and the students are required to study English, English Literature, Turkish, mathematics, physics, chemistry and biology courses. The school provides an intensive education in these courses. At the end of grade 10, students sit for examinations in the above-mentioned subjects. Each subject examination had multiple components covering different parts of each course.

The school requires students to take Turkish Literature, mathematics, English first language, English literature, physics, chemistry and biology courses. Each course has a number of components to test students' understanding of the subject. The students are expected to gain a minimum score of "C" from each course they take.

The first IGCSE subject which students are required to study is Mathematics. In mathematics course the students are given two papers (each paper is graded out of 80

marks, each weighed as 50%) at different times and asked to answer 10 to 12 short answer questions in various lengths. Students are allowed to use calculators with scientific functions in both papers (CAIE, 2018).

English and Turkish first language subjects aim to improve students' both reading and writing abilities. The students take two components and are expected to exhibit different skills in each of them. Paper one tests reading skills (maximum available mark is 50) by being asked to read two different passages and answer essay questions based on the passage. In the second paper (maximum available mark is 50) they are expected to read one or two passages of 650-700 words in total and write their answers in 250-350 words (CAIE, 2019).

The English literature course has two components. To demonstrate their skills as a competent reader, paper one (maximum available mark is 50) asks students to answer a series of comprehension questions based on a text. Students then read a second text where they write a summary based on both texts. In paper two (maximum available mark is 50), students are required to write two compositions with a word count of 350 to 500 words each (CAIE, 2015).

The school offers the individual science courses of physics, chemistry and biology, instead of a combined sciences course. The school has also chosen to offer three papers in science courses. Paper one is a multiple-choice paper (maximum available mark is 40, weighted 30%) where students are expected to answer forty multiple choice questions in 45 minutes. The second paper (maximum available mark is 80, weighed 50%) consists of short answer and structured questions. Students are given seventy-

five minutes to answer all the questions. Finally, in the third paper (maximum available mark is 40, weighed 20%) the questions are based on the experimental skills which are covered in two years of time in grades 9 and 10 (CAIE, 2017).

IBDP courses and components

IB Diploma Program is designed for students 16 to 19 years and provides students with a challenging education with a rigorous assessment system. The program aims to prepare students for tertiary education and provides opportunities to become a balanced individual who is both academically and socially aware of their strengths and weaknesses. Some universities recognize the IB Diploma as a high standard in high school education and the recognition of the program is growing every year (Resnik, 2016). Successful completion of IGCSE program is required to carry onto the Diploma program at the school in this study. The international baccalaureate diploma program is implemented in grades 11 and 12. The students are required to gain a certain letter grade from each subject to be enrolled in Grade 11 and the Diploma program. As a requirement of the international baccalaureate diploma program, students must take three higher level courses, three standard level courses as well as fulfill the requirements for the core components which are theory of knowledge, extended essay, and creativity, activity and service (Diploma Programme Assessment procedures, 2019).

Students who successfully complete the IGCSE program are admitted to the international baccalaureate diploma program. There are certain requirements for students to form a DP combination. There are six subject groups and the students required to select one subject from each subject group or one subject from groups 1 to

5 and another subject from groups 3 to 5. Students are required to select three Higher Level and three Standard Level courses, as well as complete the requirements for the core components. The school offers Turkish A: literature, English A: language and literature, German B, economics, Turkey in the twentieth century, physics, chemistry, biology, mathematics and visual arts courses. Students and their parents decide on the combinations which will be studied in Grades 11 and 12.

One notable difference between the two programs is that the IB Diploma Program expects students to conduct a range of individual investigation projects and research which affects the final score of each course. Assessment outlines also change from subject to subject. All the subjects include internally assessed, externally moderated, and externally assessed components. Weight of the components may differ according to the subject area. Externally assessed components include written examinations and written assignments, internally assessed, externally moderated components include written commentaries, oral commentaries, oral presentations, individual investigations, visual arts exhibitions and stage performances (Diploma Program Assessment Procedures, 2019). English Language and Literature and Turkish Literature courses assessment outline is the same and they are assessed by three externally assessed and one internally assessed, externally moderated components. Internal assessment component is oral presentation. The presentation is graded out of 30 and its effect on the final mark is 30%. Externally assessed written task is graded out of 20 and its effect to the final mark is 20%. Students are required to sit two 90-minutes written examinations under moderated exam conditions. Paper 1 is graded out of 20 and its effect to the final mark is 25%. Paper 2 is graded out of 25 and its effect

to the final mark is 25% (International Baccalaureate Diploma Program Language and Literature Guide, 2011, p. 26-27).

The mathematics course is assessed by three written examinations and one internally assessed, externally moderated mathematical exploration component. In paper one and two, students sit in a two-hour examination where they are required to answer short and extended response questions. Each of these components are graded out of 100 and each component contributes 30% to the final mark. Paper three is a one-hour examination which consists of one of the optional topics of the course. It is graded out of 50 and it contributes 20% to the final mark. The internally assessed, externally moderated mathematical exploration component is graded out of 20 and it contributes 20% to the final mark (International Baccalaureate Diploma Program Mathematics Guide, 2012).

Physics, chemistry, and biology courses are assessed by three written examinations and one internally assessed, externally moderated individual investigation component. In paper one, students sit in a one-hour multiple choice examination which contains forty questions. It is graded out of forty and it contributes 20% to the final mark. Paper two examination is a two-hours and fifteen minutes examination. It is graded out of 90 and it contributes 36% to the final mark. Paper three examination is a one-hour examination. It is graded out of 45 and it contributes 24% to the final mark. Individual investigation component is an independent investigation of students supervised by teachers. It is graded out of 24 and contributes 20% to the final mark (International Baccalaureate Diploma Program Chemistry Guide, 2014).

Ministry of National Education program

The Ministry of National Education is the governing body for education and consists of 12-year compulsory education in Turkey. All the Turkish schools must be authorized by the ministry and the schools which are authorized are mandated to implement certain educational programs. The schools can also be authorized to implement various international programs, but they have the responsibility to meet the requirements for the national program. The schools which implement international programs are allowed to use a different timetable where different elective courses are offered. MoNE also provides schools with the opportunity to teach courses in English except Turkish language and literature, ethics and social studies courses (MoNE, 2017). The grades that students gain throughout high school creates their cumulative high school grade point average.

The study also looked into the differences in the academic achievement in terms of gender for high school cumulative grade point average. An independent sample t-test was calculated to see the gender differences in academic achievement in high school cumulative grade point average.

University entrance examination components

The students who are in their final year of any kind of high school or graduates of any kind of high school may apply and take the university entrance examination. Turkish universities accept students to the universities based on their results in the university entrance examination. The university entrance examination is a two-stage examination as of 2020 (OSYM, 2020). The first stage is the one that everyone must apply and take. The first stage consists of questions from Turkish (40 questions), social studies (20

questions) (history, geography, philosophy, ethics), mathematics (40 questions) and physics (7 questions), chemistry (7 questions) and biology (6 questions). The second stage of the examination is a subject based stage where students choose the subjects that they wish to take according to their future career plans (Yüksek Öğretim Kurumları Sınavı Kılavuzu, 2019).

Method of data collection

Data set for the study (laboratory school admission examination results, IGCSE results, IBDP results, university entrance examination results as well as high school grade point averages) were provided by the laboratory school administration in a spreadsheet. Required permissions were granted by the school administration. In order to protect anonymity of students, the school removed any kind of information that can be used to identify students' names.

Laboratory school admission examination is administered by the high school administration every year. The exam is a high-stake examination and administered at the same time for all the students in the under strict exam conditions. Multiple choice components are scored optically; short answer questions are marked by the examination committee consisting of teachers of the respected subjects.

