Personnel Management and School Productivity: Evidence from India

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Abstract

This paper uses two new datasets to study management and productivity in primary schools in India. We report four main sets of results. First, management quality in public schools is low on average, but there is meaningful variation across public schools that is correlated with both independent measures of teaching practice, as well as measures of student value added. Second, we find higher management scores in private schools, and this advantage is mainly driven by differences in people management (as opposed to operations management). Third, we find that the private school advantage over public schools in student value-added is largely accounted for by differences in people management practices. Fourth, we find that the private-school advantage in measures of people management is consistent with independent measures of personnel policy. Specifically, private school teacher pay is positively correlated with measures of teacher value-added, and private schools are more likely to retain teachers with higher value-addition and let go teachers with lower value-addition. Neither pattern is seen in public schools.

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1 Introduction

Despite gains in school enrolment around the world since the Millennium Development Goals, we are in the midst of a "learning crisis". Children across the world are in school but not learning, with startling statistics showing that only 30% of children in third grade are able to perform reading and math tasks at their grade level (*Annual Status of Education Report* 2016). The next challenge for education systems is to address the lack of effectiveness in schooling, and the literature has started focusing on various areas of the school system.[1] Two binding constraints that governments have to face involve pedagogy (for example, see Muralidharan et al. (2017)) and governance. In this paper, we will focus on a key aspect of governance that has gained increasing interest over the past decade: school management practices.

Although "management" has been recognized as a key tool to improve governance (Pritchett 2015), there is little evidence on the relationship between management and school productivity in terms of student and teacher value added. In this paper we present the first detailed evidence of the types of management practices used in primary schools in a developing country, and further show how these management practices correlate with measures of student and teacher value added (SVA, TVA) in a low-capacity context. We use new survey data from two projects, the Development World Management Survey (D-WMS) and the Andhra Pradesh School Choice (APSC) project. The D-WMS is a survey tool — developed in Lemos & Scur (2016) — as an extension of the Bloom & VanReenen (2007) original WMS to fit the context of surveying schools about the quality of their day-to-day management practices in low-capacity settings. The APSC project of Muralidharan & Sundararaman (2015) collected four years of rich panel data on schools, students and teachers in Andhra Pradesh. The combination of these two datasets is well suited to address the open questions of whether these management matters in low-capacity settings, across public and private school systems, and how they matter for school productivity.[2]

We report four sets of results. We start by focusing on public schools and document that public schools in Andhra Pradesh have low management quality. The median school has an overall score of 1.84 (with $\sigma = 0.25$) on a scale of 1 to 5, while the school at the 90th percentile scores 2.05, suggesting weak management practices permeate across the distribution. This stands in contrast to the cross-country evidence from OECD countries and Brazil, where even in countries where the average management is relatively low, there

[1] See, for example, www.riseprogramme.org

[2] The expanded nature of the D-WMS allows for finer measurement of the management practices used at schools in developing countries, and the detailed panel data afforded by the APSC allows us to observe student performance, teacher practices, teacher salaries, and teacher transfers.

exists a tail of well-managed schools.[3] The average public school in an OECD country ($\mu_{OECD} = 2.3$) would stand just under 2 standard deviations above the mean of the AP distribution. The average public school in Brazil ($\mu_{BR} = 1.94$) would stand just over half a standard deviation above the mean of the AP distribution. The low average index in AP is driven by the low scores in the people management part of the index. Breaking the index into two sub-indices measuring operations practices and people management practices, and we find large differences in the distribution across each dimension of management: schools have lower quality in people management practices (median of 1.25) relative to operations (median of 2.10).

Second, we present the first correlation of management and independently-collected measures of school productivity for public schools in India, including teacher practices and student value added. We find that one standard deviation better management is associated with 0.36 standards deviation better teacher practices, including making lesson plans and spending a large share of class time in teaching activities. In terms of student test scores, we find that a one standard deviation better overall management score is associated with 0.14 to 0.18 standard deviations higher student value added.

Third, we compare the public schools results with a sample of private schools in Andhra Pradesh and find that public schools in AP are significantly worse managed than private schools. This deficit is primarily driven by extremely poor people management in public schools: the average private school advantage in this area is of 0.87, a difference of over two standard deviations. We further document a quantitative decomposition of the relationship between school characteristics and student value added, for the first time considering how much of the difference can be attributed to differences in management practices. We find the inclusion of people management explains 60% of the higher test scores in private schools.

