A Model for Measuring School Performance

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Abstract

Student achievement and school performance are heavily affected by different education qualities of schools, diverse education methods in different type of schools, and so forth. In this study, a model for measuring school performance is suggested. A standardized national multiple-choice test results were investigated to specify a score model for determining school performance based on school success. Performance model is applied using factual data of a city in Turkey. Suggested model can be used as an alternative way to evaluate school performance based on standardized national multiple-choice test.

Key words: School Performance, Test Performance Analysis, Performance Score, School Success

1. Performance Assessment of Schools

Today many policy makers and governments are focusing on the evaluation and assessment of students, teachers, schools, and education systems. Evaluation results were used to determine learning levels of students, to inform parents and society about education performance, and to improve schools and teaching practices. Information gained from evaluation and assessment has an important role in improvement of education quality by providing feedback [1].

Although academic quality is a difficult concept to quantify prospective students and their parents requires objective measures that will let them evaluate and compare schools. School ranking is a tool for decision makers to help them make choices. Students who will choose a high school, administration of high schools which deal with rule making and policy production, and national authorities who define long term goals for education system can use such rankings. Also the media who wants to inform the society for the quality of high schools can use this information [2].

As a developing country Turkey has various exams for their citizens, especially young ones. Student Selection and Placement System (SSPS) is being used for the selection and placement of students which are qualified to enrol higher education. This system has two stages. All candidates must participate the first stage which is called Higher Education Examination, and second stage is called Undergraduate Placement Examination. Although some program enrols students in accordance with the result of the first stage exam, the Second stage is required for enrolling to most of the departments of the universities.

School performances should be known to evaluate the efficacy of governments' education policies. Using conventional methods to prepare such performance data is not realistic and leads

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to misinterpretation of performance of the schools. Because there are too many factors that affect school performance. Hanushek and Taylor (1990) developed an approach using the data obtained from up to 36 sophomore students from each 767 public high school in United States to be able to estimate marginal school effects. Students' family and history information is also collected through demographic surveys. They systematically investigated the methods for estimating marginal school effects and explained the bias between variables that used to predict school qualities. Direct estimates of achievement growth and value-added methods are far superior to any alternative correction that is commonly employed. They tried to develop measures for determining school quality. But they found out many obstacles that prevents to establish such measures. They concluded that using the raw scores of different districts to determine school quality is not appropriate. Their work also introduces possible causes of variation in school performance in different schools.

A student who feels incompetent in the academic domain and feels controlled in the school may experience a loss of academic motivation that drops his/her school performance eventually. Fortier et al. (1995) proposed and test a motivational model of school performance using structural equation modelling. 263 students which is in ninth degree from two different high school were attended the study. They found out that perceived academic competence and perceived academic self-determination positively influence autonomous academic motivation, which is an important factor in school performance. Results from their model explains 28% of the variance in school performance, which emphasizes the academic motivation importance.

After analysing the related study, it is envisioned that it is not appropriate to determine school performance with only tests. Not only academic achievement is expected from schools but also success in life. Americans want their children to be happy in their schools. Rothstein (2000) developed a composite index for school performance, that includes four main categories as (I) academic outcomes, (II) non-academic outcomes, (III) process indicators, and (IV) whether children are secure in school, the adult attention they receive, and condition of school facilities. Weight of these factors are 40%, 25%, 15%, and 20%, respectively. Author argues that subject-matter achievement is used most of the studies because it is easy to measure, and other outcomes are not only difficult to measure but also their measurement methodology is largely unexplored.

Status based methods (based on students current year scores) generally depends on regression models that assume school effect as a fixed value. These methods do not adjust students' incoming knowledge level. Especially scores of previous year is not controlled. Beginning knowledge levels of incoming students causes different results when evaluating education quality of schools. This is especially not desired in education quality evaluation at class level. Tekwe et al. (2004) utilized value-added assessment method to evaluate students by their incoming knowledge level.