International examinations (IGCSE and IBDP) are administered in the high school building under specific exam conditions and inspected by the Cambridge Examination office and International Baccalaureate Organization. After exam administration, papers are sent to Cambridge/IB for marking. Marking is done by respective examiners employed by Cambridge or the IB.

Cumulative high school grade point average is defined as a student's total grade points divided by the number of credits taken by a student. University entrance examination is a national examination and administered by OSYM under specific examination conditions.

Table 1 below shows the descriptive statistics of participants in the components of admission examination. Maximum point that can be taken from each component, Turkish, mathematics, science, NVR, interview and Turkish essay, is 100.

Table 1
Descriptive statistics of participants in admission examination

Components	Turkish	Mathematics	Science	NVR	Interview	Turkish Essay
N	191	191	191	191	191	191
Mean	71.84	63.47	59.65	66.70	79.45	64.65
Median	73.00	63.33	60.00	70.00	79.00	65.00
Mode	67.66	68.00	64.00	80.00	92.00	58.00
Std. Deviation	11.35	12.97	9.44	14.04	12.66	14.82
Skewness	-0.44	-0.30	-0.20	-0.74	-0.21	-0.05
SE of Skewness	0.17	0.18	0.18	0.17	0.18	0.18
Kurtosis	0.35	0.15	-0.43	0.09	-0.82	-0.46
SE of Kurtosis	0.35	0.35	0.35	0.35	0.35	0.35
Minimum	38.00	24.00	35.33	23.00	53.00	28.00
Maximum	100	92.00	80.00	90.00	100.00	99.00

Pearson Correlation coefficients of between variables were calculated (Table 2). Correlations between the interview and other components were found not to be significant. Similarly, Turkish essay component has only a statistically significant relationship with Turkish. NVR component shows relatively higher correlation with the other components of the admission examination.

Table 2
Relationship between components of admission examination

Components	Turkish	Mathematics	Science	NVR	Turkish Essay	Interview
Turkish	1					
Mathematics	.091	1				
Science	.207**	.346**	1			
NVR	.284**	.265**	.247**	1		
Turkish Essay	.172*	.059	.079	-.093	1	
Interview	.017	.086	-.030	.080	-.050	1

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

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

Pearson Correlation coefficients of between exit performances were calculated (Table 3). IGCSE Turkish-IGCSE math, IBDP Turkish-IGCSE math, and IGCSE Turkish and TYT variables were found to not to be significant. IGCSE total, IBDP total and high school cumulative grade point average shows relatively high correlations between each other.

Table 3
Relationship between exit performances

Components	IGCSE Total	IGCSE Turkish	IGCSE Math	IBDP Total	IBDP Turkish	IBDP Math	CHGPA	TYT
IGCSE Total	1							
IGCSE Turkish	.401**	1						
IGCSE Math	.544**	.070	1					
IBDP Total	.744**	.304**	.307**	1				
IBDP Turkish	.486**	.320**	.085	.630**	1			
IBDP Math	.620**	.299**	.328**	.766**	.441**	1		
CHGPA	.812**	.287**	.374**	.813**	.522**	.620**	1	
TYT	.646**	.214	.281*	.645**	.388**	.562**	.622**	1

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

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

Table 4 below shows the descriptive statistics of participants in the exit performances. The maximum point can be taken from the IGCSE is 49 and IBDP is 45. Maximum

available point from IGCSE Turkish, IGCSE math, IBDP Turkish and IBDP math is 7.

Table 4
Descriptive statistics of participants in exit performances

Statistic	IGCSE	HCGPA	IBDP	TYT	IBDP Turkish	IBDP Math	IGCSE Turkish	IGCSE Math
N	191	84	83	80	83	83	191	191
Mean	37.92	82.39	33.10	383.30	5.99	4.95	6.27	5.31
Median	38.00	82.17	32.00	382.50	6.00	5.00	6.00	5.00
Mode	36.00	76.79	32.00	273.4	6.00	5.00	6.00	5.00
Std. Deviation	5.16	4.87	3.68	54.66	0.62	0.99	.760	1.06
Skewness	-0.21	0.415	0.53	0.31	0.006	0.02	-1.01	-0.77
SE. of Skewness	0.18	0.263	0.26	0.27	0.26	0.26	0.18	0.18
Kurtosis	-0.45	-0.66	0.35	-0.29	-0.27	-0.52	1.39	0.61
SE. of Kurtosis	0.35	0.52	0.52	0.53	0.52	0.52	0.35	0.35
Minimum	25.00	74.02	26.00	273.40	5.00	3.00	3.00	2.00
Maximum	49.00	93.27	43.00	527.40	7.00	7.00	7.00	7.00

Method of data analysis

The study aims to explore if the admission of a laboratory school predicts the academic achievement of students in national/international programs and examinations. The criteria variables are IGCSE IBDP, TYT and high school cumulative grade point average. Results of the admission examination in different components (Turkish, mathematics, science, NVR, interview and Turkish essay) were taken as independent variables, and IGCSE results, IBDP examinations results, TYT examinations results, high school cumulative grade point average were taken as dependent variables. Multiple linear regression analysis was used in order to examine the relationships. Regression analysis is a powerful statistical tool to investigate relationships between two variables. Since there are more than one independent variable to make predictions on a dependent variable, multiple linear regression analysis was used in order to define

a linear function of two or more variables to resolve the change in the dependent variable.

In this study, a series of hierarchical multiple linear regression analyses were conducted. For each regression, 3 blocks were defined. In the first block, Turkish, mathematics and science scores of students were included. The second block included NVR scores and the last block entered interview and Turkish essay scores into the regression equation. Eight different hierarchical multiple regression analysis were conducted to predict students' academic achievement in IGCSE total points, IGCSE Turkish course, IGCSE math course, IBDP total points, IBDP Turkish course, IBDP math course, high school cumulative grade point average, and TYT based on students' performance in the components of admission examination. Not all IGCSE and DP results were included in the study because only the IGCSE Turkish, IGCSE mathematics, IBDP Turkish and IBDP mathematics courses are consistently taken at the same level by all students in the data set.

Statistical assumptions were checked before conducting a multiple linear regression for prediction of dependent variables, IGCSE, IBDP, high school cumulative grade point average, and TYT, with components of admission examination, Turkish, science, mathematics, NVR, Turkish essay and interview. The first assumption is normality. In order to check for normality, visual inspection of histogram, examination of Skewness and Kurtosis values have been conducted. Skewness values ranged from -0.441 to 0.53 while Kurtosis values ranged from -0.66 to 0.35. Analysis of Kolmogorov-Smirnov test and Skewness / Kurtosis values provide us with information that the data shows a normal distribution (Tabachnick & Fidell, 2013). The second assumption is

homoscedasticity where variances should be equally distributed on the scatterplot. The results show that points are equally distributed above and below zero on the x axis and left and right sides of the zero on the y axis (Tabachnick & Fidell, 2013). We can assume that homoscedasticity was satisfied for the data. Finally, as for the third assumption, Variance Inflation Factor (VIF) was inspected in order to check for multicollinearity. Since all the results are below 2, we can conclude that independent variables do not exhibit a high degree of relationship between each other (Myers, 1990).

