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A better school organizational performance? Yes, but how?

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Abstract

This study ascertains, describes and examines the relationship between better school performance in a set of high secondary public schools in Campania in Italy and significant variables of the school organization. Within a systematic perspective, the study applies the analysis of principal components and the multiple regression model to first identify an objective output variable, i.e. Rate of Invalsi tests with higher marks than national average, which might measure a better school performance and then select the more significant variables which bear upon it. The findings show that these variables, when synergically working will make the system itself function more effectively. This is, in our case, the interrelated action of stakeholders and facilities of the school system that influences the variability of the output variable to the extent of 70%. Knowledge and careful consideration of these factors can help for increasing a school's effectiveness, which allows the students to achieve better results confirmed, certified we would say, by their Invalsi tests, only if such factors are successfully managed. It is, however, necessary to more deeply study and evaluate these results to find out how and to what extent stakeholders' motivation comes into play.

Keywords: Performance, public schools, resources, system, organizational performance.

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1. Introduction

Many studies have underlined the importance of measurement and evaluation of performance as one aspect of management both in the private and public sectors and many scholars have tried to better define, understand and evaluate the several meanings of performance. To shed some light on these concepts, Dubnick (2005) synthesized the different meanings of the word "performance" into the deliberateness of an action. To be more precise, he claims that "performance can be associated with a range of actions from the simple and mundane act of opening a car door, to the staging of an elaborate re-enactment of the Broadway musical "Chicago". In all these forms, performance stands in distinction from mere 'behavior' in implying some degree of intent". Therefore, performance is about intentional behavior, which can be individual or organizational" (Van Dooren, Bouckaert & Halligan, 2001). Perspective analysis of performance, developed by Dubnick, leads to the definition of 4 types of performance based on quality of the action or/and quality of achievements which are show in Table 1.

Table 1. Four perspective on how performance is understood (based on Dubnick, 2005)

Does the perspective imply quality of actions?	Does the perspective imply quality of achievements?	
	No	Yes
No	Performance as production (P1)	Performance as good results(P3)
Yes	Performance as competence/capacity(P2)	Performance as sustainable results(P4)

Source: Wouter Van Dooren, Geert Bouckaert, John Halligan, Performance Management in the Public Sector, Routledge, 2015, p.2

In this work, at the very beginning the concept of "performance as good results" is discussed, then focusing on quality of achievements by examined organizational units, finally reaching the most probably conclusion that the latter can be better read as "performance as sustainable results" which witnesses the interaction between quality of actions and of results. The units of analysis to which such argument is applied are public Italian school institutions. Measuring the performance in such environment is, though, still more complicated since the issue is not referred to a tangible product but to a service: teaching and training students, having them gain a level of knowledge, competences and abilities necessary in their social and working life.

The first problem that has been raised was finding an indicator that might measure scholastic performance in the most objective possible way; then the search for a measure of "better" scholastic performance has been dealt with; finally it has been researched a mix of input (things and persons) which had made possible to obtain such better output. Therefore, the hypothesis which is aimed to be demonstrated is the following:

Hypothesis 1a: There is a significant positive relationship between better school organizational performance and a combination of material and human resources. This study, in fact, aims at giving an answer to the questions: "A better school organizational performance? Yes, but how?" by stating, first and foremost, that performance, in the school system as well as in any other institution, is the result of the sum of several significant components, of several elements, which, from now on, we will call variables. These variables should act, within a *systemic approach***,** towards a common goal until the system as a whole will come out as something more successfully effective than the sum of its parts, as Gestalt's Psychology states (Sternberg, 2011; 2013). Bertalanffy (1968) defines a system as "a set of elements which interact mutually". Parsons (1951), referring to the *social system*, maintain that "the more general and more fundamental priority of a system is the interdependence of the parts or **variables.** The interdependence consists in the existence of specific relationships between the parts, or variables". The systemic approach does have a crucial role in the school organization, as a social system (Jensen, 1954), which offers its service to the community, and consequently helps students to more easily get the best educational results. This said, however, one might ask what actual contribution each part or variable does have on the system's performance and whether it can be somehow measured. Then it is the variables of the school system that should be carefully scrutinized if we want to find a suitable answer to the above question. The aim of our study is to try to give or help give an answer to this.

