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School Performance Using Data Envelopment Analysis: Birjand City

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ABSTRACT

: The purpose of this paper is to evaluate the performance of secondary schools in the city of Birjand in 2011-2012 school years to determine their efficiency and identify their strengths and weaknesses with the help of output-oriented CCR model in data envelopment analysis (DEA). In this paper, the analysis of data was carried out using 20 input parameters and 6 output parameters affecting the educational performance of schools which are collected in the field and the oral interview with schools officials. Finally, the 26 indices were trimmed depending on the type, importance and authenticity of the 8 inputs (3 core and 5 supplemental index) and 3 output indicators which the related model CCR is solved in Lingo software. Performance of schools was determined first with three main input parameters, and then with 8 input parameters and efficient and inefficient schools were determined. Finally, in addition to ranking efficient units, identify the weaknesses of inefficient Schools, and the benchmark of them were presented in order to improve their performance.

KEYWORDS: Performance evaluation, Birjand city schools, Efficiency**,** performance indicators

INTRODUCTION

The assessment system was largely put forwarded both at the individual level and the organizational level since 1800a in Scotland by Robert Owen who is called the first Personnel Manager in the textile industry. In United States, Britain, France, respectively, in 1923, 1944, 1946 and finally in Iran with the introductory started with teaching courses related to assessment in the universities in June 1966, a new bill called State Employment with the approval of the Joint Committee of the National Assembly and the Senate became a law and was came into force in the system of employee evaluation. [6]

But the evaluation scientifically and statistically is not older than a century. It would be stated that a method was first introduced in 1957 by Farrell which later Charnes et al. [10], during 1978-1981 applied this method entitling "Data Envelopment Analysis (DEA)".

In their article in 1978, they defined "DEA" as follows: DEA is a mathematics programming model which is applied for a series of observed data and provides the experimental estimates of extreme ratios such as production function or efficiency frontier that is the foundations of the modern economy with a completely new approach. [5] [10, 11]

In fact, DEA was first started as of today, in 1976 with the Dr. Edward Rhodes thesis at Carnegie Mellon University. Supported by Mr. Cooper he could assess the academic achievement of students in National Schools of America. The method used to assess schools was known as CCR model. [10, 11]

Grosskopf and his team in 2001 assessed the performance of high schools in Chicago with the help of DEA [14]. Also, Essid et al. [13] in 2010 measured the "productivity" of schools in Tunisia with the help of DEA.

In Iran, DEA was started with the Ph.D. Dissertation of Dr. Mohammadreza Alirezaei under the supervision of Mr. Dr. Gholamreza Jahanshahloo and Mr. Professor Wendy Penn. He finished his dissertation on the skewed performance, and dare to say that the founder of this branch of science in Iran is this group. After them, a large number of PhD and Masters Students both in theoretical expansion and applied aspect worked on it. [2] [7]

Due to the need for progress and growth in the country, assessment of the organizations and checking their productivity are needed more than ever. With evaluation organizations and reviewing their productivity, managers are able to recognize their strengths and weaknesses, profit and loss etc. Having these factors will facilitate progress path [12].

Education and training system and within it school are not excluded from this subject in its lowest mode- possible, at least as an economic institution, not man building. With a fair look, and yet optimistic, the output is manpower that can be the infrastructure and foundation for unilateral development of action of enterprises and organizations. Therefore sensitivities can be found on performance and efficiency in production of a high quality output.

Without doubt, return on investment in human resources often requires a long term process, but its return was very deep and wide, and it will reflect in both individual and collective actions in behavior, speech,

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population and economic cost reduction, health, and justice, therefore, the phrase "we live as we are trained" properly reflects the quality of education.

The process of learning knowledge, skills and education is considered as basic fundamentals of society progress. And today in the modern world, the education system is the tool and support for all modern communities to achieve sustainable and comprehensive development [4].

In today's world, the most successful countries are those who think about their performance assessment from the smallest constituent cells (individual), to the highest decision making systems (government and parliament) in it.

The importance of School as a grower and educator of the young and dynamic generation of the society and the futures of the nation is no secret for anyone. That is where in fact is beyond an economic unit, department, organization or anything else that comes to mind.

On it's important it's enough that schools regardless of spending so much costs, including the annual per capita for each student, training and administrative staffs fees, rental cost, purchasing or building educational environment, educational hardware, water, electricity, gas, phone and Internet, and thousands of other ancillary costs, that is about 15% of the national budget, directly deal with more than 14 million students and teachers and, indirectly, with over 75 million inhabitants of the country. That's where the importance of "schools performance" is evident and then monitoring this "performance" becomes necessary.

In this paper, it is tired to evaluate the performance of high schools in Birjand with the help of the latest scientific methods, i.e. data envelopment analysis, which is based on input and output indicators of the system. For this purpose, each school is considered as a decision making unit (DMU), and a group of effecting indicators on its performance are regarded as input and a number of indicators which are usually expected at the end of an academic year of a school as a result are regarded as the output indicators and then in a way that will be described in the next section, the performance of any school will be evaluated. Also the selected schools, input and output indicators, and the number and the method of selecting them will be discussed in detail in Section 3.

DATA ENVELOPMENT ANALYSIS (DEA)

In the parametric methods, the efficiency of a decision making unit can be easily calculated with a production function, but the calculation of production function is not always easy and sometimes it is not possible. Therefore, we build a collection called production possibility set and we consider its boundary as an approximate of the production function. Production function resulted from PPS is an approximate boundary which have the desired features due to the production technology.

We assume that there are n homogeneous decision making unit, such that each $(j=1,2,\ldots,n)$ DMU_j produces the output vector y_j with s of the component $(y_j \in R^{s\geq 0})$ applying the input vector x_j with m of the component $(x_j \in R^{m\geq 0})$. The overall outline of the decision making unit is shown in Figure 1. with such a structure:

Figure 1. Displaying the decision making unit

Production possibility set of T is defined as follows:

$T=\{(x,y)|$ non-negative input x can produce non-negative output of y $\}$.

The first production possibility set provided by Charnes et al. [10] is satisfied in the following principles:

1- **Inclusion of observations:** all the observations belong to the production possibility set, $\forall j \quad (x_j, y_j) \in T$.

2- **Ray infinity**: if x produces y, then λx will produce λy. So, $(x,y)\in T, \lambda \geq 0 \Rightarrow (\lambda x, \lambda y) \in T$.

