"The Role of School Leadership on Student Achievement: Evidence from Timss2003"

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Abstract

To address this question, the study uses the TIMSS2003 and investigates the relationship between head-teacher time allocation and school characteristics, student background, and student achievement in 18 countries. The model used in the empirical analysis is a three level Multilevel Model with random effects (evaluated using the R-Statistics software) that aims at evaluating the interaction effect between a particular school level variable (the time used by the head-teacher in managerial or leadership activities) and the explanatory variables describing school and student characteristics. What the study shows is that head-teacher specialization (either in management or in leadership) has negligible direct effect on student achievement. Most of all, however, head-teacher specialization is correlated to a lower impact of family SES on student achievement. Moreover, by investigating the impact of school management and school leadership on student achievement on students with different family background in terms of education, it is apparent that the high concentrations of school leadership are especially valuable for students of lower SES. On the other hand, the high concentrations of school management are most valuable for the students of higher SES.
Keywords: *secondary analysis, educational policies, school leadership, school management, multilevel modeling*

Introduction

Leadership, and especially head-teachers' leadership, has been object of study since the late '60s, but the concept of leadership is neither unanimously defined, nor a consensus has been yet reached on its actual role and actual relevance within the school environment (Fullan, 2001; Sergiovanni, 2001; Harris, 2005). Good leadership can certainly contribute to school improvement by abetting the motivation, participation, and coordination of the teachers; recent studies have widened the range of action of school leadership research to the various organizational levels: school managers, department heads, coordinators, teachers (Goldhaber, 2002; Harris, 2004), and distributed leadership that could yield a higher impact on student

achievement than what yet shown (Spillane et al., 2001, 2004). This article takes its moves within the strand of research that identifies a significant role of leadership for student achievement (e.g. Edmonds, 1979; Cheng, 2002; Marzano, 2003) and presents the results of the Pilot Project "The role of school leadership on student achievement" that was developed within the framework of CRELL, the Centre for Research on Lifelong Learning of the European Commission.[1] The project tried to understand whether there are patterns of behavior of head-teachers that yield better results than others with respect to facilitating the student learning process and whether such patterns are consistent or replicable across countries.

After a review of the existing literature, the article presents in detail the methodology and the results of the project, the last part of the manuscript is dedicated to the discussion of the results and to the suggestions for further research and for policy makers.

Methodology

The concept of School Leadership

Research on school leadership and school management is gaining momentum with the increasing awareness that – within the school environment – the head-teachers are the actors in charge of translating policies into everyday practice. In particular, The Conclusions of the Council on efficiency and equity in education and training (2006/C 298/03) recognize that "the quality of school leadership … [is one of the] key factors in achieving high quality learning outcomes."

Yet, academic research has long debated – and is still debating – about the relative role of school and family characteristics as determinants of student achievement.

Effective leadership is accepted by many as a central component in implementing and sustaining school improvement. Evidence from school improvement literature, starting with seminal studies in the United States (Brookover *et al.*, 1979; Edmonds, 1982) and the United Kingdom (Mortimore, 2000; Rutter *et al.*, 1979; Southworth, 1995), highlights that effective leaders exercise a direct or indirect but powerful influence on the school's capacity to implement reforms and improve students' levels of achievement. Bolman stresses the fact that participative leadership, mediated through teacher activity, contributed effectively to student outcomes (Bolam et al., 1993). Louis refers to the same participative dimension, and he highlights how leaders of high achieving schools "worked effectively to stimulate professional discussion and to create the networks of conversation that tied faculty together around common issues of instruction and teaching" (Louis et al., 1996: 194). The issue of networking ability is raised by Leitner (1994), who points out that head-teachers in high achieving schools engage more in behavior associated with cultural linkage than

[1] http://crell.jrc.ec.europa.eu/

head-teachers in other schools. In Leitner's study, student achievement appears to be influenced by environmental and organizational characteristics and SES.

Although it is teacher performance that directly affects student performance, quality of leadership matters in determining the motivation of teachers and the quality of their teaching (Evans, 1999; Sergiovanni, 2001; Cheng, 2002). Indeed, a number of researchers points to the role of "transformational leadership" and to the head-teacher capacity to build a "shared vision". Involving the teachers in a process of "shaping" their schools will cause them to be more motivated and to teach differently; thus, this process will make a difference to the learning and motivation of students (Elmore, Peterson and McCarthey, 1996). Leithwood and Jantzi (1999) suggest that "transformational leadership" has strong direct effects on school conditions, which in turn have strong direct effects on classroom conditions. Wiley (2001) supports this claim and suggests that transformational leadership is mostly effective within a strong professional community. Moreover, the more distributed the leadership is throughout the school community, in particular to teachers, the better the performance of that school in terms of student outcomes (Silins & Mulford, 2002). The existence of distributed leadership is especially crucial in case of shocks that can leave the school without its leader. To this respect, McMahon indicates that head-teachers' departure could be followed by an unstable period of leadership detrimental to teacher cohesion and student results (McMahon, 2001).

These indications suggest that school leadership is a complex phenomenon; it influences student learning (mostly) by means of intermediate variables. Such broad conceptualization, however, entails major challenges when trying to draw substantial conclusions on the role of school leadership on student achievement. Indeed, Hallinger & Heck (1996, 1998) point out that the effects of leadership on student achievement are indirect if not difficult to measure because, despite the traditional rhetoric concerning head-teacher effects, the actual results of empirical studies in the U.S. and U.K. are not altogether consistent in size or direction. Hence, "even as a group the studies do not resolve the most important and practical issues entailed in understanding the principal's role in contributing to school effectiveness. These concern the means by which principals achieve an impact on school outcomes as well as the interplay with contextual forces that influence the exercise of school leadership" (Hallinger and Heck, 1998: 186).

In general, the critiques to the studies on school leadership effects on student learning relate to two main orders of causes. In *theoretical and conceptual terms,* we are yet far from a unique definition of leadership; which makes the concept difficult to measure. Moreover, the different studies are difficult to compare due to the existing contextual differences and to the lack of a complete understanding of what are the intermediate variables between leadership and student achievement. In *methodological terms,* problems can be identified with respect to the validation of instruments (the questionnaires used, the scarcity of contextual information collected, and the reliability of the student achievement measures). Moreover, many of the

studies – especially the earlier ones and those referred to some of the largest datasets – do not make use of the appropriate statistical techniques. Zirkel and Greenwood (1987) list is an absence of "multivariate, longitudinal studies designed to trace causation" (Zirkel and Greenwood, 1987:256), while other studies do not take adequately into account the fact that the data has a hierarchic structure (students are nested in classes that are nested in schools that are nested in regions that are nested in countries and so on) so that the characteristics of the study-units at each level of reference must be considered separately in the regression.