Gender differences were examined in students' scores. Independent samples t-test showed that there is not a significant mean difference in the academic achievement ($M_{\text{girls}}=260.55$, $SD=32.77$, $M_{\text{boys}}=263.26$, $SD=29.74$ ($t(189)=-.58$, $p=.56$). Looking admission examination components more closely, results of the independent samples t-test showed in Turkish ($M_{\text{girls}}=74.84$, $SD=8.65$, $M_{\text{boys}}=68.09$, $SD=11.07$, $t(189)=4.721$, $p=.000$), mathematics ($M_{\text{girls}}=61.06$, $SD=12.25$, $M_{\text{boys}}=65.09$, $SD=12.17$, $t(189)=-2.244$, $p=.026$), science ($M_{\text{girls}}=57.96$, $SD=8.94$, $M_{\text{boys}}=60.93$, $SD=9.17$, $t(189)=-2.240$, $p=.026$), NVR ($M_{\text{girls}}=65.83$, $SD=13.36$, $M_{\text{boys}}=68.34$, $SD=14.07$, $t(189)=-1.251$, $p=.212$), interview ($M_{\text{girls}}=80.73$, $SD=12.12$, $M_{\text{boys}}=77.64$, $SD=13.26$, $t(189)=1.666$, $p=.097$), Turkish essay ($M_{\text{girls}}=67.05$, $SD=14.27$, $M_{\text{boys}}=61.25$, $SD=15.01$, $t(189)=2.684$, $p=.008$). Results of the independent samples t-test for the components of the admission examination shows that girls are more successful in Turkish and Turkish essay component. On the other hand, boys are more successful in the mathematics and science component. There is no significant mean difference between boys and girls for the NVR and interview components.

Similarly, no gender difference was found in IGCSE total ($M_{\text{girls}}=38.3$, $SD=4.97$, $M_{\text{boys}}=37.43$, $SD= 5.43$, $t(189)=1.10$, $p=.27$), in DP total ($M_{\text{girls}}=33.10$, $SD=3.79$, $M_{\text{boys}}=33.03$, $SD= 3.58$, $t(81)=.08$, $p=.94$), in the first stage university entrance examination (TYT) ($M_{\text{girls}}=384.68$, $SD=54.86$, $M_{\text{boys}}=381.29$, $SD= 55.17$, $t(78)=.27$, $p=.79$.) Only difference found was for the high school cumulative grade point average ($M_{\text{girls}}=83.52$, $SD=4.93$, $M_{\text{boys}}=80.56$, $SD= 4.25$, $t(82)=2.80$, $p= .005$). Girls were found more successful than boys based on this variable.



CHAPTER 4: RESULTS

Introduction

The main aim of this study is to examine predictive validity of a laboratory high school admission examination using several exit variables such as international and national examinations (IGCSE, IBDP and Turkish university entrance examination) as well as the cumulative high school grade point average.

Chapter three mainly focused on the methodology of the present study. In chapter four, results of the analyses for each research question presented. Multiple linear regression models were tested to explore the predictive validity of components of the Laboratory High School Admission examination. Exit variables were set as dependent variables and variables related to the components of admission examinations were defined as the independent variables in the multiple regression model. The research questions of the study are as follows:

Main research question: To what extent do the components of a laboratory high school admission exam predict students' academic achievement in international/national high school exit examinations and programs?

- a) To what extent do the components of a laboratory high school admission exam predict students' academic achievement in the International General Certificate of Secondary Examinations?
- b) To what extent do the components of a laboratory high school admission exam predict students' academic achievement in the International Baccalaureate Diploma Program?

- c) To what extent does the components of a laboratory high school admission exam predict students' academic achievement in the Ministry of Education National Program?
- d) To what extent do the components of a laboratory high school admission exam predict students' academic achievement in first stage university entrance examination?

This section will provide with the information about how components of admission examination, Turkish, science, mathematics, NVR, Turkish essay and interview, and predict student's academic achievement in exit criteria. In this section each research question will be introduced, and the results of related statistical calculations will be presented.

Predicting international general certificate of secondary education

IGCSE total

Prior to conducting a multiple regression analysis for the prediction of academic achievement in the IGCSE program based on performance of students in the components of the admission examination. Correlation between IGCSE components were checked.

Table 5 shows Pearson correlation coefficients between IGCSE total, IGCSE Turkish and IGCSE Mathematics variables. While IGCSE total, IGCSE Turkish and IGCSE mathematics course show a moderate correlation, IGCSE Turkish and IGCSE Mathematics variables were not found to be statistically significant correlated.

Table 5
Descriptive statistics of participants in exit performances

Components	IGCSE Total	IGCSE Turkish	IGCSE Math
IGCSE Total	1		
IGCSE Turkish	.401*	1	
IGCSE Math	.544*	.070	1

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

A hierarchical multiple linear regression was conducted to predict students' academic achievement in IGCSE total score and the IGCSE subjects of English, Turkish, Physics, Chemistry, Biology, and Mathematics based on students' performance in Turkish, Science, Mathematics, NVR, Turkish essay and interview components of a laboratory school admission. Three different blocks were created in the hierarchical multiple regression equation. Block 1 includes Turkish, science and mathematics components of admission examination, Block 2 includes NVR component addition to the components in Block 1, and finally Block 3 has Turkish essay and interview components addition to the components in Blocks 1 and 2. Table 6 presents the summary table for different models in the hierarchical multiple regression.

Table 6
Summary table for IGCSE total

Block	R	R Square	Adjusted R Square	SE. of the Estimate
1	.535	.286	.274	4.403
2	.563	.316	.302	4.319
3	.572	.327	.306	4.307

According to the data in Table 6, predictors in Block 1, components of admission examination Turkish, mathematics, science formed a significant regression equation, ($F(3,187) = 24.941$), $p < .001$. The total amount of variance explained by the variables in Block 1 was 27.4%, as indicated by $R^2_{adjusted}$. Similarly, with the Block 2, NVR

component was added to the predictors, $F(4,186) = 21.530$, $p < .001$. NVR provided only a 3% increase in the variance explained. Finally, in the last block, Block 3, Turkish essay and interview components were added to the model ($F(6,184) = 14.933$), $p < .001$), with a very small increase in total variance explained. Inclusion of the third model increased the adjusted $R^2_{adjusted}$ only by .004. The variables in block 1 make the most contribution to the prediction of the dependent variable. In the Table 7, both standardized and unstandardized coefficients for the prediction of total IGCSE score are given.

Table 7
Regression coefficients for IGCSE total

Block	Components	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	14.780	2.765		5.346	.000
	Turkish	.187	.029	.411	6.499	.000
	Mathematics	.070	.026	.175	2.652	.009
	Science	.089	.037	.162	2.423	.016
2	(Constant)	13.354	2.756		4.845	.000
	Turkish	.166	.029	.365	5.707	.000
	Mathematics	.055	.026	.137	2.077	.039
	Science	.075	.036	.138	2.080	.039
	NVR	.070	.024	.190	2.891	.004
3	(Constant)	9.599	3.512		2.733	.007
	Turkish	.162	.030	.356	5.471	.000
	Mathematics	.050	.026	.125	1.885	.061
	Science	.079	.036	.144	2.161	.032
	NVR	.070	.025	.191	2.856	.005
	Interview	.041	.025	.099	1.629	.105
	Turkish Essay	.015	.022	.042	0.670	.503

In the first block regression equation can be written as, using unstandardized coefficients $14.780 + .187 \times \text{Turkish} + .070 \times \text{Mathematics} + .089 \times \text{science}$. In this block, all variables were statistically significant. Turkish has a higher relationship with

the IGCSE total score as compared with other predictors, as evidenced by the standardized coefficients. In the second block participants predicted academic achievement is, using unstandardized coefficients, equal to $13.354 + 0.166 \times \text{Turkish} + 0.055 \times \text{mathematics} + 0.075 \times \text{science} + 0.070 \times \text{NVR}$. The new variables in the 2nd block, NRV, is a significant predictor but still Turkish has the highest relationship with IGCSE total score. Finally, In the third block participants predicted academic achievement is equal to $9.599 + 0.162 \times \text{Turkish} + 0.079 \times \text{science} + 0.070 \times \text{NVR}$. The predictors in the last block had no significant relationships between the dependent variables. Admission examination mathematics, Turkish essay and interview components were found statistically insignificant in the third block. All the independent variables except them positive relationships with IGCSE total score.