3- P**ossibility:** if $(\overline{x},\overline{y})\in T$, then for every (x,y) that $x \geq \overline{x}$ and $y \leq \overline{y}$, $(x,y)\in T$

4-C**onvexity:** if $(x_1,y_1)\in T$, $(x_2,y_2)\in T$, then $\forall \lambda \in [0,1]$, $\lambda(x_1,y_1)+(1-\lambda)(x_2,y_2)\in T$.

5 – **Minimum interpolation:** T is the smallest set which satisfies in the principles of 1 to 4.

The production possibility set which is satisfied in these five principles is shown with T_c which its mathematical form is as follows:

$$T_c = \left\{ (x,y) | x \geq \sum_{j=1}^{n} \lambda_j x_j, y \leq \sum_{j=1}^{n} \lambda_j y_j, \lambda_j \geq 0, j = 1,...,n \right\}$$

The boundary of this set is called the production possibility frontier (efficient frontier). If the evaluating unit is DMU_o and the efficiency value of DMU_o is number one, this unit is efficient and it is located on the efficient frontier. If the efficiency value of DMU_o is less than one, the decision making unit is inefficient and it is located within the production possibility set [8, 9]. Charnes et al [10] in an article in 1978 in a method known as CCR stated that if with increasing the output of y_0 (output more than y_0) we can have less or equal input than x_0 equal and DMU_o can be reached to the efficiency frontier.

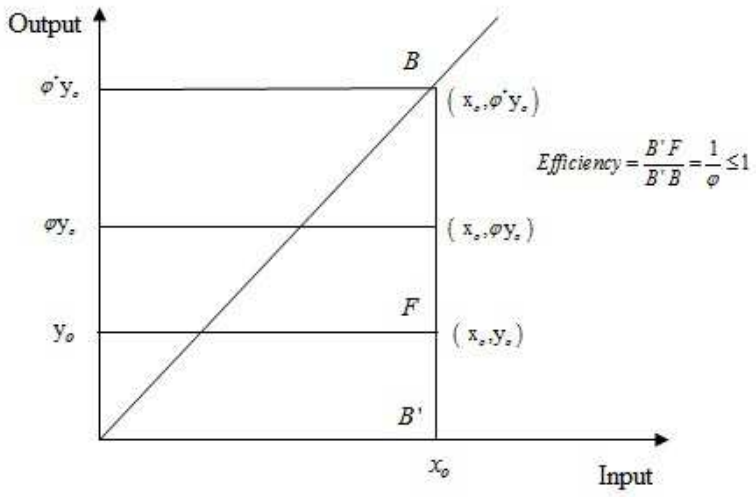

Figure 2. The method of decision making unit illustration on the efficiency of frontier

Given Figure 2. how a unit like B can be achieved algebraically? It is clear that with increasing φ, F is close to B. For this purpose, the following model which is known as the output-oriented CCR model was provided:

$$MAX \ \varphi \quad s.t \ (x_0, \varphi y_0) \in T_c$$

which is equivalent to:

$$MAX \ \varphi$$

$$s.t \sum_{j=1}^{n} \lambda_j x_j \leq x_0, \sum_{j=1}^{n} \lambda_j y_j \geq \varphi y_0, \lambda_j \geq 0, j = 1,\dots,n$$

DATA OF PROBLEM

In this paper, 14 high schools were selected from among high schools in the city of Birjand in 2011-2012 based on the following criteria to evaluate the their performance:

1) **The historical and cultural background of schools:** Schools with a long and bright history in education of Birjand have been selected.

2) **The geographical location of schools:** Schools have been chosen so that they geographically cover the entire city of Birjand.

3) **The balance between the number of girls and boys school, ordinary and particular:** in selection of schools, there is a balance between the number of boys and girls school (each 7 cases) and also special and ordinary schools. Due to lack of the same facilities and aims in high schools and conservatory, every 14 school - were selected from the high schools.

In this paper, data were collected in oral interviews and attending in schools under study through field survey, which process is among the most important and undoubtedly the most difficult and most important parts of this research for reasons discussed later.

Decision making units

In this article high schools:

1 – Talented school of boys: (D_1) 2 – Nemoneh Tarbiat Boys: (D_2) 3- Shahed boys: (D_3)

4 - Sama boys: (D_4) 5 - Chamran boys: (D_5) 6 - Taleghani boys: (D_6)

7- Talented girls: (D_7) 8 – Nemoneh Taqva girls: (D_8)

9 - Shahed girls: (D_9) 10 - Sama girls: (D_{10})

11 - Fatemeh Al Zahra girls: (D_{11})

12 - Zainab girls: (D_{12}) 13 - Esmatiyeh: (D_{13}) 14 - Shariati boys: (D_{14})

are as decision making units. 6 High schools of Chamran, Taleghani, and Shariati for boys and Fatemeto-Zahra, Zainab and Esmatiyeh for girls are ordinary state schools and 6 Tiz Houshan (Talented) boys and girls high schools, Nemoneh boys and girls, Shahed boys and girls are particular state schools and 2 high schools of Sama boys and girls are among specific nongovernmental schools (nonprofit).

Input index affecting the school performance

These indexes are classified in 5 areas as following:

1) Human resources include: **A)** Student **B)** Teacher **C)** Counselor **D)** Personnel

2) Hardware facilities includes: **A)** Lab **B)** Library **C)** Computer **D)** The video projector **E)** Smart Class and board

3) Educational Environment includes: **A)** School building **B)** Space and sports facilities in schools

4) The family includes: **A)** the level of parental education, **B)** Family Economics

5) Other effective index include: **A)** Interaction between school staff (both administrative and academic), **B)** Religious environment prevailing school and noting spiritual **C)** Parents, coaches sessions and consultation and interaction between them **D)** Remedial and reinforcement Classes **E)** Entrance classes **F)** Olympiad Classes **G)** Comprehensive exams at school level

Aggregation and composition of the input indices

After discussion and consultation with experts in the field of education, specially qualified teachers, and informed teachers and using books, journals and articles in the field of education [4 , 1] and using my own personal experience, these five areas, including 20 index are ultimately aggregated and combined to the eight indicators, including 3 core and 5 supplemental index as following based on the type, importance and severity of their impact on the performance of educational units (which are defined by a numerical factor) and their compatibility with each other.

Three main indicators are:

1 - Number of students (x_1)

2 - Teacher - Consultant – personnel (x_2)

(1 × number of ordinary teachers + 2 × number of qualified teachers of the school) + (1.5 × number of school administrative staff) + (quality grade of consultants × number of consultants)

The degree of quality of consultants is a number between 1 and 5 as well as the number of teachers is determined by school quality, in terms of performance, degree and through oral questioning of school management by a manager and assistants.