1.1. The empirical analysis of school performance factors

It is an accepted assumption that school performance is the result of the sum of several significant variables. Since variables are many and of different levels of significance, it would be complex to define to what extent each of them bears on performance. One might suggest that it would be appropriate to choose significant variables among the ones which school authorities think they are the most valid in measuring a school's performance such as, for example, the output variables, among which, at first sight, three would be even more qualifying, i.e. (i) students' marks at the end of a study cycle, (ii) the percentage of students who pass the final exam, and (iii) the rate of students who pass the *Invalsi test*, etc. [*INVALSI tests are designed and administered by* **I**stituto **N**azionale per la **Val**utazione del **S**istema dell'**I**struzione (INVALSI)*, i.e. Italy's National Institute for the Evaluation of the Country's Educational System*]. But even these variables have a different degree of validity in terms of objectiveness. In fact if we closely examine the three above mentioned variables, we notice that the first two contain subjective elements such as a student's characteristics and skills on one side and teachers' discretion when evaluating students on the other, while the third has a clearly objective connotation as it is designed by a public institution outside the schools and valid for all types of schools. Moreover *Invalsi tests* are standardized tests that do not measure the students' competence related to the disciplines taught but rather their cross competences necessary in their future social and work context.

1.2. Method

A mathematical-statistical approach consisting in the application of two models was used, in other words, the analysis of principal components and then multiple regression, respectively in order to first identify a variable that can measure the school performance in terms of learning results and then to select the more significant variables which influence the output variable.

1.3. The composition of sample

In line with the aim of the study, 39 upper secondary state schools were chosen among Technical Schools, and *Licei* (i.e. Science High Secondary Schools, Grammar Schools, special colleges, etc. from now on indicated as Lyceums) in Naples and other provinces of the Campania Region, Italy. The choice of type and level of above schools was based upon the fact that they can represent the key moment when a school can help students make their future choices in the work, university, and professional world. In addition, Campania is the geographical area of reference. Its choice was influenced by the fact that it is one of the four *Obiettivo Convergenza* regions, the other three being Calabria, Puglia and Sicily, which the European Community considers as unprivileged areas. The results of Invalsi tests in these areas are worse than those in the other regions of Italy, as we can notice in the Final Report of Invalsi (2012). To carry out research in a disadvantaged territory focusing on schools in a crucial moment of an individual's future life, would mean to operate in the field of uncertainty within which we try to find the right factor to face it. The basic data (referring to the year 2012) were provided by the *Campania Educational Department.*

For the sake of completeness we must mention a necessary limit we put to our analysis, this being the choice of schools which was not randomly made but based only on *Technical Institutes* and *Lyceums* selected in the Campania Region, whose data were the only official and complete available.

1.4. Analysis of principal components (PCA)

PCA is a multidimensional statistical technique useful for the reduction of the number of variables to be analyzed especially when the objective under scrutiny cannot be directly quantified (e.g. the school performance) while quite a few variables are correlated among them and it is difficult to understand the strength of each of them and of the relationships among them. PCA makes it possible to synthesize the available and complete information using only the variables of which we have complete information, i.e. 22 variables as shown in Table 2. Or, in simpler words, PCA makes it possible to substitute the observed variables (correlated among them) with a new group of variables (defined as main components) having the