IGCSE Turkish

Another hierarchical multiple regression analysis was conducted in order to find out to what extend components of admission examination predicts students' academic achievement in IGCSE Turkish course. Three different blocks in the regression equation were created and table 8 presents the summary table for different blocks in the hierarchical multiple regression analysis.

Table 8
Summary table for IGCSE Turkish

Block	R	R Square	Adjusted R Square	SE of the Estimate
1	.249	.062	.047	0.742
2	.278	.077	.057	0.738
3	.334	.111	.083	.728

In the first block, academic components (Turkish, science and mathematics scores) of admission examination were taken as independent variables to predict students'

IGCSE Turkish scores. The regression model in the 1st block was significant as ($F(4,107) = 6.791$, $p < .008$), with an $R^2_{adjusted}$ of .047. In the second block, NVR component was added to the independent variables in the first block. The hierarchical regression was found statistically significant as ($F(3,896) = 8.492$, $p < .005$), with an $R^2_{adjusted}$ of .057. In the third block, where the interview and Turkish essay have been added to the regression equation, the variables in the third block yielded a statistically significant regression of ($F(3,848) = 12,245$), $p < .001$, with an $R^2_{adjusted}$ of .083. Although the regression model was significant at all blocks, explained variances are very small; indicating that variation of IGCSE Turkish scores can hardly be accounted for by the scores of admission examination components. Only 8% of the variance in IGCSE total was explained by the predictors of the model. In the Table 9, coefficients of results of hierarchical multiple regression for the prediction of Turkish IGCSE score have been given.

Table 9
Regression coefficients for IGCSE Turkish

Block	Components	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.625	.466		12.069	.000
	Turkish	.015	.005	.221	3.054	.003
	Mathematics	-.008	.004	-.134	-1.781	.077
	Science	.001	.006	.017	0.227	.821
2	(Constant)	5.476	.471		11.625	.000
	Turkish	.013	.005	.189	2.540	.012
	Mathematics	-.009	.004	-.161	-2.106	.037
	Science	-1.735E-6	.006	.000	0.000	1.000
	NVR	.007	.004	.135	1.767	.079
3	(Constant)	4.554	.594		7.668	.000
	Turkish	.011	.005	.158	2.106	.037
	Mathematics	-.011	.004	-.183	-2.409	.017
	Science	.000	.006	.001	0.017	.987

Table 9 (cont'd)
Regression coefficients for IGCSE Turkish

NVR	.008	.004	.154	2.000	.047
Interview	.007	.004	.123	1.757	.081
Turkish Essay	.008	.004	.149	2.074	.039

In the third block participants predicted academic achievement on IGCSE Turkish component is equal to $4.554 + 0.011 \times \text{Turkish} + -0.011 \times \text{mathematics} + 0.008 \times \text{Turkish essay}$. In the third block, science and interview components were found to be statistically significant. As stated earlier, although there are some significant predictors, explained variances is very small for this regression model.

IGCSE mathematics

In order to predict students' academic achievement in IGCSE mathematics based on the student's performance in the admission examination, a hierarchical multiple regression analysis was conducted. Table 10 represents the summary table for different blocks in the hierarchical multiple regression.

Table 10
Summary table for IGCSE mathematics

Block	R	R Square	Adjusted R Square	SE. of the Estimate
1	.340	.116	.101	1.004
2	.386	.149	.131	0.988
3	.391	.152	.125	0.991

In the first block, academic components (Turkish, Science and Mathematics scores) of admission examination were taken as independent variables to predict students' academic achievement in IGCSE Turkish Examination. The hierarchical regression analysis was significant as $F(8,140) = 24,619, p < .000$, with an $R^2_{adjusted}$ of .101. In the second block, NVR component was added together with the predictors in the first

block. The hierarchical regression was found statistically significant as $F(8,137) = 31,743$, $p < .000$. NVR increased the explained variance by 3%, making the total explained variance 13%. In the third block, where the interview and Turkish essay were added to the regression equation. The variables in the third block yielded a statistically significant regression of $F(5,518) = 32,504$, $p < .000$, with an $R^2_{adjusted}$ of .125. However, predictors of the last block decreased the total explained variance. Again, like prediction of IGCSE Turkish the regression model was significant at all blocks in the prediction of IGCSE Mathematics, explained variances are better than IGCSE Turkish but still very small, indicating that variation of IGCSE Math scores can hardly be accounted for by scores of admission examination components. In the Table 11, regression coefficients for IGCSE mathematics course are given.

Table 11
Regression coefficients for IGCSE mathematics

Block	Components	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.478	.630		3.931	.000
	Turkish	.015	.007	.160	2.280	.024
	Mathematics	.020	.006	.244	3.334	.001
	Science	.008	.008	.074	0.994	.321
2	(Constant)	2.783	.630		4.416	.000
	Turkish	.019	.007	.208	2.913	.004
	Mathematics	.023	.006	.284	3.858	.000
	Science	.011	.008	.100	1.349	.179
	NVR	-.015	.006	-.199	-2.703	.008
3	(Constant)	2.374	.808		2.939	.004
	Turkish	.018	.007	.197	2.704	.007
	Mathematics	.023	.006	.277	3.727	.000
	Science	.011	.008	.100	1.341	.181
	NVR	-.015	.006	-.192	-2.564	.011
	Interview	.003	.006	.038	0.555	.580
	Turkish Essay	.004	.005	.050	0.708	.480

In the third block, participants predicted academic achievement on IGCSE Mathematics component is equal to $2,374 + 0.018 \times \text{Turkish} + 0.023 \times \text{mathematics} - 0.015 \times \text{NVR}$. In the third block, science, interview and Turkish Essay components have not been found to be statistically significant. As stated earlier, although there are some significant predictors, explained variance is very small for this regression model.

Predicting international baccalaureate diploma program

A hierarchical multiple linear regression was conducted to predict students' academic achievement in total IB Diploma points based on admission components of the laboratory school admission examination. There are three different models in the regression equation. As in the prediction of IGCSE scores, block 1 comprises of Turkish, science and mathematics components of admission examination, block 2 includes NVR component addition to the components in block 1, and finally block 3 involves Turkish essay and interview components addition to the components in blocks 1 and 2. Table 12 shows Pearson correlation coefficients between IBDP total, IBDP Turkish and IBDP Mathematics variables. IBDP total, IBDP Turkish course and IBDP mathematics course show a moderate correlation.

Table 12
IBDP total, IGCSE Turkish and IGCSE math correlations

Components	IBDP Total	IBDP Turkish	IBDP Math
IBDP Total	1		
IBDP Turkish	.630*	1	
IBDP Math	.766*	.441*	1

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

Table 13 shows the summary of three different models in predicting academic achievement in IBDP total.