3 – Educational environment (x_3)

((Quality × sports space area) + (Quality × foundation of school building)) ÷ 100

The quality of school buildings based on stability, longevity, heating and cooling systems, air conditioning, beauty, and façade, decorations, geographic location, lighting and ancillary facilities, health services etc. and the quality of sport space based on sport facilities and proper sports land etc. is a number between 1 to 5.

Five auxiliary indexes are:

4 - Lab – Library (x_4)

(Quality × Library area) + (Quality × Labs area)

Quality of laboratory based on number, type and variety, being up to date, performance, equipment, safety, ventilation, heating and cooling systems etc. and laboratory instruments and laboratory environment and library quality also based on the same factors were determined through oral questions from the school principal, responsible for laboratory and library is a number between 1 to 5.

5 - Computers – video projector – smart board (x_5)

(2 × number of smart boards) + Number of Video Projectors + number of computers

6- Family (x_6)

In the family discussion, two parental education and family economic indicators are discussed. In issue of parental education, parents are divided into three groups of: low literate, diploma, above diploma, bachelors, above bachelors and higher in terms of education level and its impact on academic performance and in terms of the severity of impact on the quality of education of their children which are directly or indirectly affect school performance are divided with coefficients 0.5, 5 and 10 respectively. In economy each family based on economic issues, according to the school principles' understanding of families of students and information of school counselor is attributed to a qualitative degree 1 to 5.

(Number of BA or higher parents × 10) + (5 × number of upper Diploma and Bachelor parents) + (0.5 × number of diplomas and low literate parents) + (economic level of family × number of families)

It is noted that first by the number of parents, we mean the total number of father and mother. Secondly according to experiences parents' low education has a negative impact on student performance, so we selected the coefficient less than 1 for the first group.

7 - Interaction between school staff (x_7)

By obtaining information from the principle, based on the quality level of relationships among school staff, the quality degree among 1 to 5 was considered. Meanwhile, due to the great impact of this indicator on school performance, since the maximum distance of 1 to 5 is 4 units, and this small difference could not nicely illustrate the difference among intractable school with other schools, therefore, to highlight this difference, we give it the coefficient 10.

8 - Other effective indicators (x_8)

(1 × number of religious sessions) + (their Quality × number of sessions of parents – trainees and Counseling) + (1 × number of comprehensive exams) + (4 × number of sessions of entrance exam and Olympiad) + (3 × number of compensation sessions)

Quality level of parent - teachers meetings was considered a number between 1 to 5 with oral questions of principle based on the quality and rate of effectiveness of meetings. Coefficients of other indexes is also determined based on their impact on school performance and quality of holding schools.

The effective output indexes on the performance of the schools

These indexes include:

1) An acceptance of the June month 2) An acceptance of Entrance Exam 3) An acceptance of Olympiad 4) The eminent of scientific competitions 5) The electives of fostering competitions 6) The medal winners of sports games.

The accumulation and the combination of output indexes

The output indexes also with information acquirement and consultancies with technicalities and with the utilization of the books, according to importance, type, congruity and the aims of an education unit are accumulated and composed in the form of the 3 following output indexes:

1) An acceptance of the June month (y_1)

2) The electives of scientific – fostering and sports competitions (y_2)

In this section with attention to the values difference, the three phases of towns, province and country are considered and sequentially in the third, second and first positions of each stage are being related to the following coefficient:

A- Town stage: coefficients 2, 4, 6

B- Province stage: coefficients 8, 10, 15

C- Country stage: coefficients 20, 30, 50

From the coefficient of the number of individuals of each school in each stage in the related coefficient to that stage and their addition, the number related to electives of the scientific – fostering –sports competition is obtained.

3) An acceptance of Entrance Exam and Olympiad (y_3)

In this section the two indexes; an acceptance of entrance exam and an acceptance of the Olympiad are discussed. In the entrance exam category, for maintenance of the performance value of schools and maintenance of the real gap of this performance between schools, that with regards to the university type and the field type is different, based on the scientific value and ranking of universities and the university study courses, to each as per following the numerical coefficient is related:

Primarily – Universities

1- The day university: coefficient 10

2- The night university: coefficient 5

3- The Payam-e-Noor University: coefficient 3

4- The non-profit and free university: coefficient 1

Then the educational courses:

1- Bachelor and Doctorate: coefficient 7

2- Engineering: coefficient 5

3- Bachelor's: coefficient 5.2

4- Skilled: coefficient 1

We have for each university and educational course:

$= y_{ij}$ = university coefficient js x course coefficient is x number of acceptances in the course is, university js i,j = 1,2,3,4

The accumulation of y_{ij} with y_k shows the equations as:

$$\overline{y} = (y_{11} + \ldots + y_{41}) + (y_{12} + \ldots + y_{42}) +$$

$$(y_{13} + \ldots + y_{43}) + (y_{14} + \ldots + y_{44}) = \sum_{j=1}^{4}\sum_{i=1}^{4} y_{ij}$$

Where $\overline{y}$ is the correspondent output with the entrance exam.

It is important to be mentioned that with attention to the value difference of different scientific university, especially the output information related to the entrance exam are being collected based on the university name and with the proper evaluation with ranking of each university, in addition to the presentation of a more precise work the rights of the schools in the placement of their performance assessment between the other schools were also maintained. But due to the lack of access (whether *via* the schools itself and or *via* the educational management of Birjand and even the educational organization of southern Khorasan) in the following entrance exam information, unfortunately, were not successful to carry out this importance and thus the university were divided at the adequate macro level.

In the Olympiad category with attention to the present value difference in different stages: provincial, a vernacular stage, two vernacular stage and globally and even the medal achievement and ranking in each stage the following coefficients were considered:

1- Presence in the provincial stage: coefficient 5 2- Medal achievement in the provincial stage: coefficient 15 3- Presence in a vernacular stage: coefficient 20 4- Presence in the two vernacular stage: coefficient 50 5- Media achievement in two vernacular stage: coefficient 50 6- Presence in the final stage: coefficient 200 7- Medal achievement in the global stage: coefficient 1000.

From the coefficient of individual numbers of each school (present in the stages 1 to 7) to the coefficient of that stage and their additions, $\tilde{y}$ means output is gained related to Olympiad thus eventually:

The Olympiad output + entrance exam output = $y_3 = \overline{y} + \tilde{y}$

Presentation of a secondary school as a decision maker unit

After the introduction of the selected schools and the effective output and entrance indexes on the performance, in a complete view of each of the secondary schools can be considered as a decision maker unit with index 8 of entrance and index 3 of output, which is shown in the figure 3.