Othman and Rauf (2009) observed that schools operational effectiveness and efficiency are different using four criteria: (1) leadership; (2) measurement; (3) analysis and knowledge management; and (4) strategic planning and examination results Their findings suggest that a high scored school from an examination is not necessarily perform well in other categories of performance. On the contrary the most successful schools in an examination are at the bottom in

other criteria. 76 Malaysian school randomly selected from five different districts to make some analytical analysis such as documentary analysis, observation and interviews with headmasters, parents-teachers association representatives and brainstorming with school inspectors. Considering different schools has different capacities they developed an index for each school that measures a school within its capability. They argued that incorporating some elements like leadership, measurement analysis, and strategic planning to operational effectiveness and efficiency is a better measure for determining school performance. They found out that high performing schools emphasis strongly on measurement, analysis and knowledge management. They are more determined in achieving their vision and mission in this way. These schools are eventually improved their overall performance. Their work can be useful for authorities to better monitor the operational performance of the schools.
Academic performance is determined only by specific standards in many education areas. Many models are developed to decide whether or not schools are fulfilling these standards. These models are basically on three different theme. Status models investigate the number of students who meets the required criteria with basic indicators. Growth models explores the change in one or more years. Value added models tries to control for factors assumed relevant to student achievement patterns. Finch and Cassady (2014) used the probit model to estimate the likelihood of students meeting a standard level and estimates the proportion of students within a school meeting this standard. They used probit regression model with an output value with two categories, which shows whether or not student meet the academic standard level. Their work is simple but an effective statistical tool for decision makers, teachers, parents, and other interested people to present relative performance of students in wide range of evaluation results.

In U.S. News Duhon et. al. (2014) used two methods to determine rankings of schools. First one is to identify schools that have succeeded in serving their students as measured academic performance on state assessments in reading and mathematics. Second one is to evaluate how well high schools are prepared their students for collage as measured by participation and performance on Advanced Placement (AP) or International Baccalaureate (IB) examinations [9].

2. Proposed Model

In this study, Higher Education Examination (HEE) is investigated in the context of school performance as it covers a standardized national multiple-choice test. Results from this test is used to specify a measurable score that reflects school performance. This score, which will be called School Performance Score (SPS) from now on, is used to determine the success of a particular school.

The proposed model is explained in two Sections. Classification of students explained in the first section. And a Mathematical model is given in the second section.

2.1. Classification

To simplify the model, the students is categorized in two steps. First step is to distinguish

students who participates the exam. Because some students may apply the universities without taking examination such as some vocational high school students can apply junior technical college or associate degrees in their field of study which is in fact two years of education.

In the second step, examination results are used to classify students. In this step it is required to determine threshold score for the classification already performed. With this information in mind there are constraints for selection of universities based on HEE scores. There are six different HEE scores based on different weights of test fields which are Turkish, Social Sciences, Basic Mathematic, and Life Sciences. A students' HEE score can be calculated if he/she have at least 0.5 net points from each of thetwo different test field [10]. If a students' HEE score cannot be calculated in this way, he/she is labelled as zero taker.

HEE scores is varied between 100 and 500. Students who could not take 140 point or above cannot be enrolled in any higher education program. Students who take points between 140.00000 and 179.99999 can only be enrolled in junior technical colleges' associate degrees or Open University programs. Students who take 180 point or above can compete for previously mentioned programs and undergraduate programs which accepts students with HEE scores. In addition to this, they get opportunity to apply for Undergraduate Placement Examination to be enrolled or not [10].

Students which are participated in the HEE can be classified into four groups with this information. First group (k) are the students who took 180 point or above. Second group are (m) students who took between 140.00000 and 179.99999 point. Third group (n) are students who took below 140 point. Fourth group (o) are zero takers, which are students whose HEE points cannot be calculated. There are students who applied to programs without participating in examination which can be classified as fifth group (s). All groups are weighted to ensure that no single group could have a dramatic positive or negative impact on SPS. A high ranking in SPS indicates that the school is an exceptional academic institution in terms of student performance. This classification and weights are summarized in Table 1.