Witziers, Bosker, and Krüger perform a quantitative meta-analysis on 42 studies (37 for direct effect and 5 for indirect effects) examining to what extent head-teachers affect student outcomes. Their research indicates that not more than 1% of the variation in student achievement is associated with differences in educational leadership, and – in general – suggests the existence of heavy limitations to the direct effects approach to linking leadership with student achievement (Witziers, B., Bosker R. J. and Krüger M. L. 2003). In their review of 70 studies, Marzano et al. (2004) show the existence of contradictory evidences ranging from effect size for leadership and achievement as high as .50 (which translates mathematically into a one-standard-deviation difference in results) to studies in which leaders who displayed the very same leadership qualities had only a marginal--or worse, a negative--impact on student achievement (correlations as low as -.02).

Analyses using data from the Third International Mathematics and Science Study (TIMSS) in multilevel regression models suggest that although instructional leaders tailor their behaviors to their schools' environments, variations in behavior are not consistently associated with variation in instructional effectiveness as measured by instructional outcomes such as student achievement (Wiseman, 2001). The recent analysis of Miller and Rowan (2006) on two Australian databases to estimate a series of three-level growth models of student achievement at the elementary and secondary levels indicates that organic forms of management are not a particularly powerful determinant of student achievement at either of these levels of schooling. Moreover, numerous in-depth studies performed in the Netherlands fail to find a significant correlation between leadership and educational achievement (Van de Grift and Houtveen, 1999; Scheerens & Bosker, 1997, Scheerens, 2000). To add one extra little piece to the confusion on head-teacher leadership, recent research – as indicated previously – is also dealing with the issue of leadership distributed to other individuals within the school context, such as the teachers. The most recent and comprehensive review of the teacher leadership literature (York-Barr & Duke, 2004; see also Murphy, 2005) was able to locate only five empirical studies of teacher leadership effects on pupils and none reported significant positive effects.

For these reasons, recent research has often dwelled more on the role of *intermediate variables* such as school climate (Scheerens, 2000). Indeed, the problem relates to identifying exactly the relationship between the different elements intervening in the determination of student

results. Scheerens and Bosker (1997) extensive re-analysis and meta-analysis of existing studies and datasets indicates that resource-input factors have a negligible effect, school factors have a small effect, and instructional factors have an average to large effect. However, as Scheerens points out, "there is an interesting difference between the relatively small effect size for the school level variables reported in the meta-analysis and the degree of certainty and consensus on the relevance of these factors in the more qualitative research reviews."
These latter studies debate the strong emphasis on leadership, but they do not dismiss the issue. Indeed, it is very likely that – as previously indicated – the shallowness of results were due to theoretical and conceptual problems existing in the definition of leadership, together with the methodological issues related to the adequate models of analysis and the availability of data.

Taking a step forward

The pilot project takes a step forward with respect to the previous studies and attempts to quantify also the indirect impact of school leadership on student achievement.
To address this question, the study uses the TIMSS2003 and investigates the relationship between head-teacher time allocation and school characteristics, student background, and student achievement in 18 countries. The model used in the empirical analysis is a three level Multilevel Model with random effects (evaluated using the R-Statistics software) that aims at evaluating the interaction effect between a particular school level variable (the time used by the head-teacher in managerial or leadership activities) and the explanatory variables describing school and student characteristics.
The TIMSS School Questionnaire, on the other hand, provides some items that are better fit to investigate the issue. Some researchers have already used these variables (i.e. Wiseman, 2001; Suskavcevic and Blake, 2001); nonetheless, some studies – such the one by Suskavcevic and Blake – are limited to the US sample, and all of them limit the investigation to the direct relationship between school leadership and student achievement.

1.1. the variables of interest: Management or Leadership?

For the aims of this study, the first crucial step regarded the distinction of head-teacher actions between "leadership" and "management" activities. Although the terms "leadership" and "management" are often used interchangeably, "management" could be better conceptualized as the "executive function" of educational leadership, whose primary task is to develop strategies for achieving the school's core targets, including the desired student results (Card & Krüger, 1998). In this sense, "an educational leader then is someone whose actions (both in relation to administrative and educational tasks) are intentionally geared to influencing the school's primary processes and, therefore, ultimately students' achievement levels" (Witziers, Bosker and Krüger, 2003). Their activities are necessarily conditioned by the legal framework in which they operate and by the contextual conditions (student intake, labor market

conditions, resources, staff…) of the area where the school is located, but they focus on making the best of the existing situation and consequently favor the student educational development. Accordingly, one possible distinction between leadership and management could be empirical and use the *relative weight of the head-teacher's administrative and educational tasks* as a means for determining the more-managerial or more-educational leadership style.

Following this approach, the variables of interest in the TIMSS indicate the % of time spent by head-teacher on instructional issues (aggregated in the variable Lead – Leadership – and encompassing teaching, supervising teachers, and instructional leadership, i.e. giving demonstration lessons, discussing educational objectives with teachers, initiating curriculum revision and/or planning, training teachers, and providing professional development activities), and the % of time spent on non-instructional issues (aggregated in the variable "Mana" – Management – and encompassing internal administrative tasks, representing the school in the community, representing the school in official meetings, talking with parents, counseling and disciplining students, and responding to education officials' requests).
The variables Mana and Lead add to 100% of the head-teacher time and are a crucial component of the analytic model described later in the text. In fact, a dichotomous version of the variable Mana is used to identify the cases in which the management activities are prevalent, and the variables are also to study the model behavior with respect to changes in head-teacher specialization in management or leadership.
As it could be expected, no consistent pattern emerges yet among the different average behavior of head-teachers in the different countries. After the considerations of the previous chapters, this result could be expected as the variables that determine head-teachers' time allocation are too many and too different for allowing any macro-level consideration. However, looking more in depth at how the "leadership" and the "management" categories are built, we can see that in all countries individual schools act very differently so that the average levels at country levels end up telling only a very small portion of the story. In most countries, both management and leadership range form 0% to 100% of the head-teacher time with large standard deviations.