following properties (Jolliffe, 2002): they are linear combinations of the observed variables; they are uncorrelated; they appear in a decreasing order in respect to their variance (See Table 3).This means that the top components possess a high degree of total variance, consequently the first principal component is the linear combination of the 22 variables having the highest variance (23.8%); the second main component is the linear combination of the 22 variables having the second highest variance (12.8%) and subject to the constraint that they must be uncorrelated to the preceding variable. Similarly are the following main components defined. As to the choice of the number of main components to take into account, various methods suggested in literature have been taken into account. In our case the following criteria have been chosen: the Criterion of eigenvalues equal or greater than 1 (Kaiser, 1960), Parallel Analysis (PA) (Horn, 1965), Minimum Average Partial (MAP) (Velicer, 1976) and the Scree Plot criterion. "The Scree Plot is a useful visual aid for determining an appropriate number of principal components. The Scree Plot graphs the eigenvalue against the component number. To determine the appropriate number of components, we look for an *elbow* in the Scree Plot and the number of components considered as the point at which the remaining eigenvalues are relatively small and all about the same size" (Hair, Black, Babin, Anderson & Tatham, 1995). The combination of the utilized criteria of choice has allowed us to identify two meaningful components corresponding to the first two eigenvalues. Though we are aware of the fact that variability in the two combined components is not high (summing up to about 40%), we do think that the two components together are significant from a computational view point on the basis of a Boot Strap operation.

Table 2. Variables observed (***** The variables marked with an asterisk signal output variables).

Variables	Symbols
Rate of tests higher than average of INVALSI tests;	RItestsHMthanNA *
Number of students passed;	Tassodipr~ne*
Dropout rate;	Tassodropout*
End of cycle score;	Votofineci~o*
Rate of regularity of studies;	Tassodireg~i*
Rate of classrooms equipped with PC or LIM;	Tassodiau~10
Rate of staff rotation;	Tassodiro~11
Catchment area concentration;	Concentraz~z *
Total number of students;	totstuden~25
Rate of teachers engaged in educational activities for foreigners;	Percentua~di
Total number of students enrolled in the first classes;	totstudent~s
Total number of teachers;	totaledoc~28
Classrooms;	aulex30
Total number of types of lab;	Laborator~31
Teachers/students;	Doscentist~33
Students/classrooms;	Studentia~34
Availability of spaces provided by labs and special rooms;	Disponibil lab
Availability of library space;	Disponibil biblio
Rate of teachers' professional updating;	Tassodiagg~c
Rate of use of labs;	Tassodiuti~1
Teachers with more ten years in the same school;	docenti10~29
Registered foreign students.	studenti is 27

The significant components are shown in Table 3 and are specified by 22 indicators that we think can better characterize the many aspects of the school environment, such as **RItestsHMthanNA**, the rate of promoted students, the teacher/student ratio, the rate of use of labs, etc.

Table 3. Principal components

Component	Eigenvalue	Proportion	Cumulative
Comp1	5.23117	0.2378	0.2378
Comp2	2.8343	0.1288	0.3666
Comp3	2.14298	0.0974	0.4640
Comp4	1.9842	0.0902	0.5542
Comp5	1.51164	0.0687	0.6229
Comp6	1.37076	0.0623	0.6852
Comp7	1.30691	0.0594	0.7446
Comp8	1.13062	0.0514	0.7960
Comp9	1.00793	0.0458	0.8418
Comp10	.680846	0.0309	0.8728
Comp11	.550457	0.0250	0.8978

In Table 4 we represent the coordinates on the first two axes of the utilized variables.

Table 4. The variables' coordinates on the first two factorial axes

Variable	Componente1	Componente2
– RItestsHMthanNA *	0,49	0,3137
– Tassodipr~ne *	-0,0599	0,0869
– Tassodropout *	0,0058	-0,0906
– Votofineci~o *	-0,0614	0,0716
– Tassodireg~i *	-0,1302	0,0385
– Tassodiau~10	-0,1024	0,0676
– Tassodiro~11	-0,0459	-0,1146
– Concentraz~z	-0,0299	0,3468
– totstuden~25	0,1512	0,1005
– Percentua~di	0,0143	-0,1468
– totstudent~s	0,3481	0,0444
– totaledoc~28	0,3358	-0,1063
– aulex30	0,355	0,0067
– Laborator~31	0,3251	-0,2615
– Docentist~33	-0,1739	-0,4461
– Studentia~34	0,1489	0,4607
– Disponibil lab	0,3178	0,3011
– Disponibil biblio	0,362	0,3301
– Tassodiagg~c	0,4192	0,3275
– Tassodiuti~1	0,3335	0,2448
– docenti10~29	0,3243	0,2072
– studenti is 27	-0,0889	0,0263