Table 1. Student classification and weights depending on participation and results of HEE

Group	Description	Weight
k	Students who take 180 or above points	W_k
m	Students who take between 140.00000-179.99999 points	W_m
n	Students who take below 140 points	W_n
o	Students whose HEE points cannot be calculated (zero takers)	W_o
s	Students who applied to programs without participating in examination	W_s

Depending on this classification the total number of students of a school (N) can be calculated by Equation 1.

$$N = \sum N_J \qquad (1)$$

N_j student count of group j $(j = k, m, n, o, s)$.

2.2. Student Success Point

After calculating examination scores in HEE, student diploma grades are also counted in Turkey and added as secondary education success point. In this model we use diploma grades to include the success of a student in his/her courses. Diploma grades can vary in 50 to 100 points.

Success of a student in terms of school and examination results are defined as Student Success Point (SSP). SSP of each student can be calculated depending on his/her school diploma grades as well as HEE scores. Diploma grades which shows the degree of a student with respect to his/her own school system are used to take the school success of a student into account. Diploma grades are necessary to include effect of groups o and s as mentioned in Table1 as they have no HEE score to include in calculation. To calculate SSP, diploma grades (DG) are multiplied by a coefficient (DC) and then summed up with HEE scores. Hence SSP value of i^{th} student can be calculated as given in Equation (2).

$$SSP_i = DC \times DG_i + HEE_i \qquad (2)$$

A normalization process is required to equate the points of different classes given in Table . Especially groups of o and s because they have no HEE score which heavily affect the SSP. SSP_i values are normalized using Equation 2.

$$SSPN_i = \frac{SSP_i - SSP_{min}}{SSP_{max} - SSP_{min}} \qquad (2)$$

Average value of $SSPN$ is calculated as in given Equation 3.

$$\overline{SSPN_j} = \frac{\sum_{i=1}^{N_j} SSPN_i}{N_j} \qquad j = k, m, n, o, s \qquad (3)$$

Other than students who take 180 points or above (group k) have a negative effect on SPS. SPS is calculated by subtracting the sum of multiplying weights $W_{\text{m}}, W_{\text{n}}, W_{\text{o}}$, and W_{s} with the average value of the groups m, n, o, and s, respectively from group k with weight W_{k} as in given Equation 4.

$$SPS = W_k \times \overline{SSPN_k} - \sum \left(W_J \times \left(1 - \overline{SSPN_j} \right) \right) \qquad j = m, n, o, s \qquad (4)$$

3. Case Study

Higher Education Examination results of students in a specific city obtained from Student Selection and Placement System (SSPS) for this application. Factual data were inspected for suitability and adjusted for utilization.

2014 Higher Education Examination results of one of the cities in Turkey which contains 178 different schools and 23,649 students were used in the application.

SPS is calculated by assigning weights W_k, W_m, W_n, W_o, and W_s as 1.00, 0.05, 0.10, 0.20, and 0.10, respectively. Diploma grade coefficient is taken as 0.60. All six HEE scores are calculated with *SPS* and their average is taken. On the other hand average of six HEE scores is calculated. All results normalized to [0,1] interval and then compared. Ascending distribution of two normalized average values are given in Figure 1. Findings shows 0.844 Pearson correlation between the two calculations within the 0.99 confidence bound.