Table 13
Summary table for IBDP

Block	R	R Square	Adjusted R Square	SE. of the Estimate
1	.394	.155	.123	3.450
2	.412	.170	.127	3.442
3	.412	.170	.104	3.487

According to Table 13, predictors of block 1, admission examination Turkish, science, and mathematics components are able to explain 12.3% of student's academic achievement in the IGCSE with a significant regression model, $F(3,79) = 4.846$, $p < .004$. Similarly, in block 2, admission examination Turkish, science, mathematics and NVR components explain the academic achievement of students in IGCSE by 12.7%. The model is significant, $F(4,78) = 3.992$, $p < .005$, but most of the additional variance is explained by the variables in block 2. Finally, in block 3, admission examination Turkish, science, mathematics, nonverbal reasoning. The Turkish essay and interview were added to the model. total explained variance decreased. Although the model is significant as the last two components in the third layer of hierarchical regression, explain the academic achievement of students in IGCSE by 10.4% with a significant regression equation of $F(6,76) = 2.594$, $p < .024$. In the Table 14, coefficients of results of multiple regression are given.

Table 14
Regression coefficients for IBDP total

Block	Components	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	19.772	4.030		4.906	.000
	Turkish	.090	.037	.252	2.435	.017
	Mathematics	.096	.037	.279	2.604	.011
	Science	.013	.048	.029	0.275	.784

Table 14 (cont'd)
Regression coefficients for IBDP total

2	(Constant)	17.461	4.482		3.896	.000
	Turkish	.091	.037	.255	2.468	.016
	Mathematics	.094	.037	.271	2.530	.013
	Science	.017	.048	.038	0.357	.722
	NVR	.036	.031	.121	1.167	.247
3	(Constant)	17.682	6.138		2.880	.005
	Turkish	.091	.038	.256	2.435	.017
	Mathematics	.094	.037	.271	2.494	.015
	Science	.017	.050	.037	0.335	.738
	NVR	.035	.036	.120	0.986	.327
	Interview	-.001	.033	-.005	-0.042	.967
	Turkish Essay	-.001	.029	-.005	-0.039	.969

In the first block participants predicted academic achievement is equal to $19.772 + 0.090 \times \text{Turkish} + 0.096 \times \text{mathematics}$. Admission examination science component is not a significant predictor of academic achievement in IBDP total in the first model. In the second block, participants predicted academic achievement is equal to $17.461 + 0.091 \times \text{Turkish} + 0.094 \times \text{mathematics}$. Science and nonverbal reasoning components are not reported as significant predictors of academic achievement in IBDP. Finally, in the third block, participants predicted academic achievement is equal to $17.682 + 0.090 \times \text{Turkish} + 0.094 \times \text{mathematics}$. Admission examination science, nonverbal reasoning, Turkish Essay and interview components were found not significant in the block 3.

IBDP Turkish

One of the IBDP courses that students commonly take is the IBDP Turkish Literature course. Components of the admission examination have been used to predict students' academic achievement in the IBDP Turkish course. A three-block hierarchical

multiple regression was used to predict a student's academic achievement in the IBDP Turkish course. The results of the hierarchical multiple regression show that none of the blocks significantly predicted students' academic achievement for IBDP Turkish course.

IBDP mathematics

Another IBDP course that students commonly take is high level mathematics in the Diploma Program I. A hierarchical multiple regression with 3 blocks was conducted to explore to what extent the components of admission examination predict a student's academic achievement in IBDP Mathematics course. The same regression models that were used above were replicated to explore the proportion of the value that explains the dependent variable based on the independent variables. Table 15 shows the summary of three different models in predicting academic achievement in IBDP Mathematics course based on students' performance in components of admission examination.

Table 15
Summary table for IBDP mathematics

Block	R	R Square	Adjusted R Square	SE. of the Estimate
1	.365	.133	.100	0.936
2	.508	.258	.220	0.871
3	.515	.266	.208	0.878

In the first block in which academic components (Turkish, Science and Mathematics scores) of admission examination were taken as independent variables to predict students' academic achievement in IBDP Mathematics Examination. The hierarchical regression analysis was significant ($F(4,045) = 10.627$), $p < .010$, with an $R^2_{adjusted}$ of .100.

In the second block, the NVR component has been added to the independent variables in the first block. The hierarchical regression was again found statistically significant ($F(6,779) = 20.588$), $p < .001$), with an $R^2_{adjusted}$ of .220. In the third block, where the interview and Turkish essay have been added to the regression equation, the variables in the third block yielded a statistically significant regression ($F(4,582) = 21.201$), $p < .001$, with an $R^2_{adjusted}$ of .208. Explained variances are moderate, indicating that variation of IBDP Math scores can hardly be accounted for scores of admission examination components. In Table 16, both unstandardized and standardized coefficients of the model are given.

Table 16
Regression coefficients for IBDP mathematics course

Block	Components	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.219	1.093		2.030	.046
	Turkish	.018	.010	.190	1.809	.074
	Mathematics	.029	.010	.311	2.865	.005
	Science	-.007	.013	-.055	-0.502	.617
2	(Constant)	.404	1.134		0.356	.723
	Turkish	.019	.009	.199	2.031	.046
	Mathematics	.027	.009	.288	2.837	.006
	Science	-.003	.012	-.029	-0.285	.776
	NVR	.028	.008	.355	3.622	.001
3	(Constant)	1.315	1.546		0.850	.398
	Turkish	.020	.009	.204	2.068	.042
	Mathematics	.027	.009	.289	2.822	.006
	Science	-.005	.013	-.046	-0.436	.664
	NVR	.027	.009	.339	2.973	.004
	Interview	-.006	.008	-.078	-0.747	.457
	Turkish Essay	-.004	.007	-.065	-0.574	.568

When we look at the regression table for IGCSE mathematics course in the first block, participants predicted academic achievement is equal to $2.219 + 0.29 \times \text{mathematics}$.

The Turkish and science components did not satisfy a statistically significant result. On the other hand, in the second block, participants predicted academic achievement is equal to $.404 + .019 \times \text{Turkish} + .027 \times \text{mathematics} + .028 \text{ NVR}$. Finally, in the third block participants predicted academic achievement is equal to $1.315 + 0.020 \times \text{Turkish} + 0.027 \times \text{Admission examination Mathematics} + 0.027 (\text{Admission examination NVR})$. Admission examination science, Turkish Essay and interview components have been found statistically insignificant in the block 3.

Predicting high school cumulative grade point average

A hierarchical multiple linear regression was conducted to predict students' academic achievement in cumulative high school grade point average based on students' performance in Turkish, Science, Mathematics, NVR, Turkish essay and interview components of a laboratory school admission examination. As above, there are three different models in the regression equation. Block 1 comprises of Turkish, science and mathematics components of admission examination, block 2 includes NVR component addition to the components block 1, and finally block 3 involves Turkish essay and interview components addition to the components in blocks 1 and 2. Table 17 shows the results of hierarchical regression analysis for three different models.

Table 17
Summary for cumulative high school grade point average

Block	R	R Square	Adjusted R Square	SE. of the Estimate
1	.479	.229	.201	4.363
2	.523	.273	.236	4.264
3	.523	.273	.216	4.310

In block 1, admission examination Turkish, mathematics, science components provide with a statistically significant regression equation, $F(3,80) = 7.941$, $p < .001$, with an $R^2_{adjusted}$ of .201. In model 2, admission examination Turkish, mathematics, science, nonverbal reasoning, components explain the high school cumulative grade point average by 23.6% with a statistically significant regression equation of $F(6,77) = 7.419$, $p < .001$. Finally, the last model, the model 3, admission examination Turkish, science, mathematics, nonverbal reasoning, Turkish essay and interview components predict cumulative high school grade point average by 21.6% with a statistically significant regression equation of $F(6,77) = 4.827$, $p < .001$. In Table 18 below, coefficients of results of hierarchical multiple regression analysis have been given.