1.2. Head-teacher – student interaction, the theoretical model of reference

In the afore-presented conception, head-teachers intervene on the "malleable factors" at their reach to make the best of the school environment. To do so, they focus on the administrative (Mana) and/or educational (Lead) tasks depending on their ability and on the existing contextual constraints.
The problem is of course to understand *how and if* the head-teacher actions make a visible difference above and beyond the impact of the contextual conditions. The theoretical model used, which is based on Scheerens' model of school effectiveness (2000), consideres

explicitly the role of the head-teacher (Figure 1). In this representation, head-teachers actions (either Mana or Lead) are influenced by the specific context in which they operate. In turn, their actions can either:

1. Influence students directly (direct teaching, mentoring…),
2. or impact on a range of different policies and situations inside or outside the school (refer to ch.1 for the models of interaction between system agents, and see the previous chapter for a taxonomy of existing models of leadership and management)

In this second case, the head-teacher's impact on student outputs is mediated by other agents and cannot be directly measured. The other agents respond to the head-teacher solicitations and modify their behavior, which affects directly student outputs; the same pattern holds for the head-teacher intervention on resources and background situations.

Head-teachers perceive the results of their interactions with students, system agents, and background conditions and use this feedback to further modify their actions.

[Take in Figure 1 about here]

On the basis of this approach, the assessment of head-teacher's influence on student outputs depends both on the direct and the indirect effects. Hence, the study will investigate both instances.

In particular, addressing the indirect-effects-issue implies answering the question: "*Do the head-teacher actions make a difference?*" As anticipated, this dimension cannot be measured directly, but we can consider that head-teachers focus on Management or Leadership activities as they consider best for incrementing school quality. Hence, the time they spend on Mana or Lead can be interpreted as a mediating variable between the measured dimensions (context, school, class and individual characteristics) and student results. The differential impact of these characteristics when the head-teacher focuses on Management or Leadership, minus the impact of the head-teacher direct effect, allows us to gauge whether head-teacher actions make a difference at all, whether any of the two strategies (management or leadership) yields more substantial differences, and – eventually – the magnitude of this difference.

1.3. The dataset for the analysis[2]

Although it was not built for this purpose, the TIMMS 2003 project is one of the few databases that can be used to measure school leadership characteristics in terms of head-teacher time allocation and the role of school leadership on student achievement. With respect to Europe, the database provides data on 14 countries (Belgium - Flemish Community, Bulgaria, Cyprus, England, Estonia, Hungary, Italy, Latvia, Lithuania, Netherlands, Romania, Scotland,

[2] This section makes extensive use of the information available in the TIMSS 2003 User Guide, http://timss.bc.edu/timss2003i/

Slovenia, and Sweden). Analyses have been carried out to investigate the models of school leadership in use in these countries and the relationship between school leadership and student achievement. To inscribe the European situation in the world scenario, the same analyses were also performed on Australia, Japan, Norway and the United States of America.

The TIMSS 2003 international database contains student achievement data in mathematics and science as well as student, teacher, school, and curricular background data for the 48 countries that participated in TIMSS 2003 at the eighth grade and 26 countries that participated in TIMSS 2003 at the fourth grade. The database includes data from over 360,000 students, about 25,000 teachers, about 12,000 school head-teachers, and the National Research Coordinators of each country.

The TIMSS 2003 data files reflect the result of an extensive series of data management and quality control steps taken to ensure the international comparability, quality, accuracy, and general utility of the database in order to provide a strong foundation for secondary analyses. They contain responses to background questionnaires administered to students, their teachers, and the head-teachers of their schools. As part of the international data files, variables derived for reporting in the international reports are also included. The database also contains student achievement data and scoring reliability data, as well as the responses to national curriculum questionnaires provided by the National Research Coordinators.

In the present study, student, teacher and school background questionnaires were collected linking their information by means of class and school identification codes. The information about student achievement was then connected to the other information building a full comprehensive archive.

1.4. The Model

The hierarchical structure, considered in the present work, is a three level structure having the individuals grouped in the school structures and the schools grouped in the countries. Given that the interest lays mostly the analysis of European states, the third level macro units are a sample of the collected data, which are a sample of the country schools. In other words, we are considering a subset of the available data, which is a sample of the population of schools. Moreover, the number of individuals belonging to the schools varies between 1 and 88 and the average size of the groups is 27.37. Finally, the total number of schools considered in our study is 1901 clustered in 18 countries. The large number of second level groups implies the necessity of parsimonious model specification such as the random coefficients one.

The model used in the empirical analysis presents a peculiar formulation which aim is to evaluate the interaction effect between a particular school level variable (the prevalence of management in head-teacher activities) and the student level variable summarizing the schooling level of the family members. The management prevalence dummy variable (defined as $I_{(Mana>60\%)}$) produce a classification of the observed values. The model specification reflects

this classification. In fact, the fixed component of the model is defined by separated equations for the two data clusters:

$$SCORE_{ijk} = \begin{cases} \alpha_0 + \beta_0 x_{ijk} + \gamma_0 z_{jk} + \theta_k + \delta_{jk} + \varepsilon_{ijk} \text{ for } Mana > 60\% \\ \alpha_1 + \beta_1 x_{ijk} + \gamma_1 z_{jk} + \theta_k + \delta_{jk} + \varepsilon_{ijk} \text{ otherwise} \end{cases} \quad (3)$$

The stochastic part of the model is otherwise invariant to the classification. The three error components are considered independently distributed with zero mean. The estimation process requires an ulterior assumption: the normality. Under this assumption the estimation can be based the maximization of the likelihood (or log-likelihood) function. The ML approach supplies the researcher with estimates of the coefficient of the deterministic part of the model ($\{\alpha_0, \beta_0, \gamma_0, \alpha_1, \beta_1, \gamma_1\}$) and of the error components variances ($\{\sigma^2, \tau^2, \varphi^2\}$).

The model specification is than completed considering a particular variance structure, which is supposed to depend on the "TOTWGT" covariate. The software used for the model estimation is R-Statistics and in particular the Linear Mixed Model estimation library "nlme". The adopted computational methods are described in Bates, D.M. and Pinheiro (1998) and follow on the general framework of Lindstrom, M.J. and Bates, D.M. (1988).