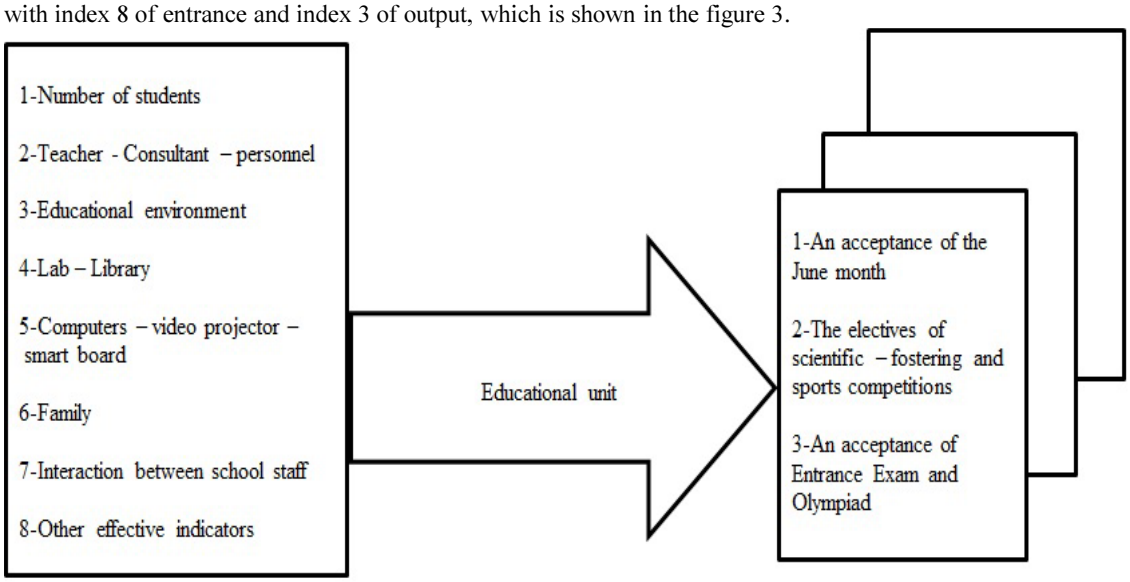

Figure 3. Structuring of Birjand schools as the decision maker units

SCHOOL PERFORMANCE ANALYSIS

The entrance and output indexes which were evaluated with regards to the performance assessment of 14 secondary schools are presented in the Table 1. The performance and efficiency of the decision making units are presented in Tables 2 and 7.

Table 1. Input-output indices

DMU	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	y_1	y_2	y_3
D_1	340	102	97	420	27	4095	50	1583	325	598	3265
D_2	400	127	265	660	31	2384.5	50	1053.5	383	191	3112.5
D_3	342	110.75	89	340	36	3872.5	50	3345	275	157	1510
D_4	85	62.25	27.01	408	8	1052.5	50	683	43	32	185
D_5	272	64.5	59.5	72	17	675	50	233	146	82	707.5
D_6	248	64.5	76.5	340	20	1274.5	35	647	124	179	702.5
D_7	339	124	72.35	250	30	4244	50	4370	335	296	2419.5
D_8	434	137	125.37	725	41	2677.5	50	1796	421	88	2942
D_9	355	98.5	66	525	24	4004.25	50	3792	333	410	1230
D_{10}	60	62.25	51.7	210	12	728	50	2614	50	20	374.5
D_{11}	371	97	75.5	661.5	16	1797.75	50	747.33	309	134	1067.5
D_{12}	282	80.5	82.125	67	76	1652	40	636	211	24	638.5
D_{13}	332	102	49.97	139	19	1017.5	50	352	244	100	542.5
D_{14}	241	57	120	109	21	1814	50	400	134	-	-

The second column of the Table 2 is the performance of education unit that is a number equal or bigger than one. This number of each educational unit as per the effect of the main triathlon on its exits is being calculated with the help of lingo software.

Table 2. Efficiency with three main inputs

DMU	Performance	Efficiency	Efficiency percentage
D_1	1.00000	1.0000000	100
D_2	1.01056	0.9895503	98.95
D_3	1.20735	0.8282602	82.82
D_4	1.95342	0.5119227	51.19
D_5	1.47718	0.6769656	67.69
D_6	1.72187	0.5807639	58.07
D_7	1.00000	1.0000000	100
D_8	1.00000	1.0000000	100
D_9	1.00000	1.0000000	100
D_{10}	1.18205	0.8459879	84.59
D_{11}	1.06126	0.9422762	94.22
D_{12}	1.26262	0.7920039	79.20
D_{13}	1.03328	0.9677919	96.77
D_{14}	-	-	-

The third column of Table 2, exhibits the efficiency of each educational unit which is the picture of its performance thus 0≤ efficiency ≤1.

The fourth column of Table 2, states the percent efficient of each education unit. i.e. Efficiency * 100.

Based on the Table 2, the education units are divided into two groups of efficient and non-efficient. From the 13 educational units whose information was present, 4 schools were efficient and 9 were non-efficient, where from the total efficient, 3 were girls' schools and 1 boy's schools and from the total of non-efficient, were 4 girls' schools and 5 boys' schools. The schools whose efficiency was 1 were efficient. These schools comprised 30.76 percent of the total schools (without considering the Shariati secondary school). The 9 other schools, i.e. 69.23 percent of schools, were non-efficient. Which themselves are divided into three groups based on the nearness or farness:

1- High efficiency: The progenitor boys' schools, Esmatiye and Fatima-al-Zahra. These schools comprised 23 percent of schools.

0.9<efficiency<1

2-Median efficiency: The Shahed boys' schools, girls Sama and Zeinab. These schools comprised 23 percent of schools.

0.7<efficiency<0.9

3-Weak efficiency: The Sama, Chamran and Taleqani boys' schools. These schools comprised 23 percent of schools.

0.5<efficiency<0.7

With attention to the Table 2 it can be mentioned that the girls' schools in relation to boys' schools had a better performance since from the total of 7 girls' schools, 3 schools with equivalence of 42.85 percent (43%) were efficient. This was in the manner that between the 6 boys' schools, only one school with the equivalent of 16.67 percent (17%) was efficient.

Among the efficient schools 75 percent of them were girls and only 25 percent was boys and among the non-efficient schools 44.44 percent of them were girls and 55.56 percent of them were boys. In addition, among the non-efficient schools 33.33 percent of them had efficiency between 90 and 100 (close to efficient) among which 66.67 percent of them were girls.