Table 18
Regression coefficients for high school cumulative grade point average

Block	Components	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	63.668	5.045		12.620	.000
	Turkish	.184	.047	.387	3.933	.000
	Mathematics	.121	.046	.267	2.617	.011
	Science	-.033	.061	-.055	-0.540	.591
2	(Constant)	58.628	5.447		10.763	.000
	Turkish	.185	.046	.390	4.053	.000
	Mathematics	.112	.045	.247	2.469	.016
	Science	-.024	.059	-.040	-0.404	.687
	NVR	.081	.037	.210	2.177	.032
3	(Constant)	58.794	7.446		7.896	.000
	Turkish	.185	.046	.390	3.994	.000
	Mathematics	.112	.046	.247	2.438	.017
	Science	-.025	.062	-.041	-0.399	.691
	NVR	.082	.043	.211	1.879	.064
	Interview	-.002	.041	-.005	-0.044	.965
	Turkish Essay	.000	.036	-.001	-0.006	.995

In the block 1, participants predicted academic achievement is equal to $63.668 + 0.184 \times \text{Turkish} + 0.121 \times \text{on mathematics}$. Science component has not been found to be statistically significant predictor of high school cumulative grade point average. In the block 2, participants predicted academic achievement is equal to $58.628 + 0.185 \times \text{Turkish} + 0.112 \times \text{mathematics} + 0.081 \times \text{NVR}$. Science component did not produce a statistically significant result at that block, too. In the third block, participants predicted academic achievement is equal to $58.794 + 0.185 \times \text{Turkish} + 0.112 \times \text{mathematics}$. Science, NVR, Turkish essay and interview components were not found to be statistically significant predictors of high school cumulative grade point average.

Predicting first stage of the university entrance examination

Scores taken in the first stage of the university entrance examination was taken as one of the dependent variables. In order to predict students' academic achievement in the examination, a hierarchical multiple linear regression analysis was conducted. Therefore, different regression models were created. Firstly, Turkish, mathematics, and science components were included in the model 1. Addition to the components in the model 1, NVR was included in model 2. Finally, along with the addition the components in the model 2, Turkish essay and interview components were included in model 3. Table 19 provides the results of hierarchical regression analysis for three different models.

Table 19
Summary for university entrance examination

Block	R	R Square	Adjusted R Square	SE. of the Estimate
1	.450	.203	.171	49.764
2	.501	.251	.211	48.547
3	.507	.257	.196	48.999

A hierarchical multiple linear regression was conducted to predict students' academic achievement in the first stage university entrance examination based on students' performance in Turkish, science, mathematics, NVR, Turkish essay and interview components of a laboratory school admission examination. Block 1, admission examination Turkish, science, mathematics components explain 17.1% of students' academic achievement in university entrance examination with a significant regression equation of $F(3,76) = 6.435$, $p < .001$, with an $R^2_{adjusted}$ of .171. In model 2, adding NVR component to the equation the explained variance increases by 0.04 with a statistically significant regression equation of $F(4,75) = 6.286$, $p < .001$, with a $R^2_{adjusted}$ of .211. Finally, in the third model, inclusion of Turkish essay and interview to the admission examination Turkish, science, mathematics and NVR components explained variance decreases to 19.6% with a statistically significant regression of $F(6,73) = 4.217$, $p < .001$ with a $R^2_{adjusted}$ of .196. In Table 20, coefficients of results of hierarchical multiple regression have been given.

Table 20
Regression coefficients for university entrance examination

		Unstandardized Coefficients		Standardized Coefficients		
Block	Components	B	Std. Error	Beta	t	Sig.
1	(Constant)	144.876	58.806		2.464	.016
	Turkish	.968	.543	.183	1.782	.079
	Mathematics	1.662	.553	.323	3.007	.004
	Science	1.067	.707	.162	1.509	.135
2	(Constant)	81.993	64.070		1.280	.205
	Turkish	.998	.530	.189	1.883	.064
	Mathematics	1.630	.540	.316	3.020	.003
	Science	1.134	.691	.172	1.642	.105
	NVR	.958	.435	.221	2.204	.031
3	(Constant)	85.878	87.314		0.984	.329
	Turkish	.993	.536	.188	1.853	.068

Table 20 (cont'd)

Regression coefficients for university entrance examination

Mathematics	1.581	.548	.307	2.884	.005
Science	1.238	.719	.188	1.722	.089
NVR	.759	.517	.175	1.467	.147
Interview	.246	.471	.056	0.524	.602
Turkish Essay	-.227	.419	-.064	-0.542	.590

In block 1, participants predicted academic achievement is equal to $144.876 + 1.662 \times$ mathematics. Turkish and science components have not been found to be a statistically significant predictor of TYT. In block 2, participants predicted academic achievement is equal to $81.993 + 1.630 \times$ mathematics + $.958 \times$ nonverbal reasoning. Turkish and science have not been found as statistically significant predictors of achievement in TYT. In the third block, participants predicted academic achievement is equal to $85.878 + 1.581 \times$ mathematic. Turkish, science, NVR, Turkish essay and interview components were not found to be statistically significant predictors of TYT.

Summary

The Table 21 shows the R^2 values for all the dependent variables for three models. We can understand from the table that model 1 and model 2 are the most effective models for predicting a student's academic achievement in the exit performances based on student's performance in the entrance examination.

Table 21

Adjusted R^2 table for depended variables

Block	IGCSE Total	IGCSE Turkish	IGCSE Mathematics	IBDP Total	IBDP Turkish	IBDP Math	CHGPA	University Entrance
1	.274	.047	.101	.123	-	.100	.201	.171
2	.302	.057	.131	.127	-	.220	.236	.211
3	.306	.083	.125	.104	-	.208	.216	.196

Table 22 shows the beta values for each dependent variable. We can understand from the values that the majority of the independent variables in the model 1 and model 2 are significant whereas the majority of the variables are statistically insignificant in the model 3. Interview and Turkish essay components are statistically insignificant for all of the dependent variables.

Table 22
Beta values for all depended variables

Block	Components	IGCSE	IGCSE Turkish	IGCSE Math	IBDP	IBDP Turkish	IBDP Math	CHGPA	University Entrance
1	Turkish	0.411	0.221	0.160	0.252	-	-	0.387	-
	Mathematics	0.175	-	0.244	0.279	-	0.311	0.267	0.323
	Science	0.162	-	-	-	-	-	-	-
2	Turkish	0.365	0.189	0.208	0.255	-	0.199	0.390	-
	Mathematics	0.137	-0.161	0.284	0.271	-	0.288	0.247	0.316
	Science	0.138	-	-	-	-	-	-	-
	NVR	0.190	-	-0.199	-	-	0.355	0.210	0.221
3	Turkish	0.356	0.158	0.197	0.256	-	0.204	0.390	-
	Mathematics	-	-0.183	0.277	0.271	-	0.289	0.247	0.307
	Science	0.144	-	-	-	-	-	-	-
	NVR	0.191	0.154	-0.192	-	-	0.339	-	-
	Interview	-	-	-	-	-	-	-	-
	Turkish Essay	-	0.149	-	-	-	-	-	-

CHAPTER 5: DISCUSSION

Introduction

In this chapter, first, a summary of the study is given. Then, main findings are given and discussed. And then, based on the discussions and the conclusions of the results, implications for further studies and implications are presented. Finally, limitations of the study are identified and acknowledged in order to provide the full picture of the study.