The analyses reported in this work make use of a sub-sample of 21 variables, for 52.036 students observed in 1901 schools clustered in 18 different states. This sample is taken from the 8th grade TIMMS dataset and is used to study the effect of a set of control variables on the student achievement in mathematics and science. The reasons for concentrating on the 8th grade data are both practical and theoretical. On the practical level, only a smaller set of European countries were available in the 4th grade database, and this limitation would have limited the scope of a project that is referred to the whole European Union. Second, in the case of the indirect effects, the ratio is that the head-teacher can create conditions that the students can ultimately profit more for their learning. This conception implies – at least partially – an active role of the student that is aware of the background conditions and is responsive to an entire set of solicitations coming from different sources. Such awareness could be more easily expected from student of about 13 years of age than from their much younger peer of about 9 years old.

Apart of the response variables "Math" and "Science" scores, the analysis involved a set of explanatory variables, 7 of these are student-level characteristics and 14 are school specific characteristics. The analysis did not consider any country specific variable, and the variable selection process adopted in the model specification is based on a backward search.

The model was estimated separately for Math and Science scores; moreover, it was first run on the subgroup of European Union member countries (Belgium - Flemish Community, Bulgaria, Cyprus, England, Estonia, Hungary, Italy, Latvia, Lithuania, Netherlands, Romania,

Scotland, Slovenia, Sweden), then on the group of non-EU countries considered (Australia, Japan, Norway and the United States of America), and then on the entire dataset of the 18 countries.

The models for Math and science are partially different. The variables used in each model are reported in the table below. Hereinafter, for the sake of space, the results will refer only to the analysis of the model for Math; still, the results of the model for Science go in the exact same direction.

[Take in Table 1 about here]

Although the mix of significant variables would likely be different in each country, the same set was also used when replicating the analysis on a country by country basis; the decision was taken to allow for a direct comparison of the results.

Statistical significance for all statistical analyses was set at .05. The three level random effect model used for the analysis does not provide us with any R-Squared measure for gauging the amount of variance explained. However, as indicated by Snijders, we can approximate this figure by looking at the total variance of the basic linear model (Var_0) and the total variance for the multilevel model (Var_x). With these values, the percentage of variance explained by the model can be calculated as follows: (Var_0 - Var_x)/(Var_0).

[Take in Table 2 about here]

The models appear to be extremely convincing, as they generally explain more than 50% of the variance for both subjects. The tables below show specifically the significant variables in the 6 models side-by-side.

Finding and Discussion

The first point to highlight regards the extremely high impact of student SES and family characteristics in all the models. Indeed, this effect is consistent with the literature (Coleman, 1966; Voelkl, 1995; Crane, 1991; Ensminger & Slusarcick, 1992; Rumberger, 1995; Janosz et al., 1997; Raudenbush & Kasim, 1998; Johnson, Crosnoe, & Elder, 2001), and in all the models the highest level of parental education appears to be the most influential factor; the main difference between EU and non-EU countries is the existence of a threshold at ISCED3 for the non-EU countries. In fact, in Europe any level of parent attainment above primary school is related to better student outcomes,[3] while in the non-EU countries under analysis the differences become relevant only if parents have attained at least middle school. The

[3] The same effect is visible in the comprehensive models as the EU countries outnumber the non-EU countries.

possessions in the house – a proxy for the family SES – are relevant, and not having a calculator or a computer accounts for a lower performance of at least 10 points in all the models. Similarly, the possession of a larger amount of books is associated with better results, with effects ranging between 7 and 9 points. In EU countries, children older than their peers perform worse; while this is not the case in the other countries under exam (age is irrelevant in Math). The reason of this effect could be linked to the fact that TIMSS is a grade-based examination, and the school cycles in Europe are more fixed than those of the other countries under analysis, so that older children are likely to be students who have not achieved passing marks during the previous year. Girls perform slightly better than boys in Europe, while the opposite is true for the non-European countries. European students in comprehensive schools perform slightly better than their peers; for non-EU countries the difference is non relevant. The size of the community has only little impact; the students in cities of 500.000 or more perform 1-2 points better than their peers in Europe and in non-EU countries. Student absenteeism has a negative effect on student results; while more parental support to the study and the parental involvement in school activities lead to better results. The language spoken at home is irrelevant.

With respect to the school level and consistently with the literature (e.g. Scheerens, 2000, 2005), a positive school climate appears to be the most influential variable on student achievement. The teacher understanding of school goals and the years of presence of the head-teacher in the school have a positive effect in Europe, but no effect in the other countries. The negligible impact of the head-teacher actions on student achievement is consistent with and further confirms the large body of literature presented through the text (e.g. Scheerens and Bosker, 1997; Hallinger and Heck, 1998).

Regardless of these negligible direct effects, the Leadership and Management variables appear to have *strong and significant indirect effects.* Indeed, recalling equation (1), the model used in the empirical analysis presents a peculiar formulation whose aim is to evaluate the interaction effect between the prevalence of management in head-teacher activities and the other explanatory variables.

The subsequent analytic step investigated whether the explanatory variables behaved any differently in the two parts of the model, and whether these differences were significant. Of course, 60% time in Management activities is only one very specific strategy; hence, the model was replicated to test the differences for a wider range of strategies (20 to 80%). Accordingly to how the variables have been constructed, the sum of management and leadership activities covers the entire span of the head-teacher available time; i.e. saying: "At least 50% time on Management activities" is equivalent to saying: "No more than 50% time in Leadership activities" and so forth.

The results suggest that, although head-teacher actions have generally a small impact on the role of the majority of individual and school variables, the head-teacher actions have an

extremely high impact on the role of "highest level of parental education" on student outcomes.

Figure 2 shows the results for the European countries. What is striking in this case is that *head-teacher specialization in either management or leadership reduces substantially the impact of parental education on student outcomes.* As shown earlier, the highest level of parental education – a very strong proxy of the family SES – is the most influential factor for the determination of student results, and this result is true in for all the combinations of Management and Leadership. The literature discussed through the text confirms this result (Bielby, 1981; Jencks et al., 1979; Reynolds et al. 1992; Sewell & Hauser, 1975; White, 1982; Heckman 2000); in fact, the family SES summarizes a vast range of characteristics ranging from availability of material and intellectual resources, to choice of school and area of dwelling. Still, the magnitude by which its importance is reduced tells us that, by specializing in the activities that are most appropriate to the specific situation, the head-teacher can modify the existing situation and create conditions that support the students in their learning process. The specific elements vary greatly (school climate and teacher understanding of school goals are the most relevant throughout), but altogether the school is responsive to the different managerial strategies so that – in the end - it does make a difference. In sum "education *can* compensate for society".