33.33 percent of them had an efficiency percent between 70 and 90 where 66.67 percent were girls.

33.33 percent of them had a efficiency percent between 50 and 70 (weak non-efficient) where all of them were boys.

If the case sample is divided by the distance between MIN and MAX of percent efficiency (50 to 100) from the viewpoint of efficiency to four spans (of course unequal), (50 to 70, 70 to 90, 90 to 100 and 100), 75 percent high span (same efficient), in the credentials of girls and 100 percent low span (50 to 70) to the credentials of the boys and the share of girls in the two median spans is 66.67 percent. This translates into the fact that the percent efficiency of none of the girls' schools was not less than 70 percent and this is in the manner that precisely 50 percent of boys' school had the efficiency percent below 70. The strongest and the weakest schools were in the share of boys. The Sama boys with efficiency of 51.19 percent were settled in depth and intellectuals and the boys with 100 percent efficiency were settled in the upper section. This translates to the fact that the efficiency of none of the educational units was not below 50. So, the 100 percent efficiency of schools in the two high quarters that among the 10 schools i.e. 76.92 percent of schools were in the fourth quarter i.e. had the efficiency above 75 percent where 7 schools with equivalence of 70 percent of this quarter were girls and three schools with equivalence of 30 percent of this quarter were boys.

Meanwhile the 3 school equivalence of 23.08 percent of schools was placed in the third quarter (50 to 75) among which the 100 percent of them were boys. In other words, 100 percent girls' schools and 50 percent boys' schools had efficiency higher than 75 percent and in the fourth quarter and 50 percent of the boys' schools with efficiency between 50 and 75 percent were placed in the third quarter. However,

Variation range of total school efficiency = -0.5119227= 0.48807331

Variation range of boys' school efficiency = -0.5119227 = 0.48807331

Variation range of girls' school efficiency = 1 – 0.7920039 = 0.2079961

Mean efficiency of all the schools÷13= 0.856538511.11350

Mean efficiency of boys' schools=4.5872÷6=0.7645333

Mean efficiency of girls' schools=6.5478÷7=0.9354

Deviation from the boys' schools mean efficiency=-0.0920052

Deviation from the girls' schools mean efficiency=+0.0788615

The differences of boys and girls schools Non-efficient =0.1708667

The summarization of the performance results of boys and girls schools described in detail is presented in Table 3.

Table 3. Comparing the performance of girl and boy schools with main 3 inputs

Sch.	Eff.	Non-eff.	Eff. percent	Non-eff. percent	4th quarter	3th quarter	1st, 2nd quarters	Variation range	Mean eff.	Deviation mean eff.
Boy	1	5	%16.67	%83.33	%50	%50	%0	0.4880	0.7645	- 0.092
Girl	3	4	%42.85	%57.14	%100	%0	%0	0.2079	0.9354	+ 0.078
All	4	9	%30.76	%69.23	%76.92	%23.08	%0	0.4880	0.8565	0

The results showed that the special schools had a performance in relation to the regular schools. Since from the total of 8 special schools, 4 school equivalence to 50 percent of them were efficient. This is in the manner that among the 5 regular schools, none of them, i.e. zero percent of them is efficient. This relates to the fact that the 50 percent of special schools (four of them) and 100 percent of general schools (5 of them) were non-efficient.

Each 4 schools of efficient are among the special schools. That means 100 percent were efficient, special and the regular schools did not have any space among the efficient schools. From the 9 non-efficient schools, 4 schools were special and 5 schools were regular. That means 44.44 percent were non-efficient, special and 55.56 percent were regular.

The share of the special and regular schools in the total of the three non-efficient schools is as follows;

1-High efficiency: 33.33 percent and 66.67 percent

2-Median efficiency: 66.66 percent and 33.33 percent

3-Weak efficiency: 33.33 percent and 66.66 percent

If we divide the investigated the case study is in the distance between MIN and MAX percent efficiency (50 to 100) from the viewpoint of efficiency into 4 spans (however unequal), (50 to 70, 70 to 90, 90 to 100 and 100), 100 percent of the high spans (same efficiency), were credited to the special schools and 66.67 percent low span, i.e. weak non-efficient (50 and 70), was credited to regular schools. Meanwhile the strongest and the weakest educational units were from special schools which were sequentially boys' intellectuals and boys Sama.

Among the 10 schools that were settled in the high quarter of society 7 schools with equivalence of 70 percent this quarter special schools and 3 schools with equivalence of 30 percent in the school quarter were regular and among the 3 schools that are settled in the third quarter, one school with 33.33 percent equivalence of it was special and 2 schools with equivalence of 66.67 percent of them are regular. In other words 87.5 percent of the special schools and 60 percent of the regular schools, with high efficiency of 75 percent and in the fourth quarter, and 12.5 percent of special schools and 40 percent of regular schools had the efficiency between 50 and 75 that means were placed in the third quarter and none of the special and regular schools were placed in the first and second quarter.

Variation range of special school efficiency = -0.5119227 = 0.48807331

Variation range of regular school efficiency =0.9677919 -0.5807639 = 0.387028

The mean of the special school efficiency= 7.1755÷8 = 0.8969375

The mean of the regular school efficiency=3.9595÷5=0.7919

The difference of means efficiency of special and regular schools=0.8969375-0.7979=0.1050375

The deviations from the special schools mean efficiency=-0.8565385=0.8969375

The deviations from the regular schools mean efficiency0.7919-0.85665385=0.0646385

The summarization of the performance results of the special and regular schools described in detail is presented in the Table 4.

Table 4. Comparing the performance of special and normal schools with main 3 inputs

Sch.	Eff.	Non-eff.	Eff. percent	Non-eff. percent	4th quarter	3th quarter	1st, 2nd quarters	Variation range	Mean eff.	Deviation mean eff.
Special	4	4	%50	%50	%87.5	%12.5	%0	0.4880	0.8969	+0.0403
Ordinary	0	5	%0	%100	%60	%40	%0	0.3870	0.7919	-0.0646
All	4	9	%30.76	%69.23	%76.92	%23.08	%0	0.4880	0.8565	0

The above numbers and numerals show the supremacy of the special schools in relation to the regular schools. This subject justifies the interest of families and students towards education in the special schools. And the implicitly of the education policy, questions the separation of the students and evacuation of the regular schools from the compendium forces (student, teacher, facilities and ….) that particularly leads to the destruction of the regular schools (even with consideration of the past) and lack of equality observance in the training and upbringing. However, it is important to be mentioned here that the presence of the Sama boys' secondary school, as a special school (of course non-profit) places in the lowest efficiency ranking.