Fourth, we examine the mechanisms behind how higher personnel management scores translate into differences in personnel policy along two key margins: teacher wages and teacher selection and retention. In terms of wages, we find that one standard deviation higher TVA ($\sigma_{tva} = 0.20$) is correlated with approximately 5% higher wages in private schools, but TVA is not correlated with wages in public schools. In terms of selection and retention, we find there is a relationship between better management and better selection and retention of teachers in private schools, but not so in public schools: a one standard deviation better management in private schools suggests between 4% to 12% higher probability that the school will select and retain their best teachers as well as dismiss their worse ones. There is no statistically significant relationship in public schools.

[3] More broadly, the stylized fact referring to the poor management of government-run organizations has been established in recent research (Bloom et al. 2014, Rasul & Rogger 2015).

Our results contribute to the growing literature on the impact of governance, and specifically, management practices in education. The first contribution is to measurement. Thus far, measurement of management has been focused on secondary schools and primarily in OECD countries. Bloom et al. (2015) presents stylized facts from the first project that measured management practices in over 1,800 schools across eight countries using data from the World Management Survey. They find substantial variation in school management practices across countries and a strong correlation between management practices and student outcomes within countries. Other papers focusing on management at the school level have used superintendent fixed effects to identify management (Levy & Boiko 2017) or have focused on a small set of practices (Dobbie & Fryer 2011). Our paper focuses on management in primary schools in a developing country, and we present the first data ever collected using an enhanced survey tool that was specifically designed for low-capacity contexts (Lemos & Scur 2016).

Second, we contribute to the literature on explaining student value added in developing countries. Although previous work using Indian data has shown correlations between cross-sectional levels student achievement and management, these are subject to classic endogeneity concerns. While a number of papers have looked at determinants of student value added (Muralidharan & Sundararaman 2015, Singh 2015, Glewwe & Muralidharan 2015), none have explicitly considered the role of management practices. Using our detailed data from the APSC project, we present the first correlations between management and value added for Indian schools. Although we do not have experimental data, a review in Singh (2015) suggests that value added models are a reliable approach for the identification of treatment effects, especially if used for cross-school comparisons rather than within-school comparisons.

Third, we contribute to the literature exploring the determinants of the well-documented differences in student achievement across public and low-cost private systems. The achievement gap is documented in detail in Singh (2015), Muralidharan & Sundararaman (2015), who note that private time use (household inputs) and school time use (hours spent on each subject) explain some of the results. Our base estimates of student value added are broadly in line with these reference-setting studies. However, our paper is the first to include a direct measure of people management practices in the analysis.

Fourth, we contribute more broadly to the literature on management and the centrality of carefully designed personnel management policy as a driver of efficiency. Despite the ubiquity of performance-based compensation in non-education sectors, data on worker-level productivity is not often accessible by researchers.[4] In the education sector, however,

[4] Bender et al. (2018) shows evidence of a correlation between management practices and individual person-specific effects estimated using an AKM model. While this is a popular measure of worker-level

teacher-level performance and pay metrics are relatively more available to researchers. Our paper presents suggestive evidence that public schools are failing at the most basic set of personnel policies, such as recruitment, retention and compensation of teachers. We find that better managed private schools tend to have a higher incidence of good personnel policies along these dimensions, while we find no such relationship in public schools. In the public sector, research has found that health workers increase performance in response to career incentives (Ashraf et al. 2015), and public school teachers increase performance in response to performance pay in India (Muralidharan & Sundararaman 2011, 2013). However, public school teachers fail to increase performance in response to an unconditional doubling of salaries in Indonesia (de Ree et al. 2015), and show no response to a reduction in salaries in Pakistan (Das & Bau 2017).

Our findings suggest two broad sets of policy implications. The first is that increasing the use of efficiency-enhancing personnel policies, including greater attention to selection and retention as well as performance-related compensation could yield large increases in public organizations, particularly schools. The second is that there is scope to creatively use public-private partnerships to alleviate the constraints imposed by rigid public sector structures. For example, infusing the flexibility in personnel policy from private schools into a strictly-monitored public sector establishment (Romero et al. 2017) can be a powerful combination.

The remainder of this paper is structured as follows. Section 2 provides a brief overview of the Indian institutional system. Section 3 describes the datasets used. Section 4 presents the results and Section 6 concludes.