Figure 1 shows the first two components set against the axes accounting for almost 40% of the total variability. Variables positioned around the origin represent a sort of average and do not characterize the axes. In the circled cloud, on the contrary, we can see variables which characterize first and second axes, and we also notice that **RI-testsHMthanNA** is the one which best characterizes the axes as it positioned at the farthest point of the cloud.

Consequently the output variable (**RI-testsHMthanNA**), more significantly influenced by the other variables within the cloud, will be utilized in the multiple regression model as a dependent variable.

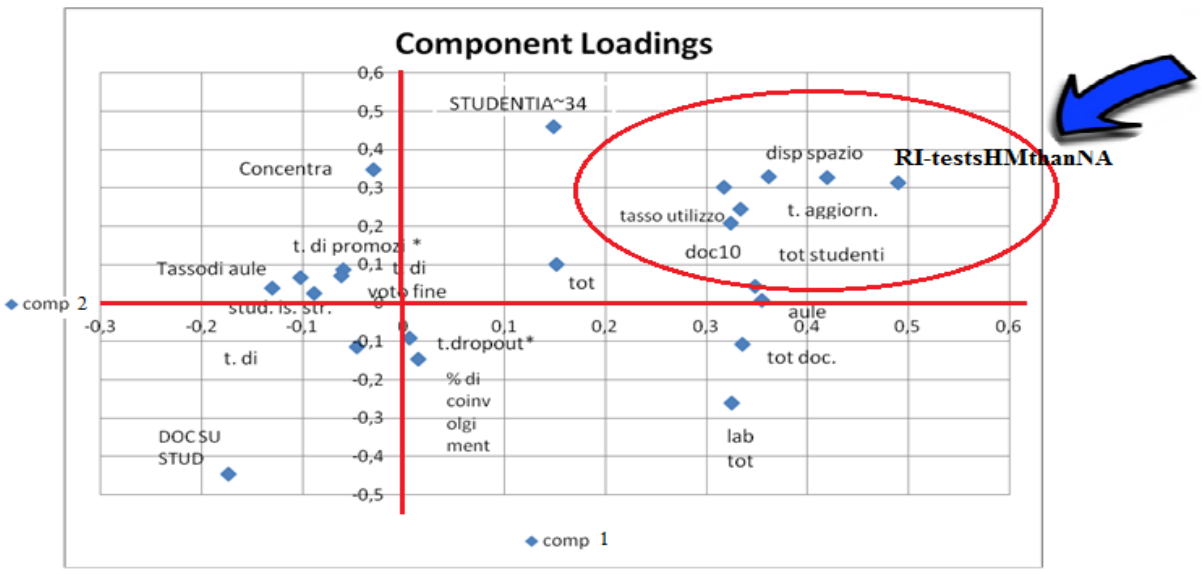

Figure 1. Representation of the variables on the factorial level

1.5. Multiple regression

Based on the analysis of principal components we came to consider variable **RItestsHMthanNA** as dependent variable when applying the multiple regression model. The reason of this choice depends also on our firm belief that this variable can be considered the most objective output variable (see 1.1 above) to measure the school performance. The explanatory independent variables used (referring to the five Provinces of Campania) are shown in Table5.