It is possible to analyze the operation of the decision maker units from a new angle through summing up the talented/ ordinary, girls' and boys' schools which is available in Table 5.

Table 5. Comparing the performance of girl and boy-special and normal schools with main 3 inputs

Sch.	Eff.	Non-eff.	Eff. percent	Non-eff. percent	4th quarter	3th quarter	1st, 2nd quarters	Variation range	Mean eff.	Deviation mean eff.
Girl's special	3	1	%75	%25	%100	%0	%0	0.1540	0.9614	+0.1049
Girl's ordinary	0	3	%0	%100	%100	%0	%0	0.1757	0.9006	+0.0440
Boy's special	1	3	%25	%75	%75	%25	%0	0.4880	0.8324	-0.0241
Boys's ordinary	0	2	%0	%100	%0	%100	%0	0.0962	0.6288	-0.2277
All	4	9	%30.76	%69.23	%76.92	%23.08	%0	0.4880	0.8565	0

Table 6 shows the rank of the efficient units.

Table 6. Ranking of efficient schools with 3 input

Efficient school	Super efficiency	Ranking
Talented boys	1.885	**1**
Shahed girls	1.240	**2**
Talented girls	1.175	**3**
Nemoneh Taqva girls	1.006	**4**

The summary of school performance with three indices can be expressed as follows:

The girls' and talent schools have higher performance that the boys' and ordinary schools. Also the girls' talent schools have higher performance than the boys' talent schools and the ordinary girls' schools have higher performance than ordinary boys' schools. In addition, the talented girls' schools have higher performance that the ordinary girls' schools and the talented boys' schools have higher performance than ordinary boys' schools.

Table 7 shows the performance and operation of the decision maker units based on 5 indices: The items of Table 7 are similar to Table 2. The second column is the operation of the educational units which are above or equal to 1 the third column of the Table 7 shows the performance of each unit which is opposite of its operation. And the third column explains the percentage of each educational unit's performance. Based on the results of Table 7 training courses are divided into two groups: Efficient and non-efficient. Out of 13 educational units, 9 schools are efficient and 4 are non-efficient and among the efficient units 6 are girls' schools and 3 are boys' schools ad among the non-efficient units 1 is girls' school and 3 of them are boys' schools. Schools with the performance index of are considered efficient. The efficient schools consist 69.23% of the total schools. The non-efficient consist 30.76% of the total schools. Which are classified into 3 groups based on their performance index proximity to 1:

1-High efficiency: Including Talaghani School which is 7.69% of the total schools.

0.9<efficiency<1

2-Medium efficiency: Including Shahed boys' school and Sama girl's schools which are 15.38% of the total schools.

0.8<efficiency<0.9

3-Weak efficiency: Sama boys' school which is 7.69% of the total schools.

0.5<efficiency<0.0.66

It should be noted that none of the school have the performance index of (0.0,51.83).

In other words in a flexible statistical view if we consider Sama boys' school as a non-conforming input and ignore it, 100% of the educational unit have above 80% performance. And even with Sama Boys school 12 or 92.30 percent units have above 84 percent performance which shows the role of other 5 indices in improving education.

Table 7 indicates that girls' schools have better performance than boys' schools. Because:

Among 7 girls' schools 6 (87.72%) are efficient and just one school (14.28%) is non- efficient. Among 6 boys' schools 3 are efficient and 3 schools are non- efficient.

Among 66.67 efficient schools 66.67% are girls and 33.33% are boys' schools and among non-efficient schools 25% are girls' and 75% are boys' schools. In addition among non-efficient schools 25% have a performance between 90 and 100, 100% of which are boys' schools. 50% have a performance between 80 and 90 (Medium non-efficient), 50% of which is associated with girls and 50% with boys. 25% are non-efficient with the performance between 50 and 60, 100% of which is associated with boys.

Table 7. Efficiency with 8 inputs

DMU	Performance	Efficiency	Efficiency percentage
D_1	1.00000	1.0000000	100
D_2	1.00000	1.0000000	100
D_3	1.18242	0.8457232	84.57

D_4	1.92904	0.5183926	51.83
D_5	1.00000	1.0000000	100
D_6	1.01501	0.9852120	98.52
D_7	1.00000	1.0000000	100
D_8	1.00000	1.0000000	100
D_9	1.00000	1.0000000	100
D_{10}	1.18076	0.8469122	84.69
D_{11}	1.00000	1.0000000	100
D_{12}	1.00000	1.0000000	100
D_{13}	1.00000	1.0000000	100
D_{14}	-	-	-

If we divide the difference between MAX and MIN percentage of performance (50-100) into 4 unequal intervals (50-80, 80-90, 90-100 & 100) 66.67% of the above intervals (efficient) is associated with girls and 100% of the lowest interval (50-80) is associated with boys and the girls' share of this interval is 0% and from the second interval is 50%. This means that the performance of all girls' schools is above 80 while 16.66% of boys' schools have the performance less than 80% (even 60%).

Boys are associated with the strongest and weakest schools. Sama with performance of 51.83 is lowest and boys' Talented school with 100% performance is the highest. This means that the performance level of all units is above 50%. So the performance of 100% of schools is in the two above quarters of the population. 12 schools (92.30%) are in the 4th quarter which means above 75%. And among them all girls' schools include (58.23%) of this quarter and 5 boys' schools include (41.66%) of this quarter. Only one school (7.59%) is in the 3rd quarter or 50-75% the 100% of which are boys.

In other words 100% of girls' schools have performance level of 75% or higher and are placed in the 4th quarter and 83.33% of boys' schools have performance level of 75% or higher and are placed in the 4th quarter and 16.66% of boys' schools have performance level of 50-75% and are placed in the 3rd quarter while girls do not appear in this quarter.

There is a summary of girls' and boys' school performance in Table 8. Top tables show the superiority of girls over boys. But superiority strength compared to the performance of the three input indices is less evident. In other words 5 secondary indices have approximated the performance of boys to girls.