2 The Indian primary school institutional context

Andhra Pradesh (AP) is the fifth largest Indian state, with a population equivalent to that of South Korea (50 million). About three quarters of the population in Andhra Pradesh live in rural areas. AP is an interesting Indian state to study because it is similar to pan-Indian averages on measures of human development and per capita net state domestic product, as well as primary school enrolment, literacy, infant mortality and teacher absenteeism.[5] Public schools here mean schools that are owned and run by the government, and private schools are schools owned and run by private individuals or organizations (for profit and not for profit). In total, it is estimated that approximately 3.2 million children in AP

productivity in the labor economics literature, we are interested in the relationship between worker-level productivity and wage itself. Thus, we need non-wage measures of performance.

[5] Lemos & Scur (2012), Das et al. (2011).

attend public schools and approximately 2.1 million children attend private schools.[6] These private schools are not elite schools found in much of the developed world, but rather they are mostly low-cost schools targeted at children of poor families. Since their explosion in popularity across a number of developing countries, they have attracted much academic and media attention.[7] The Annual Status of Education Report (ASER) reports an increase of 60% in the share of children attending low-cost private schools over 7 years — an increase from about 19% in 2006 to nearly 30% in 2013.[8]

The main feature of these low-cost private schools is that they have substantially lower per-student expenditure when compared to public schools, and one of the main reasons is the striking difference in teacher pay. In our sample, the average teacher monthly salary in public schools is about 12,350 rupees, while the private school teacher salary is about 2,400 rupees.[9] This over five-fold difference is partially due to the nature of the contracts within each type of school; teachers in public schools are civil servants with relatively higher teaching qualifications and lifelong contracts, and teachers in low-cost private schools tend to be "contract teachers" with only annual renewable contracts and lower qualification requirements.[10] Incentives for teacher effort (attendance and performance) in public schools tend to be lacking, with reported teacher absence rates on average over 25% with little to no disciplinary action for offending teachers.[11]

The voluminous literature on low-cost private schools in India finds that, although these schools are targeted at the poor, the students who attend these schools tend to come from relatively less-poor households and have parents who tend to have relatively higher levels of education.[12] Cross-sectional results have found that children in low-cost private schools tend to outperform the children in public schools, but more rigorous panel analysis accounting for time-use as well as experimental evidence from a school voucher experiment suggest that private schools do not have a value added premium per se in math and local language (Telugu), but that they are able to achieve the same level of grades with lower instructional time and use the additional time to achieve higher value added in English.[13]

Most public schools are quite small, and the reason is that the government considers it

[6] 2008 data from Young Lives project.

[7] For example, media coverage: *The $1-a-week school* (August 1st 2015).

[8] Children between 6 and 14 years of age. ASER data available at `http://www.asercentre.org/`. Data cited here from the time close to the APSC survey.

[9] In fact, the average salary of a regular teacher is over four times the income per capita in Andhra Pradesh. Muralidharan & Sundararaman (2010), Das et al. (2011)

[10] Das et al. (2011), Muralidharan & Sundararaman (2013)

[11] Muralidharan & Sundararaman (2010), Kremer et al. (2005).

[12] *The Beautiful Tree: A Personal Journey into How the World's Poorest People are Educating Themselves* (2009), Muralidharan & Sundararaman (2015), Muralidharan & Kremer (2008), Vennam et al. (2014)

[13] Panel analysis using Young Lives data in Singh (2015), and experimental evidence from Muralidharan & Sundararaman (2015).

a priority to provide children with access to primary schooling within one kilometer from their homes. Public schools in Andhra Pradesh in our sample have on average 65 students and about 3 teachers. Public schools are substantially larger with a over 200 students on average and about 14 teachers. Primary schools cover grades one through five, and classes are not usually separated by subject at the primary school level. In public schools, it is usually one teacher who teaches all subjects within a grade though that is not the case in private schools, where teachers teach their own specialty. Finally, there is a 'no detention' policy in place in the state, where grade promotion is automatic and students advance through school mostly based on age rather than learning outcomes. We describe the summary statistics for our sample of schools in the next section.