Overview of the study

Prediction of students' academic achievement is a hot topic in education. Institutions wish to select students who have the best fit for their educational programs. Considering the imbalance between limited resources and demand, admission procedures are widely used to select students. There are different components employed by educational institutions to find the students that best match its mission. Validity of admission procedures and prediction ability of such systems for students' exit performance is an important concern. This study focuses on the problem of prediction of student's exit variables using admission system components for a special group of schools in Turkey which implement both national and international curricula.

Laboratory high schools have a different educational system than other high schools in Turkey. Students must implement two consecutive international programs run in tandem with a national curriculum. Students must be successful in all programs implemented in laboratory schools and failing any of them may result in not receiving a high school diploma. Expectedly, such schools expect a higher performance from

students and, in parallel to this, laboratory schools select students who can be successful in these challenging programs using admission tests. This study was conducted to examine the predictive validity of a laboratory high school's admission examination and to what extent admission examination predicts students' academic achievement defined based on different exit performances.

The study looks for answers to the following research questions,

Main research question: To what extent do the components of a laboratory high school admission exam predict students' academic achievement in international/national high school exit examinations and programs?

- a) To what extent do the components of a laboratory high school admission exam predict students' academic achievement in the International General Certificate of Secondary Examinations?
- b) To what extent do the components of a laboratory high school admission exam predict students' academic achievement in the International Baccalaureate Diploma Program?
- c) To what extent does the components of a laboratory high school admission exam predict students' academic achievement in the Ministry of Education National Program?
- d) To what extent do the components of a laboratory high school admission exam predict students' academic achievement in first stage university entrance examination?

Major findings and conclusions

Research question a: Predicting IGCSE total, Turkish and math

For the regression analysis where IGCSE and IGCSE Turkish were defined as the dependent variable, highest contribution to the explained variance came from the variables in the 1st block (27%). Turkish, mathematics and science scores of students based on standardized tests well predicted the IGCSE total scores. Almost 30 percent of the variability was explained by these variables. The admission examination's Turkish component is by far the best predictor of total IGCSE score as evidenced by its beta value, .411 (.175 for math and .162 for science). Even though other variables (NVR, Turkish essay and interview) contributed to predict student's academic achievement in IGCSE examinations, their contributions are very small. There are studies in the literature which report findings contrary to findings of this current study. Kuncel and Hezlett (2007) conducted a study which examined the predictive validity of different variables to predict graduate students' academic achievement. They did a meta-analysis to analyze the results of predictive validity studies. One of the findings of this study concluded that a combination of academic and non-academic provided the most valid prediction of student success. Whereas in this study, academic components provided a better prediction, rather than the nonacademic components. Interview and Turkish essay components negatively affect the prediction validity of academic components of the admission examination.

Finding standardized test scores as strong predictors can be explained by the fact that curricular knowledge gained in earlier levels have helped students be familiarized with such tests. In the Turkish educational system, students become familiar with such

demanding tests at earlier grade levels (Bahar, 2011; Doğan & Demir, 2015; Kaplan, 2010).

NRV, a test designed to measure student's ability to understand and analyze the given information and solve problems using nonverbal reasoning abilities, seemed to significantly contribute to the prediction of students' exit variables for IGCSE total and sub scores. Sambo (2015) suggested in his study that students who perform better in nonverbal reasoning tests tend to show better academic performance. The researcher also suggested that nonverbal reasoning tests can be used as a tool for streaming students into different classes. Kytala and Lehto (2008) reported in their study that nonverbal intelligence is purely related to a students' general mathematics ability. Therefore, NRV test results can be used only to predict students' general mathematics abilities. The results of the current study show that NVR component explain more variance in IGCSE mathematics course than IGCSE Turkish course.

Even though the Turkish essay and interview components increase the prediction value, the change in predictability in the second and third blocks are very small. Adding another variable in the model could have increased the prediction power of the instrument since there are studies supporting the idea of diversifying the independent variables to make more reliable predictions on the dependent variable.

For example, Vulperhorst, Lutz, Kleijn and Tartwijk (2018) concluded in their study that a combination of variables such as high school cumulative grade point average and university first year grade point average better predict a student's final grade point average at the university. Adding university first year grade point average to the model

increased the explained variable by 17-29 per cent in their study. However, in this study, the essay and interview provided little contribution to the regression equations. There may be several explanations for the limited contribution of interview and essay components of the admission system. The students' oral and written skills of expressing themselves are one of the possible factors that may explain this. Considering the weight of standardized tests in the Turkish educational system, students' low level of such skills seem plausible since they have less experience expressing themselves in this manner. However, the assessing abilities of the interviewers may be another factor. Standardized interviewers should be secured to increase the validity of their reported results. Inter-rater agreement for written and oral components is of significant importance. Such components may be open to threats such as instrument decay. Thus, before interpreting contributions of oral and verbal components, validity of these components should be tested.

Moreover, looking at the results for IGCSE Turkish and mathematics courses, the block 3 in the hierarchical multiple regression results reports that admission examination can only explain 8 per cent of IGCSE Turkish and 12 per cent of IGCSE mathematics performance of the students. Although the difference is small, the block 3 is the best predictor of student's performance for IGCSE Turkish course and block 2 is the best predictor of students' performance in IGCSE mathematics course.

While NVR component of the admission examination is positively correlated with IGCSE Turkish result, it is negatively correlated with the IGCSE mathematics course. These results are very interesting that even though NVR test measures students' nonverbal abilities, it predicts students' achievement in IGCSE Turkish better than

IGCSE mathematics course. Although mathematics is a non-verbal subject area, basic reading skills such as are inevitable. Level required for IGCSE Turkish subject may be higher, explaining lower relationship between NVR and IGCSE Turkish.

There are number of studies in the literature which focused on students reading achievement in elementary school and how it affects their mathematics achievement in the following educational stages (Björn, Aunola & Nurmi, 2014; Geary, Hamson, & Hoard, 2000). Although language of the admission examination and IGCSE mathematics course is different it can still be accounted that student's language abilities in the admission examination effect their achievement in mathematics in following years.

Research question b: Predicting IBDP total, Turkish and math

IBDP total points used as another predictor variable in the study. Students take IBDP examinations at the end of grade 12, five year after the admission examination. Amount of variance by the regression model in IBDP total was one third of the explained variance in IGCSE total. Results of hierarchical multiple regression analysis shows that block 1 makes major contribution to the explained variance of academic achievement in the IBDP program based on students' performance in the admission examination. While block 1 explains 12.3 percent of student's academic achievement alone, adding block 2 explains 12.7 percent. Adding Turkish essay and interview results in the third block of the hierarchical regression analysis explained variable decreases to 10.4 per cent. Turkish essay and interview results make negative effect to the prediction for this dependent variable. These findings contradict with Foley and Hijazi (2012) and Lee et al (2016) who argue that mini interviews can be counted as good predictors of academic achievement in future educational programs. In this study,

Turkish essay and interview makes a negative effect to the prediction. Similarly, interview and Turkish essay components are statistically insignificant in predicting students' academic achievement in IGCSE total points. Although Husband and Dowell (2013) found a significant correlation between students' performance in multiple mini interviews and their future academic performance interview component is not valid predictor in this laboratory school's context. Since the literature support use of interviews in admission, low/non-existing relationships between interviews and exit criteria may be due to implementation of the interviews in this school context. Hence, the school may need to look at the assessment criteria of the interviews and make appropriate amendments such as identifying a problem in a context, analyze the problem and make appropriate suggestions for improvement.

Although the validity and reliability of interview is a controversial topic in the academia, it is valued by many institutions for choosing the best candidates for their programs. Standardized tests may not assess all of the required skills. Thus, such components like interviews may help the school assess students' ability to think critically in a given context and their non-cognitive attributes (Lemay, Lockyer, Collin, & Brownell, 2007; Nitko, 1996).