Table 8. Comparing the performance of girl and boy schools with main 8 inputs

Sch.	Eff.	Non -eff.	Eff. percent	Non-eff. percent	4th quarter	3th quarter	1st, 2nd quarters	Variation range	Mean eff.	Deviation mean eff.
Boy	3	3	%50	%50	%83.33	%16.66	%0	0.4816	0.8915	**-0.0466**
Girl	6	1	%85.72	%14.28	%100	%0	%0	0.1530	0.9781	**+0.0399**
All	9	4	%69.23	%30.76	%92.30	%7.69	%0	0.4816	0.9381	**0**

Also, the results show that the ordinary schools have better performance than talent schools. Among 8 talent schools 5 schools (62.5%) are efficient and among 5 ordinary schools 4 schools (80%) are efficient. This means that 37.5% of talent schools (3) and 20% of ordinary schools are non-efficient.

Among 9 efficient schools, 5 (55.56%) are talent schools and 4 (44.44%) are ordinary. And among 4 non-efficient 3 (75%) are talent schools and 1(25%) are ordinary. The share of talent and ordinary schools in non-efficient schools includes:

1-High efficiency: 0% and 100%

2-Medium efficiency: 100% and 0%

3-Low efficiency: 100% and 0%

So all ordinary schools' performance is above 90%.

If we divide the difference between MAX and MIN percentage of performance (50-100%) into 4 unequal intervals (50-80, 80-90, 90-100 & 100) 55.56% of the above intervals (efficient) is associated with talent and 44.44% is the share of ordinary schools 100% of the lowest interval (50-80%) is associated with talent schools and ordinary schools do not appear in this interval.

Among 12 schools in the highest quarter there are 7 talent schools (58.33%) and 5 ordinary schools (41.66%). And the only school that performs in the 3rd quarter is a talent school. That means 100% of this quarter are talent schools.

87.5% of talent schools and 100% of ordinary schools have the performance level of 75% or higher and in 3rd quarter 12.5% of talent schools and 0% of ordinary schools have the performance level of 50-75%. There is no school in 1st and 2nd quarters. The strongest and weakest efficient schools are among talent schools called Talented and Sama.

There is a summary of talent and ordinary school performance in Table 9.

Table 9. Comparing the performance of special and normal schools with main 8 inputs

Sch.	Eff.	Non-eff.	Eff. percent	Non-eff. percent	4th quarter	3th quarter	1st, 2nd quarters	Variation range	Mean eff.	Deviation mean eff.
Special	5	3	%62.5	%37.5	%87.5	%12.5	%0	0.4816	0.9013	**-0.0367**
Ordinary	4	1	%80	%20	%100	%0	%0	0.0147	0.9970	**+0.0588**
All	9	4	%69.23	%30.76	%92.30	%7.69	%0	0.4816	0.9381	**0**

Top tables show the superiority of ordinary schools over talent schools. In other words 5 secondary indices have raised the performance of ordinary schools greatly.

It is possible to analyze the operation of the decision maker units from a new angle through summing the talented/ ordinary, girls' and boys' schools which is available in Table 10. So:

Table 10. Comparing the performance of girl and boy-special and normal schools with main 8 inputs

Sch.	Eff.	Non-eff.	Eff. percent	Non-eff. percent	4th quarter	3th quarter	1st, 2nd quarters	Variation range	Mean eff.	Deviation mean eff.
Girl's special	3	0	%100	%0	%100	%0	%0	0	1	+0.0618
Girl's ordinary	1	1	%50	%50	%100	%0	%0	0.0147	0.9926	+0.0544
Boy's special	3	1	%75	%25	%100	%0	%0	0.1530	0.9617	+0.0235
Boys's ordinary	2	2	%50	%50	%75	%25	%0	0.4816	0.8410	-0.0971
All	9	4	%69.23	%30.76	%92.30	%7.69	%0	0.4816	0.9381	0

Table 11 shows the rank of the efficient units.

Table 11. Ranking of efficient schools with 8 inputs

School	Super efficiency	Ranking
Talented boys	2.492	**1**
Esmatiyeh	1.696	**2**
Zeinab	1.616	**3**
Chamran	1.587	**4**
Fatemeh Al Zahra	1.491	**5**
Nemoneh Tarbiat boys	1.464	**6**
Talented girls	1.327	**7**
Nemoneh Taqva girls	1.291	**8**
Shahed girls	1/240	**9**

The summary of school performance with eight indices can be expressed as follows:

The girls' and talent schools have higher performance that the boys' and ordinary schools. Also the girls' talent schools have higher performance than the boys' talent schools and the ordinary girls' schools have higher performance than ordinary boys' schools. In addition, the talented girls' schools have higher performance that the ordinary girls' schools and the talented boys' schools have higher performance than ordinary boys' schools.

CHECKING THE WEAKNESSES AND OUTPUT IMPROVEMENT OF SCHOOLS

Based on the study using three input indices 9 Training Units were non-efficient and using eight input indices 3 Training Units were non-efficient. Since in this article is evaluating the performance of the educational units using DEA is based on output-oriented CCR model, and due to limitations in education, including legislation, funding structures and values it is impossible to change the input indices (specially the 3rd index), therefore, to improve the performance of non-efficient units it is necessary to modify the output of these units. In other words, by adopting measures we could increase the output of these units. It should be noted that the

efficient units do not need to improve their output at this stage. The last three columns of Tables 12 and 13 represent the new outputs for the non-efficient units (based on 3 and 8 input indices) to become efficient.

Table 12. Improvement of outputs of non-efficient units to reach efficiency with 3 inputs

Non-efficient schools	y_1	y_2	y_3
Nemoneh Tarbiat boys	386.83	192.91	3143.625
Shahed boys	330	188.4	1812
Sama boys	83.85	62.4	360.75
Chamran	214.62	120.54	1040.025
Taleghani	213.28	307.88	1208.3
Sama girls	59.1	23.64	442.659
Fatemeh Al Zahra	327.54	142.04	1131.55
Zeinab	265.86	30.24	804.51
Esmatiyeh	251.32	103	558.775

Table 13. Improvement of outputs of non-efficient units to reach efficiency with 8 inputs

Non-efficient schools	y_1	y_2	y_3
Shahed boys	324.5	185.26	1781.8
Sama boys	82.56	61.44	355.2
Taleghani	125.24	180.79	709.525
Sama girls	59	23.6	441.91

By comparing these two Tables 12 and 13 with input and output indices Table 1 it is evident that the output values of units is improved. The new output values (improved) are driven by the initial outputs multiplied by the performance value of units, up to 2 decimals.

As an example we will discuss this improvement for some non-efficient units.

1.Nemoneh Tarbiat boys with 1.01 of performance score (with three input indices):

Passed in June-July: 383*1.01=386.83

Winners of scientific, educational and sport competitions: 191*1.01=192.91

Passed the university entrance exams (Konkoor) and Olympiads: 3112*1.01=3143.625

If we want to Nemoneh Tarbiat boy school becomes efficient, then the school needs to increase the level of output into the above numbers. In other words, it must increase its outputs 1%. 1% increase of the output with the current input seems possible for Nemoneh Tarbiat boy school and it is probably obtainable with a better plan within one educational year.