3 Data

3.1 Measuring management: the Development WMS (D-WMS)

The original WMS project started in 2002 and since then has collected over 30,000 data points on quality of management practices in establishments in the manufacturing, retail, education and healthcare sectors across 35 countries.[14] Over the years it has become clear that developing countries tend to be at the lower end of the rankings, and schools in particular had distributions significantly skewed towards the bottom tail.[15] To better capture valuable variation in this thick bottom tail, we use an enhanced tool developed in Lemos & Scur (2016) which builds on the original grid while maintaining backwards-comparability: the "Development WMS" expands the survey "horizontally" to allow for greater variation of scores including half-points, and "vertically" by disentangling three main processes of management being measured in each of the 20 management topics, creating a total of 60 topics to be explored.[16]

The expanded survey instrument measures the level of formality of management practices on a scale of 1 to 5, in increments of 0.5. Generally speaking a score of 1 means there are no managerial processes in place at all pertaining to the topic being measured. A score of 3 suggests there is a formal process, though with some flaws. A score of 5 means the school has implemented "best practice" processes. For example, one of the topics measures whether the school measures key school and student outcomes and uses this information appropriately. The principals are asked open-ended questions such as "What kind of key

[14] For a recent review, see Bloom et al. (2014)

[15] Bloom et al. (2015)

[16] The three main management processes are: process implementation, process usage and process monitoring.

performance indicators do you use to keep track of how well the school and the students are doing?" They are also asked about how often these indicators are measured and who gets to see the tracking of these measures in the school. Higher scores are awarded to principals who are knowledgeable about the type of indicators that would be relevant in their school and context; who ensure the indicators are collected regularly and often enough to be useful; and who share the information widely with teachers and the school community. A score of between 1 and 5 is given to each of three sub-topics in each of the 20 management topics surveyed, and then averaged to represent the score for each management topic. We build an average management index by standardizing each of the 20 questions, taking the average and then standardizing the resulting average. We include a thorough description of the survey tool in Appendix C.

Broadly, we measure two areas of management: operations management and people management. In operations management, we measure the following practices: (a) *standardization of instructional planning processes*: measures whether school uses meaningful processes that allow pupils to learn over time; (b) *personalization of instruction and learning*: measures whether the school incorporates teaching methods that ensure all students can master the learning objectives; (c) *data-driven planning and transitions*: measures whether the school uses assessment and easily available data to verify learning outcomes at critical stages; (d) *adopting educational best practices*: measures whether the school incorporates and shares teaching best practices and strategies across classrooms; (e) *continuous improvement*: measures whether the school implements processes towards continuous improvement and encourages lessons to be captured and documented; (f) *performance tracking*: measures whether school performance is regularly tracked with useful metrics; (g) *performance review*: measures whether school performance is discussed with appropriate content; (h) *performance dialogue*: measures whether school performance is discussed with appropriate content; (i) *consequence management*: measures whether there are mechanisms to follow-up on performance issues; (j) *target balance*: measures whether the school targets cover a sufficiently broad set of goals at the school, department and student levels; (k) *target interconnection*: measures whether the school established well-aligned targets across all levels; (l) *time horizon*: measures whether there is a rational approach to planning and setting targets; (m) *target stretch*: measures whether the school sets targets with the appropriate level of difficulty; (n) *clarity and comparability of targets*: measures whether the school sets understandable targets and openly communicates and compares school, department and individual performance.

In people management, we measure the following practices: (a) *rewarding high performers*: measures whether the school implements a systematic approach to identifying good and bad performance; (b) *fixing poor performance*: measures whether the school deals with under-

performers promptly – not necessarily firing teachers, but ensuring underperformance is acknowledged and addressed appropriately; (c) *promoting high performers*: measures whether the school promotes employees based on job performance rather than simply tenure; (d) *managing talent*: measures whether the school nurtures and develops teaching and leadership talent; (e) *retaining talent*: measures whether the school attempts to retain teachers with high performance; (f) *creating a distinctive employee value proposition*: measures whether the school has a thought-out approach to attract the best employees.

The D-WMS data was collected for a random sample of schools in the APSC project sample within five districts from January to May 2013 through face-to-face interviews with school principals. Each interview lasted approximately 1.5 hours and was carried out by two enumerators – a primary interviewer and secondary note-taker – who immediately after the interview reviewed the notes and scored the practices according to the scoring manual. The enumerators passed a one-week intensive training session with the D-WMS team and reported to the APSC project partners in AP with the data they collected.