Looking at the results of hierarchical multiple regression analysis for prediction on student's performance in IBDP Turkish and mathematics, the results are different than IGCSE Turkish and mathematics courses. The analysis shows that admission examination does not significantly predict student's academic achievement in IBDP Turkish course. On the other hand, in terms of mathematics, Block 1 and block 2 explain 22 percent of student's academic achievement on IBDP mathematics course.

Explained variances doubles between block 1 and block 2. Although in total scores contribution of NRV was limited, it made a major contribution to the explained variance; therefore, it is the best predictor among the other variables. This finding is in line with Kytala and Lehto (2008) who reported that nonverbal reasoning skills are directly related to general mathematics performance.

Although NVR component was not a significant predictor for IGCSE mathematics course, the scenario is completely different for IBDP mathematics course. NVR component is a very strong predictor of student's IBDP mathematics achievement. The beta value of the NVR component is .355. There may be number of reasons behind this difference in prediction. The school is offering the most challenging and demanding mathematics curriculum that Cambridge offers for 14-16 ages. Students may not be as successful as they are in IGCSE mathematics course compared to IBDP mathematics course. The students tend to focus on more mathematics in IBDP years since they will be taking the university entrance examination. This may be the main reason behind NVR differently predicting IGCSE and IBDP mathematics.

Research question c: Predicting high school grade point average

Cumulative high school grade point average was used as another dependent variable to predict student's academic achievement in high school based on student's performance in the admission examination. Individual examination of three blocks in the regression model, block 2 become prominent as the best predictor of academic achievement in high school by almost 25 percent. Adding NVR to the regression model contributes by just % 3. These results obtained from the multiple regression reveal that even though Turkish, science and math component significantly predict

students' high school academic achievement, adding NVR component in the criteria provides small difference in the prediction. It is expectable to see a relationship between standardized subject area scores and grade point average because constructs measured by them are very close to each other. These results are in contrast with the findings of a research by Sambo (2015) who recommend that nonverbal intelligence test can be used as the predictor of future academic achievement. On the other hand, these results are supported by the research by Wilson (1983) who examined several studies which focused on the relation between SAT scores and students' academic achievement in the college. The results of the Wilson's study suggest that SAT scores satisfactory prediction of long-term measures such as graduation and cumulative grade point average. The results of the Wilson's study support the results of the current study that academic components, Turkish, science and mathematics, of the admission examination are the best predictors of students' cumulative grade point average.

Research question d: Predicting first stage university entrance examination

Scores taken in the first stage of the university entrance examination is the last dependent variable for predicting student's exit performance. The first stage of the university entrance examination is taken five years after the admission examination. Block 1 predicts students TYT performance by 17 per cent. Adding NVR in the model increases the explained variance by 4 per cent. Again, Turkish, science and math components are the one which contributes the most to the prediction in the regression model. These results are in line with Bahar's (2013) study in which there is a positive correlation between students TEOG scores in mathematics / science and university entrance examination in mathematics / science components. TEOG examination has been used to place students in high schools which admit students based on their TEOG.

The school administer its own admission examination and the results of the current study show that the academic components of the admission examination make the biggest contribution to the prediction of student academic achievement in the exit performances. Bahar's study also remark that students' mathematics and science performance in TEOG are correlated their performance in university entrance examination science and mathematics performance.

Implications for further research

This research was based on a quantitative methodology. Further research may be utilized including interviews of students who takes the exam. Students' study strategies for the admission examination and other exit performances can be examined to find out if there is difference in terms of preparation strategies among the programs and examinations. In addition to students, teachers who prepare the admission examination and teach in the school can be interviewed to learn about the relationships on the differences between admission examination and other exit criteria.

This study also analyzed the prediction power of Turkish, science, mathematics, NVR, Turkish essay and interview components of admission examination. Further research can be conducted to compare the TOEG and admission examinations scores to see the how these two examinations predict students' academic achievement in different exit performances.

Furthermore, interview and essay writing components may be further examined in terms of validity and reliability. These two components seem to have lower predictive ability on exit performance. Except for Turkish test and essay writing, these two

components had no relationship with other components of the admission examination. More evidence is needed to decide predictive abilities of these components.

Implications for practice

The results of the current study may have important implications both for laboratory school's and other high school's administrators. The findings provide a valuable information on predictive validity of components of an admission examination. One of the most significant result of the current study shows that schools administering their own admission examination must carefully analyze the examination results and adjust their acceptance formulas according the components which are able to provide the best prediction in students' future academic performance. As put forward by this study, academic components such as Turkish, science, mathematics, and NVR are the best predictors of student's future success rather than the non-academic components such as interview and Turkish essay. Nevertheless, schools can collect additional data for their entrance system. Even though some variables cannot be used as predictors of exit performance, such data can be used for other purposes such as assisting learning, designing instruction, evaluating programs, or making informed decisions on students' performance on different domains (Hanaor, 2002). Results of nonacademic component such as interview and Turkish essay can be used for variety of purposes such as counseling students for debate, academic writing, diction clubs. Students who are successful in expressing themselves, defending and debating a prespecified topic can be counselled to take part in debate club. Also, students who are good at writing influential articles can be counselled to take part in academic writing club.

As manifested by the results, interview result does not predict students' future academic achievement in this research context. Therefore, the school can take further

actions for conducting interviews which provide more reliable results. One of the further actions can be providing professional development sessions for teachers who are conducting the interview sessions in the admission examination. A standardization protocol can be developed, and teachers can be trained according to this specific protocol. Teachers conducting interview sessions can also be asked to go through a qualification process where they grade pre-assessed interviews and receive feedback accordingly.

Adding another component to the admission process can also be considered by school administrators. Letters of recommendation can be a good way for collecting valuable information about student's academic studies in their previous educational stages. At the exam registration process, students may be asked to provide three professional reference letters, in sealed envelope, for admission examination registration. Schools may verify student's academic potential with admission examination results as well as reference letters provided by students' previous teachers and administrators. Similarly, including certified skills can be considered in the admission process. Student portfolio may be another component that can be used at that stage.

In regard to serious consequences for failing the international programs, teachers and administrators of schools are expected to closely follow up students' academic progress. With the advancement of technology, data mining and machine learning strategies, schools may successfully create systems where they use variety of assessment data to make future predictions on students' performance (Wakelam, Jefferies, Davey & Sun, 2020). They suggest in their study that modern data mining and machine learning strategies provide increasingly accurate prediction results on

future academic performances. Similarly, Ashraf, Answer and Khan (2018) put forward that prediction of student academic performance in earlier stages is a vital issue for institutions in order to interfere interventions for struggling students. There are number of ways for following of academic achievement such as data mining algorithms. They can provide exceptionally reliable results on students' potential future academic achievement based on real data sets that are provide by teachers.

Limitations

This study used the admission results of three graduated classes to predict students' academic achievement in IBDP, TYT and high school cumulative grade point average based on student's performance in the admission examination. Enlarging the sample size may help researchers to come up with more reliable results.

Admission examination of the school was prepared by the teachers who works in the school. The factor analysis for the items are not conducted to check validity of the items in the examination. The school may consider revealing a system where factor analysis added to the process to improve the quality of the admission examination in future years.

On the other hand, there are other factors which may affect students' academic performance over the years such as socio-economic status, financial aid, school types, and parental expectations. Long and Pang (2016) and Takele (2017) support this claim in their research. They argue that family socio-economic status and parental expectations can be counted as the key factors in academic achievement.

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