[Take in Figure 2 about here]

Moreover, if we split the impact of the head-teacher activities by level of student's highest level of parental education, we can see how 70% time spent on leadership activities is especially beneficial to students of lower level of parental education (thus, likely, lower SES), 70% time spent on management is especially beneficial to students of higher level of parental education (Figure 3, 4). The effect is consistent also for the other levels of specialization, although the differences are a little less accentuated. This effect suggests that head-teachers highly concerned with educational issues obtain relevant results in terms of *equity* and create environments with characteristics supportive for the low achievers. On the other hand, head-teachers with a strong managerial focus create resource-rich environments that are best profited by the students of higher SES. In this sense, the focus on management could be related to *excellence.*

[Take in Figure 3 about here]

[Take in Figure 4 about here]

Although the mayor impact of head-teacher strategies is confirmed, in the analysis of non-EU countries the picture comes out somewhat different (figure 5). In this case, in fact, the positive results in reducing the impact of family SES are only associated to a specialization in

management. A specialization in Leadership, on the other hand, enhances the relevance of family SES for the determination of student results. Further research is required to understand whether this phenomenon is more general, but a first possible consideration regards the structure of the educational systems under investigation. The educational systems investigated in Europe (ranging from the very centralized cases of Italy and Cyprus to the extremely decentralized case of the Netherlands and Belgium) obey to different logics. In some cases, the head-teachers have a variety of responsibilities also in relation to hiring/firing staff, acquiring resources, chasing funding. In other cases their actions can only regard the educational sphere. Thus, head-teachers must be malleable and play the system with the tools that they have in hands – whether they are administrative or educational. Once we include in the analysis the non-EU countries, on the other hand, there is a prevalence of Anglo-Saxon and decentralized systems where the head-teacher is often the real manager of the institution. In this case a too-heavy-involvement of the head-teachers in educational activities could be considered as a form of "micro-management" that goes to detriment of their ability to govern the school effectively.

Conclusion and Implications

"*Do head-teachers make a difference?*" This study trying to shade some further light on this long-debated question by looking at subset of 18 countries in the TIMSS 2003 8th grade dataset and investigating whether the head-teacher's specialization in administrative or educational tasks (management or leadership) has an influence on student outputs, both in terms of direct and indirect effects.

The key-variables of interest considered in the analysis indicate the % of time spent by head-teachers on instructional issues (teaching, supervising teachers, and instructional leadership – i.e. giving demonstration lessons, discussing educational objectives with teachers, initiating curriculum revision and/or planning, training teachers, and providing professional development activities), and the % of time spent on non-instructional issues (internal administrative tasks, representing the school in the community, representing the school in official meetings, talking with parents, counseling and disciplining students, and responding to education officials' requests). For the purposes of the research, these variables were aggregated in the two derived variables Management and Leadership that indicate the total amount of time spent by the head-teacher in non-instructional (Mana) and instructional (Lead) activities.

These notes on the construction of the variables also indicate the first limitation of the study; in fact, a self reported measure of the % time used in a range of activities does not give any indication on the *outputs* of those tasks. It is impossible to discern whether larger amounts of time spent in one activity instead of another were the result of specific choice or simply of the individual head-teacher's inability to carry out the task effectively.

Maybe due to this limitation, the head-teacher's focus on Management activities (60% time or more) does not have a statistically significant impact on student achievement. This result is consistent with the large body of literature presented through the text (e.g. Scheerens and Bosker, 1997; Hallinger and Heck, 1998) and could be partly due to the definition of the variable, but – most likely – it depends on the fact that:

1. the head-teacher effects on student outputs are mostly indirect;
2. the range of actions that head-teachers can implement is necessarily limited by the institutional set-up of the system (macro level) and by the environmental conditions of the school (micro level).

In terms of point 1., the subsequent step of the investigation built a three-level multilevel model for evaluating *whether the focus of head-teacher's actions makes a significant different in the behavior of the other variables.* If so, what are the variables that are mostly affected, and what is the magnitude of this difference.

The model is stable and explains above 90% of the variance among student results. However, this result must be considered only an indicative figure, obtained by considering the estimated variance as the difference between the total variance and the variance of the residuals. This naïve procedure been used because the model does not provide any R-squared measure.

The model shows a *strong link between the head-teacher's actions and how much student achievement depends from the maximum level of parental education.*

Moreover, in the case of EU27 countries, the model indicate that a strong focus on leadership activities is especially beneficial to students of lower level of parental education (thus, likely, lower SES), while the head-teacher specialization on management is especially beneficial to students of higher level of parental education. One possible explanation of these effects is that the attentiveness to the leadership process implies a deep involvement of the headteacher in activities related to the modeling and tailoring of the educational process to the needs of the students. Such process has its highest payoffs on the students who come from disadvantaged situations and need special attentions in order to fully express their potential and favor *equity*. On the other hand, the focus on the managerial side aims at rationalizing and making the best use of resources. This approach has high payoffs on students of all extractions, but is specifically relevant for the students of higher SES who are possibly already quite independent and whose performance can improve autonomously by making use of the extra resources that the management can provide. In this sense, the focus on management can be seen as a tool for favoring *excellence*.

The analysis for Non-EU countries partly confirm the result. Indeed, in this specific case, the positive results in reducing the impact of family SES are only associated to a specialization in management. A specialization in Leadership, on the other hand, enhances the relevance of family SES for the determination of student results. Further research is required to understand whether this phenomenon is more general, but a first possible consideration regards the

structure of the educational systems under investigation. The educational systems investigated in Europe (ranging from the very centralized cases of Italy and Cyprus to the extremely decentralized case of the Netherlands and Belgium) obey to different logics. In some cases, the head-teachers have a variety of responsibilities also in relation to hiring/firing staff, acquiring resources, chasing funding. In other cases their actions can only regard the educational sphere. Thus, head-teachers must be malleable and play the system with the tools that they have in hands – whether they are administrative or educational. In the non-EU countries under analysis, on the other hand, there is a prevalence of Anglo-Saxon and decentralized systems where the head-teacher is often the real manager of the institution. In this case a too-heavy-involvement of the head-teachers in educational activities could be considered as a form of "micro-management" that goes to detriment of their ability to govern the school effectively.