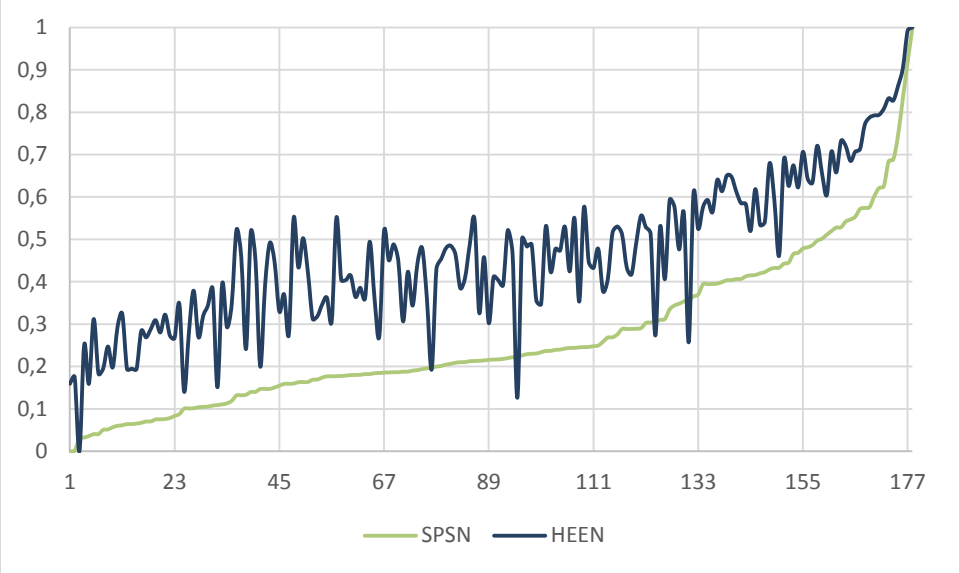

Figure 1. Normalized SPS scores versus normalized HEE scores

4. Discussion and Conclusion

School performance is very crucial for a nation to monitor its education system and also very difficult to decide its factors, because of variety of variables. Some of these variables are very difficult to find or specify like satisfaction of students and their parents from a school, quality of health and safety, assessment of the culture and diversity, quality of teachers, quality of resources and facilities, quality of the extracurricular and etc. There is a need for a solid performance index

that could monitor the situation of schools and help decision makers to act upon them.

This study investigated the measurable score model for determining school performance based on school success. A measurable school performance score is suggested to calculate school performance. Suggested model can be used as an alternative way to evaluate school performance based on standardized national multiple-choice test. This score can be used to clarify performance of a school but there are many types of schools with diverse branches. For that reason schools can also be categorized to evaluate the results objectively. Possibly there are also other measurable factors like school performance score, which should be investigated thoroughly in this context.

References

[1] OECD. Synergies for Better Learning. Paris: Organisation for Economic Co-operation and Development; 2013.
[2] Al-Juboori AFMA, Na Y, Ko F. University ranking and evaluation: Trend and existing approaches. 2011 2nd Int Conf Gener Inf Technol ICNIT 2011;137–142.
[3] Hanushek EA, Taylor LL. Alternative Assessments of the Performance of Schools: Measurement of State Variations in Achievement. J Hum Resour 1990;25:179–201.
[4] Fortier MS, Vallerand RJ, Guay F. Academic Motivation and School Performance: Toward a Structural Model. Contemp Educ Psychol 1995;20:257–274.
[5] Rothstein R. Toward a Composite Index of School Performance. Elem Sch J 2000;100:409–41.
[6] Tekwe CD, Carter RL, Ma C-X, Algina J, Lucas ME, Roth J, Ariet M, Fisher T, Resnick MB. An Empirical Comparison of Statistical Models for Value-Added Assessment of School Performance. J Educ Behav Stat 2004;29:11–36.
[7] Othman R, Rauf FA. Implementing school performance index (SPIn) in Malaysian primary schools. Int J Educ Manag 2009;23:505–522.
[8] Finch WH, Cassady JC. Use of the probit model to estimate school performance in student attainment of achievement testing standards. Educ Assess Eval Account 2014;1–25.
[9] Duhon C, Kurki A, Noel A, Zhang A, Blankenship C. Identifying Top-Performing High Schools for the “Best High Schools” Rankings Analytical Methodology and Technical Appendices. 2014;
[10] ÖSYM. 2014 Öğrenci Seçme ve Yerleştirme Sistemi (ÖSYS) Kılavuzu. Ölçme, Seçme ve Yerleştirme Merkezi (ÖSYM); 2014.