Table 5. Variables used in multiple regression and relative symbols

Variables	Symbols
Dummy variable: geographic location (Napoli – provinces)	1)
Dummy variable: School type (Lyceums – Technical Institutes)	2)
Availability of library spaces	a.
Catchment area concentration	b.
Availability of space devoted to labs	c.
Rate of classrooms equipped with PCs or LIMs	d.
Staff turnover	e.
Rate of foreign students	f.
Rate of teachers' professional updating	g.
Rate of use of labs	h.
Total number of students	i.
Rate of teachers engaged in educational activities for foreigners	j.
Total number of students enrolled in the first year	k.
Foreign students registered	l.
Teachers with more than ten years in the same school	m.
Classrooms	n.
Total number of labs	o.
Total number of types of lab	p.
Teacher/student ratio	q.
Student/classroom ratio	r.

Before carrying out the regression analysis, we verified the validity of the hypotheses tied to the regression model, particularly the normality hypothesis, the homoscedasticity hypothesis, and the multicollinearity hypothesis (Gupta, Agrawal, Joshi & Misra, 2011). The R-squared index is equal to 0.69, which shows that **69%** of the variability of the dependent variable (**RI-testsHMthanNA**) is explained by the independent variables. The deviance decomposition, used to verify the value of the regression model, gave the results reported hereafter.The statistic F(19,19) = 2.26 shows that the model is significant. This result is confirmed by Prob > F = 0.04. Finally the *Student's t* (obtained from the ratio between the coefficient and the standard error) are listed together with the confidence intervals for each regression coefficient.

Table 6. Deviance decomposition to verify the value of regression coefficients

Source	Sum of the Squares	Degrees of freedom	Mean Square= SS/Df
Model	80.4902189	19	4.23632731
Residual	35.5970872	19	1.8735309
Total	116.087306	38	3.05492911

Number of observations = 39
F(19,19) = 2.26 Prob > F = 0.0417
R-squared = 0.6934 Adjusted R-squared = 0.3867

The results of the multiple regression are given in Table7

Table 7. Results of multiple regression. (The relevant variables are given in bold)

Y	Coefficients	Standard Error	Student's t	P>|t|	[95% Confidence Intervals]	
1)	-.3946202	.745	0.53	0.603	1.955773	1.16
2)	.9396623	.836	1.00	0.330	2.597685	6.91
a.	.905979	. 461	1.95.	0.05	.368475	.656
b.	-.0213538	.0149	-1.43	0.169	-.0526108	.00990
c.	.849017	.0435	1.95	0.05	0.0454	.056573
d.	.016364	.0119	1.36	0.189	.04148	.088752
e.	.0065009	.0397	0.16	0.872	-.0766995	.089701
f.	-0.0926	0.461	0,20	0.841	0.325	.975
g.	.662968	.333	1.99	0.04	.04120	.08380
h.	0.968227	.0.438	2.21	0.02	.32777	.98685
i.	.0088944	.0056	1.59	0.129	-.002832	.0206208
j.	.0345337	.0572	0.60	0.554	-.0853878	.1544551
k.	-.0060364	00488	-1.24	0.231	-.0162538	.004181
l.	.0100547	.0257	0.39	0.701	-.0438672	.0639765
m.	.130926	.0 545	2.40	0.02	009637	.0558222
n.	-.1370898	.1268	-1.08	0.293	-.4025044	.1283248
o.	-.1121394	.0580	-1.93	0.068	-.2335484	.0092695
p.	.0252429	.1387	0.18	0.858	-.265135	.3156209
q.	-.0579831	.0416	-1.39	0.180	-.1452034	.0292371
r.	-.2389152	.20135	-1.19	0.250	-.6603487	.1825183
costante	13.78829	6.645	2.07	0.052	-.121216	27.69779

It must be first highlighted the fact that there is no difference between the types of schools (i.e. Lyceums and Technical schools) and moreover there is no territorial difference between Naples and the other Campania Provinces because the coefficient is not significant. The result, truly unexpected, gives our research more incisiveness and deeper meaning. The analysis has shown that the variables more influent on dependent variable are **a, c, g, h, m** which correspond to the following variables respectively *Availability of library spaces*, *Availability of labs*, *Rate of teachers' professional updating*, *Rate of use of labs*, and *Teachers who have remained in the same school for more than 10 years*.