Of course, further research would be needed to adequately contextualize the results within the different educational systems. Indeed, the first suggestion for further research strongly points to the need of blending quantitative and qualitative research methods so to provide a more comprehensive and in-depth picture.

The second suggestion, instead, regards an issue of variables. By explicating the indirect role of the head-teacher in the manner previously described, the role of other school organizational variables (teacher collaboration, evaluation of courses, distributed leadership…) was strongly reduced. It is very likely that the problem were linked to the definition of the variables, but the existence of evidence suggesting their relatively lower importance would need further research to identify what are the areas that – in a situation of scarce resources – would need to be prioritized in terms of investments.

One school variable that proved again to be extremely relevant is school climate. However, this subject could also be further analyzed. In fact, the direction of the causal chain is unclear and the issue could be flawed by problems of endogenity – i.e. is "climate" a cause of better result, an effect, or a concurrent factor?

The last – but not least – point regards the intimate structure of the research project, which was conceived and implemented on a "one shot" database. Although "forced" to use the TIMSS 2003 database for the limitedness of alternative internationally comparable data sources, doubts still remain on the real possibility of gauging a long-term process such as school leadership on a picture taken at one very specific instant in time. Teaching and learning are activities that require years to produce results, even more so an indirect activity such as school leadership, which would mostly produce influences on teaching and learning opportunities. The results of the students tested in the TIMSS, therefore, are very likely to be dependent from the *past history* of the student rather than on the specific activity of the current head-teacher. For this reason, the availability of longitudinal, reliable, and comparable data is perceived as the only possible way out.

Nonetheless, these analyses have produces results. Of course, these evidences must be further contextualized in the legal framework and practices of each country, and the considerations carried out along these pages show that the variables that enter in the process of determining the headteacher time allocation are too many for suggesting any specific policy direction based on average country behaviors.

Still, the specialization of head-teachers in leadership or management shows significant turnouts in terms of reducing the need of the student to rely only on the family resources (family SES) for improving their performance.

In policy terms, such results suggest the need of allowing for different managerial strategies that could exploit local knowledge leads to foster the system's equity and excellence.

Moreover, the available data on school management is rather old. New insights could be derived from new data collection, and analyses related to the governance strategies adopted in terms of networking, public-private partnerships and consideration of the stakeholders.

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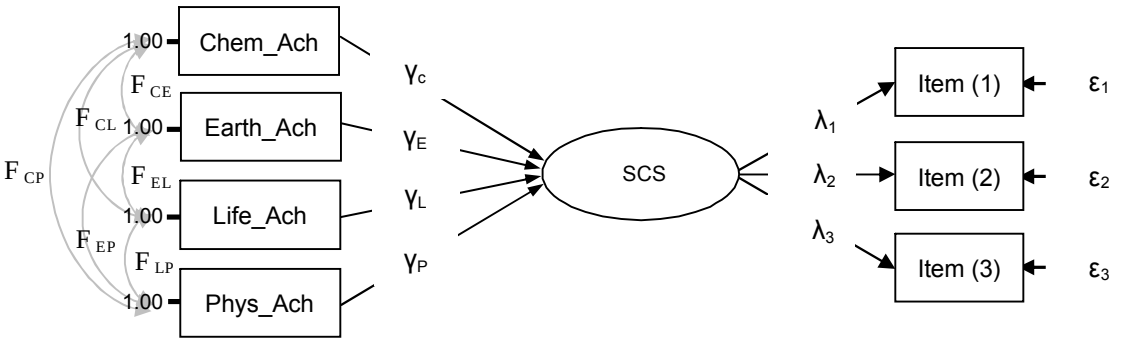

Fig.1: Structural diagram of the testing model

Table 2: Parameter estimation for full models by LISREL 8.70

Sampling - Subject	N	Model	Measurement Model						Structural Model									
			λ_1	λ_2	λ_3	ε_1	ε_2	ε_3	γ_C	γ_E	γ_L	γ_P	Φ_{CP}	Φ_{CE}	Φ_{CL}	Φ_{EL}	Φ_{EP}	Φ_{LP}
All	5772	B	.77	.83	.78	.41	.32	.40	.12	.10	.12	.12	.56	.42	.50	.44	.47	.52
HSASs	1919	A	.79	.85	.78	.37	.28	.38	.11	.01	.10	.10	.40	.20	.23	.18	.22	.22
LSASs	1937	A	.65	.80	.71	.58	.36	.49	-.05	.07	.05	-.01	.32	.22	.27	.27	.31	.35

Table 5: The effects of different science-subject achievement on self-concept in science learning

Sample-Subjects	N	Model	Science-Subject	Direct Effect	Indirect Effect Through Other Science Subject					Total Effect
					Physics	Chemistry	Life Science	Earth Science	Sum	
All	5772	B	Physics	0.12***	-	0.067	0.062	0.047	0.177	0.30
			Chemistry	0.12***	0.067	-	0.060	0.042	0.169	0.29
			Life Science	0.12***	0.062	0.060	-	0.044	0.166	0.29
			Earth Science	0.10***	0.056	0.050	0.053	-	0.160	0.26
HSASs	1919	A	Physics	0.10***	-	0.044	0.022	0.002	0.068	0.17
			Chemistry	0.11***	0.040	-	0.023	0.002	0.065	0.18
			Life Science	0.10***	0.022	0.025	-	0.002	0.049	0.15
			Earth Science	0.01	0.022	0.022	0.018	-	0.062	0.07
LSASs	1937	A	Physics	-0.01	-	-0.016	0.018	0.022	0.023	0.01
			Chemistry	-0.05	-0.003	-	0.014	0.015	0.026	-0.02

	Life Science	0.05	-0.004	-0.014	-	0.019	0.002	0.05
	Earth Science	0.07**	-0.003	-0.011	0.014	-	-0.001	0.07