In addition, the proposed model for the purpose of this unit is in Table 14. It should be noted that this unit is efficient with 8 input indices.

Table 14. Benchmarks for non-efficient units with 3 inputs

Non-efficient schools	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9	D_{10}	D_{11}	D_{12}	D_{13}
Nemoneh Tarbiat boys	×						×	×					
Shahed boys	×						×	×	×				
Sama boys							×						
Chamran	×								×				
Taleghani	×								×				
Sama girls	×						×						
Fatemeh Al Zahra									×				
Zeinab								×	×				
Esmatiyeh									×				

2.Taleghani high school with 1.72 score (under 3 input indices)

Passed in June-July: 124*1.72=213.28

Winners of scientific, educational and sport competitions: 179*1.01=307.88

Passed the university entrance exams (Konkoor) and Olympiads: 702/5*1.01=1208.3

If we want to Taleghani high school become efficient, the school needs to increase the level of output into the above calculated scores. In other words, it must increase its outputs 72%.

72% increase of the output with the current input seems difficult and demands more effort and official programming so that they could revive this school which was once among the most well-known high schools once again and this could obtained with better planning and effort through years. In addition, the benchmarks for this unit is reported in Table 14.

3.Boys' Shahed high school with 1.18 score of its performance (under 8 input indices)
Passed in June-July: 275*1.18=324.5
Winners of scientific, educational and sport competitions: 157*1.18=185.26
Passed the university entrance exams (Konkoor) and Olympiads: 1510*1.18=1781.8
If we want to Boys' Shahed high school is efficient, the school needs to increase the level of output into the mentioned values. In other words, it must increase its outputs 18%.

18% increase of the output with the current inputs of Boys' Shahed high school is possible and it is probably obtainable with a better plan within 2-4 year interval. In addition, benchmarks for this unit is provided in Table 15.

Table 15. Benchmarks for non-efficient units with 8 inputs

Non-efficient schools	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9	D_{10}	D_{11}	D_{12}	D_{13}
Shahed boys	×						×	×				×	
Sama boys	×						×	×					
Taleghani	×				×								
Sama girls	×	×					×						

4.Girls' Sama high school with score of 1.18 score (with 8 input indices)
Passed in June-July: 50*1.18=59
Winners of scientific, educational and sport competitions: 20*1.18=23.6
Passed the university entrance exams (Konkoor) and Olympiads: 374.5*1.18=441.91
Girls' Sama high school needs to increase the level of output into the above mentioned values to reach efficiency. In other words, in order to be efficient, it must increase its outputs 18%.

18% increase of the output with the current input is possible for Girls' Sama high school and it is probably obtainable with a better plan within 2-4 year interval. In addition, the benchmarks for this unit is presented in Table 15.

The necessary output level and the value of increasing the outputs of other non-efficient educational units with the same input is obtainable through the same procedure. Non-efficient units through using an effective program and benchmarking the efficient units presented in Tables 14 and 15 become efficient according to their abilities and in appropriate timing.

There are some suggestions about accelerating the performance of non-efficient units in section 6.

BENCHMARK SCHOOLS

In the previous section, the output level and the percentage increase in output per non-efficient units required to become efficient, along with a proposed duration to achieve this for each unit was identified. Now in order to accelerate the process it is proposed that the non-efficient units use a target of efficient schools and achieve their purposes through benchmarking it.

Moreover, the proposed patterns are tangible and among the units under investigation. In units using several benchmarks any combination of them can be used. But it is proposed that these units start their experience with the easiest and feasible benchmark so that they could approach the best benchmark with a suitable timing and planning.

For example in Table 15 the boys' Talented and Chamran units are the proposed benchmarks for Taleghani. The authorities of Taleghani should use Chamran as a short term purpose and then approach the Talented complicated in a stronger and longer process. They may also use the linear combination of these benchmarks.

CONCLUSIONS

The 5 secondary indices have had a great positive effect on the performance of schools. Increasing the number of efficient schools from 4 to 9 and the increasing average performance of schools is evidence to this claim. This indicates that unfortunately students do not use their maximum potential performance in scientific preparation and in fact they are wasting their capacities.

Results show that girls' schools are better than boys'. Because among 4 efficient schools with 3 input indices 3 are girls' and among 9 efficient schools with 8 input indices 6 are girls'. However, the effect of the 5 secondary indices had the same effect on both types of schools. The strongest and weakest efficient schools are among talent schools called Talented and Sama. The results indicate that the talent schools with 4 representatives in efficient schools (100% of the efficient schools) with 3 input indices have a greater performance than ordinary schools. Whereas among 9 efficient schools with 8 input indices, 5 are talent and 4 are ordinary schools. So the 5 secondary indices have had a great impact on the performance of ordinary schools and these schools have used these indices very well. However the effect of these 5 indices on talent schools has been negligible. These results indicate that the students of talent schools use their maximum capacity compare to the ordinary school

students. Additionally, the lack of justice in a uniform distribution of opportunities and educational facilities (nice teachers, officials and environment) due to the separation of school policy has caused this wide gap and imposing injustice on the so-called ordinary students whole do not have a chance (for any reason) to study in these schools (good teachers are absorbed in talent schools). Filling the gap between these types of schools or even priority of ordinary schools, based on the performance and ranking tables, through injecting these indices indicates the similarity of capacities in both types of students and through providing the appropriate context and equal educational capacities, maybe it is time to say goodbye to terms like talented and ordinary, the signs of injustice and discrimination, through which a great cruelty is imposed on the students of this nation.

Another sobering fact is that the two representative private schools, Girls' and boys' Sama schools, had the weakest performance (specially the boys) and even injecting the 5 indices did not affect them and they were non-efficient in both situations. Based on the obtained results and the challenges facing the educational system, the following proposals are presented in both regional and trans-regional (macro) level s for greater effectiveness and performance:

Through survey and evaluation of the model using data envelopment analysis in the region over the next 5 years, the strengths, weaknesses, shortcomings, potentials and existing capacities could be analyzed and through long term planning it would be possible to improve cultural and educational system of this nation.

The educational units must provide the opportunity to use the maximum capacity (5 secondary indices) through appropriate planning

In addition, it is suggested to the researchers to use the input-oriented CCR model to evaluate the school operation.

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