2. Results and Discussion

The Invalsi tests variable, identified in the principal components analysis, in the 39 schools under investigation revealed the presence of marks higher than the National average, which certainly will appear surprising when we think that the Campania region is considered an unprivileged area by the European Community. We can immediately pose some questions: How can 'unprivileged schools' take results in this tests better than the national average?, What components/units/variables of the school system influenced the school performance?, Their teachers' professional competence and their commitment? The school's organization? The manager's professional commitment? Or what else? The answer to these questions will not only highlight the relationship between a mix of school factors (teachers and facilities) and performance, but also which variables will bear upon the Invalsi Tests' performance.

In the light of the carried out analysis we can infer that the school performance measured with indicator **RI-testsHMthanNA** (dependent variable), depends on five significant independent variables: 1 *Availability of Library spaces*, 2 *Availability of labs*, 3 *Rate of teachers' professional updating*, 4 *Rate of use of labs*, and 5 *Teachers who have worked in the same school for more than 10 years.* We must first of all state that the results of our data processing do not derive from subjective data referring to specific characteristics of teachers, students, and schools, which could not bring about generalized results applicable everywhere and every time, as they are very specific. The detected variables are strictly linked to what goes on within the analyzed schools in terms of work/action (the use of labs, teachers' updating, permanence in the workplace), and to what a school possesses when it comes to structural facilities (laboratories, libraries).

3. Conclusion and Implications

The aim of this study must be seen as a contribution to a more scientific assessment of the important role of measuring the performance of a school system. The approach used is the multiple regression which enabled us to carry out an analysis of those variables which more significantly condition the school performance. We found out that of these variables, the dependent one, i.e. "*Number of students who passed the INVALSI tests with a score higher than the national average"*, varies (up to a percentage of about 70%) according to the variation of the related independent variables consisting of material and human resources.

Some interesting interpretative elements have emerged. The first is the importance of having data about one or more objective variables when tackling problems like performance in public institutions and identifying a significant objectively-measurable output variables (Invalsi tests with a higher marks than the national average) which can lead us to identify the input variables which when synergically working will make the system work more effectively. INVALSI tests are in fact the key to the whole development of this study. The second lies in the outcome itself of our study, which demonstrates that a school's better organizational performance is influenced by input variables that you normally would not associate with the most important in the school system. This is in our case the interrelated action of stakeholders (teachers) and facilities (library and labs) of the school system.

This combination allows students, in our case, to achieve better results confirmed, certified I would say, by their INVALSI tests. To influence and better a school's organizational performance, we now believe that the teachers of the 39 schools from Campania could have never been able to contribute to the result the students obtained, if the systemic mechanism had not come into play. In brief, teachers and facilities were the key to success.

On the basis of the analysis carried out with statistical rigor and the necessary implications for a correct and complete management of a school, we can maintain that school managers should consider the interrelation of the parts of the organization a driver. The implementation modalities are many, but what is absolutely sure is the fact that we need to project our school toward the creation of a network, where we

can share competences and facilities, especially in such a moment when there's a definitive feeling in the air of strong concentration of financial resources in the public system as a whole and notably in schools. In the light of these considerations, I believe that the better school organizational performance is the combined outcome of quality results and quality teachers actions as individual-level factors and thus such performance can be depicted, together with Dubnick, as "sustainable results (P4)". Kim (2005) suggests that managers should also know how to better manage and promote the individual-level factors, such as job satisfaction, affective commitment, public service motivation, and organizational citizenship behaviour, in order to improve organizational performance in the public sector. For instance public service motivation, in particular, seems to be correlated to individual and organizational performance (Brewer, 2010). Future research should continue to explicate the relationship of individual-level factors and structural level factors to organizational performance. The issues are actually about which mix of factors /resources between human and material resources will be used in the school, and the measure of performance will ultimate depend on the particular mix that emerges.

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