***: p< .001 **: p< .01

Figure 1: Influence of head-teacher actions on student results

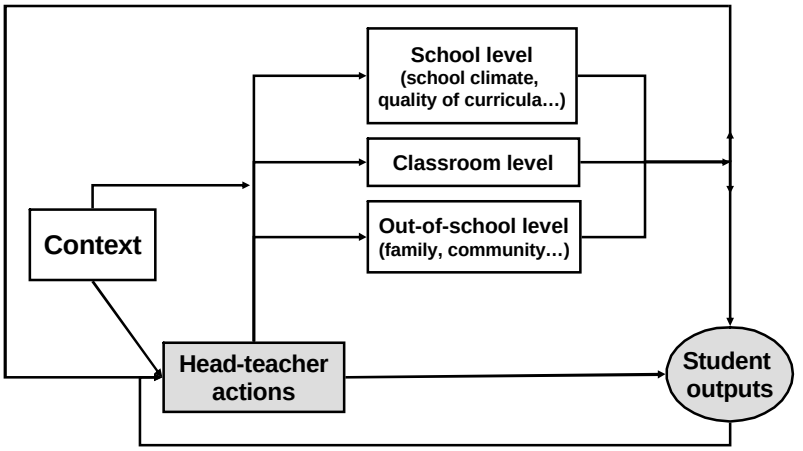

Table 1: variables entering each of the models

Model for Math	**Model for Science**
Size of the community	Sex of the Student
Age of the teacher	Head-teacher time in management>60%
Years of Experience of the teacher	Size of the community
Head-teacher time in management>60%	How often the student speaks at home the language of the test
Sex of Student	Teacher age
Number of Years Principal of the School	Evaluation of science teacher
Highest grade in the school	Sex of teacher
Level of parental collaboration	Number of Years Principal of the School
Teacher Understanding of school goals	Level of parental collaboration
Student absenteeism	Highest grade in the school
School Climate	Teacher Understanding of school goals
Presence of calculator at home	Student absenteeism
Age of student	School Climate
Presence of computer at home	Presence of calculator at home
Number of books at home	Age of student
Maximum level of parental education	Presence of computer at home
	Number of books at home
	Maximum level of parental education

Table 2: Total, Residual, and Explained variance for Math

Math	Var_0	Var_x	% Explained Var
EU27	2343.845	878.910	62.51%
Non-EU	2822.555	1390.971	50.71%
All	2416.078	1070.966	55.67%

Table 3: Significant variables, Math.

Math	EU			Non EU			Tot		
	Value	Std.Er	p	Value	Std.Er	P	Value	Std.Er	P
(Intercept)	523.743	18.70564	0	386.3136	44.9587	0	511.1803	16.66953	0
I(Mana>60)FALSE: factor(BSDGEDUP)7	300.413	11.63786	0	175.9543	29.5504	0	296.0834	9.933589	0
I(Mana>60)TRUE: factor(BSDGEDUP)7	251.995	17.71836	0	211.5556	30.4972	0	251.3913	14.84026	0
I(Mana>60)FALSE: factor(BSDGEDUP)6	246.927	9.879046	0	148.4426	27.7451	0	244.7764	8.493333	0
I(Mana>60)TRUE: factor(BSDGEDUP)6	215.446	15.61305	0	164.6597	28.2514	0	213.0897	13.14763	0
I(Mana>60)FALSE: factor(BSDGEDUP)5	202.16	9.828009	0	103.4589	27.6942	2E-04	200.0919	8.451963	0
I(Mana>60)TRUE: factor(BSDGEDUP)5	179.959	15.51887	0	116.5495	28.1532	0	175.9441	13.07275	0
I(Mana>60)FALSE: factor(BSDGEDUP)4	155.796	9.813013	0	64.2942	27.6842	0.02	154.5883	8.440147	0
I(Mana>60)TRUE: factor(BSDGEDUP)4	134.286	15.50414	0	77.4626	28.1402	0.006	131.2686	13.06162	0
I(Mana>60)FALSE: factor(BSDGEDUP)3	109.257	9.827514	0				108.3889	8.452209	0
I(Mana>60)TRUE: factor(BSDGEDUP)3	94.3956	15.5563	0				91.4718	13.10307	0
I(Mana>60)FALSE: factor(BSDGEDUP)2	72.0168	10.19432	0				70.247	8.764599	0
I(Mana>60)TRUE: factor(BSDGEDUP)2	48.4223	16.0542	0.003				44.747	13.52551	0.0009
I(Mana>60)FALSE: BSBGBOOK	6.9633	0.311368	0	7.7852	0.47034	0	6.9473	0.258937	0
I(Mana>60)TRUE: BSBGBOOK	6.937	0.486227	0	7.9214	0.60883	0	6.9966	0.395482	0
I(Mana>60)TRUE: BCBGHIGG	3.8747	0.852965	0	5.5483	1.90999	0.004	3.9824	0.783394	0
I(Mana>60)FALSE: ParenCol	3.7729	1.889017	0.046	9.7734	4.34668	0.025	4.8699	1.734616	0.005
I(Mana>60)FALSE: BCBGHIGG	2.9318	0.576141	0				2.8218	0.54048	0
I(Mana>60)TRUE: BCBGYEPS	0.4738	0.228278	0.038				0.3851	0.188283	0.041
I(Mana>60)FALSE: BCBGCOMU	-1.8573	0.518635	4E-04	-2.5966	0.94539	0.006	-1.8596	0.464269	0.0001
I(Mana>60)FALSE: factor(BTBGSEX)2	-2.2899	0.666587	6E-04	2.9229	1.06497	0.006	-1.8079	0.556555	0.0012
I(Mana>60)TRUE: factor(BTBGSEX)2	-2.7444	1.078986	0.011	4.0197	1.33768	0.003			
I(Mana>60)FALSE: BCBGASTD	-3.5672	1.71664	0.038	-7.6282	2.73684	0.006	-4.3471	1.491222	0.0036
I(Mana>60)FALSE: climaM	-5.1141	1.231455	0	-4.8993	1.82668	0.008	-5.3635	1.053157	0
I(Mana>60)FALSE: TeachUnd	-5.5718	2.114633	0.009				-4.7972	1.902201	0.0118
I(Mana>60)TRUE: BCBGASTD	-7.2604	3.039646	0.017				-6.6471	2.368062	0.0051
I(Mana>60)TRUE: BSDAGE	-10.9891	1.119829	0				-9.7171	0.937424	0
I(Mana>60)TRUE:BSBGPS02	-11.5418	1.469228	0	-16.2274	3.47857	0	-11.7266	1.256451	0
I(Mana>60)FALSE:BSBGPS02	-11.7483	0.844352	0	-9.4098	2.47662	1E-04	-11.6537	0.72779	0
I(Mana>60)FALSE: BSDAGE	-12.6182	0.746987	0				-11.7179	0.633483	0
I(Mana>60)TRUE:climaM	-13.5417	2.022903	0	-9.7764	2.49128	1E-04	-11.9923	1.653523	0
I(Mana>60)TRUE: BSBGPS01	-20.1899	3.478476	0	-11.7444	4.85245	0.016	-19.636	2.865011	0
I(Mana>60)FALSE: BSBGPS01	-23.0025	2.296922	0	-13.657	3.9669	6E-04	-22.4036	1.932125	0

Figure 2: Differential impact of highest level of parental education on student outcomes in Math for the different head-teacher behaviors, EU countries.

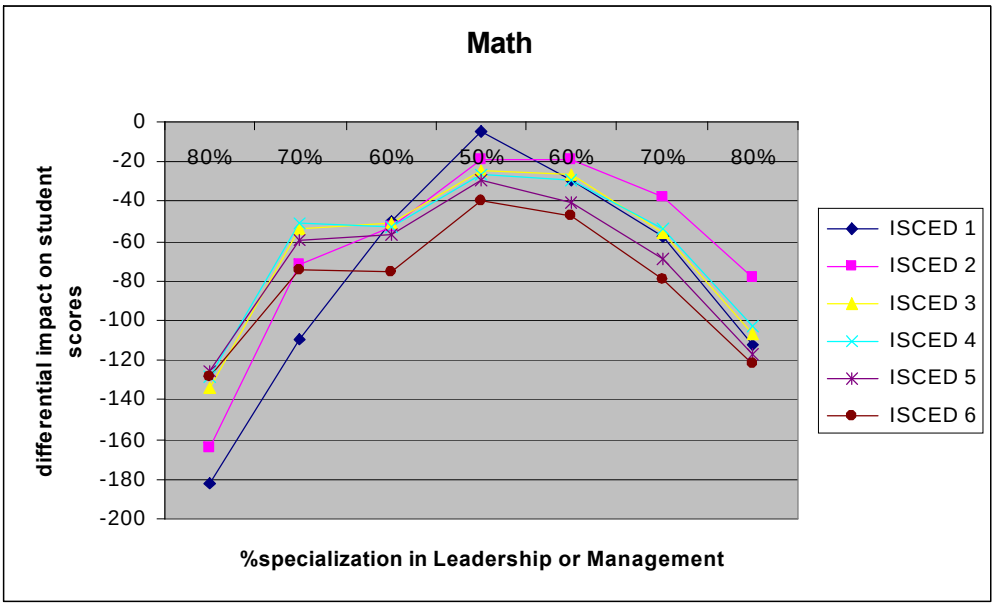

Figure 3: impact of leadership at 70% on students from different SES.

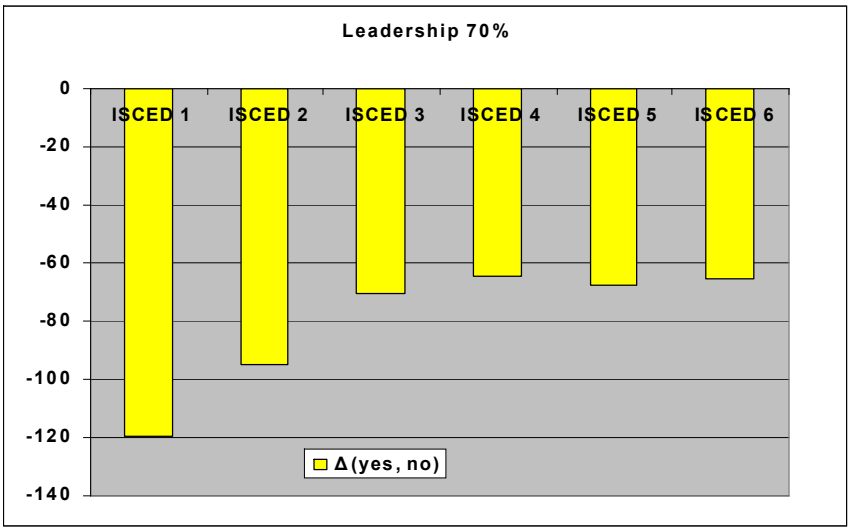

Figure 4: impact of management at 70% on students from different SES.

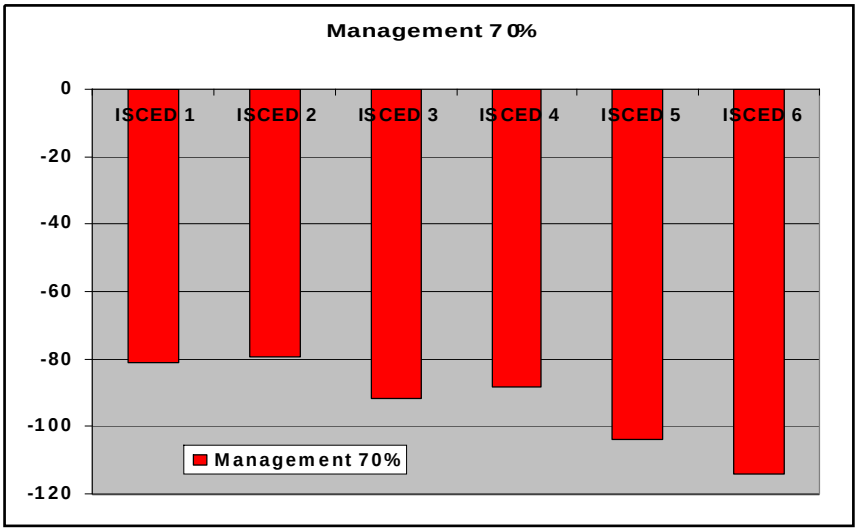

Figure 5: Differential impact of highest level of parental education on student outcomes in Math for the different head-teacher behaviors, EU and non-EU countries.