3.2 School, teacher and student data: the APSC dataset

The main student-teacher-school data from the APSC project is explained in detail in Muralidharan & Sundararaman (2015), and spans the 4 years of the project in AP (2008/09-2011/12). We rely on the panel data characteristic of the APSC data and proxy student learning by student test scores across years. We use the subject-specific test scores from tests administered by the APSC project team for Telugu and Math for the main specifications in this paper, and include English test scores in the Appendix. We only use Math and Telugu because they are the two subjects taught across all public and private schools. We also include student characteristics as controls in our specifications, namely the student test score from the previous year as well as the student's gender, caste, religion, whether parents are labourers and whether parents are literate. This data was collected through the student questionnaires and tests. A detailed description of the data construction is provided in Appendix A, and we summarize the key points below.

3.2.1 Teacher value added

Value-added models (VAMs) of student achievement have increased in popularity in the past decades. The aim of this paper is not to contribute directly to the discussion of measurement of teacher value added and its merits as a proxy for teacher quality, but rather to understand how better school management practices are related to current available measures of teacher value added as a proxy for labour productivity in the education sector. Guarino et al.

(2014) test six common approaches to measuring teacher value added and conclude that the Dynamic OLS (DOLS) method is best among the six studied methods, with the Average Residual (AR) method also performing well.[17] The DOLS model is expected to control for a student's ability and previous inputs through the lagged test score, but teacher effects are assumed to be constant over time.[18] In a more recent paper, Chetty et al. (2014) expand the model by allowing teacher quality to vary across time. Using data from a large urban school district in the US, they show that "value-added models that control for a student's prior-year test scores provide unbiased forecasts of teachers' causal impacts on student achievement."[19]

For the analysis in the paper we use 4 years of student and teacher data from the APSC project and estimate teacher value added (TVA) using the Chetty et al. (2014) method. We also use the DOLS and AR methods as robustness checks and present them in Appendix A.2, along with a more thorough description of the measure estimation procedure.

3.2.2 Teacher practices

To construct the teacher practices index we use the data from questionnaires that were administered by enumerators to all teachers in the schools. These questionnaires were administered independently of the student tests and the management survey, using a combination of self-reporting by the teachers and classroom observation by the enumerators. There were over 20 practices measured by the APSC teacher survey. We analyzed the relationship between each practice and student value added to identify which practices seemed relevant. We present a detailed description of the relationship between each practice and student value added to Appendix A.1.[20] There were six practices in particular that showed

[17] They test the ability of the following models to assess teacher quality by simulating a dataset of a hypothetical school system: (a) Dynamic OLS (DOLS); (b) Arellano and Bond Approach; (c) Pooled OLS on the gain score; (d) Average Residual (AR) approach; (e) Fixed Effects on the gain score; (f) Empirical Bayes and related estimators. They carefully describe the assumptions implied in each method, and how they could be violated in practice. They suggest that if we consider that violations of the assumptions will invariably happen given the "real world" data generating mechanisms, which estimator performs best becomes an empirical question. Singh (2015) uses the DOLS method in his context using the Young Lives dataset also from Andhra Pradesh.

[18] DOLS is also computationally challenging to estimate and not as efficient as methods such as the Empirical Bayes methods used by Kane & Staiger (2008), Chetty et al. (2014).

[19] This model was subsequently used in replication exercises by Rothstein (2014) using data from North Carolina and Kane et al. (2014) using data from Los Angeles. Although Rothstein (2014) argues that there are issues with the methodology, Chetty et al. post responses and further analysis to refute the claims. Raj Chetty's website for this project, http://www.rajchetty.com/chettyfiles/value_added.htm, has all the working papers and responses.

[20] We experimented with a large number of practices that could be drawn out of the APSC survey data, for example, homework frequency and whether the teacher interacted with the students' parents, and we found many to not be correlated with student outcomes. Considering that our key question here is whether teacher practices that are correlated with student learning are also correlated with management, rather

a correlation with student value added in either the public or private sector. We describe each teacher practice and how it is coded below:

(i) Do you prepare a lesson plan before teaching?

(ii) Do you have a copy of the textbook? Do you have a copy of the workbook? (having both = 1)

(iii) How often are the children observed for health/hygiene related habits? (daily=1)

(iv) How much time do you spend in a typical day on each of the following activities? Teaching activity; preparing for classes; correcting homework; maintaining order and discipline; administrative/paper work; breaks during school; getting children to attend school; mid-day meals; extra classes; others. The first variable I use from this set of questions is the amount of time dedicated to teaching divided by the total time reported by the teacher.

(v) I also define a variable as "time on-task": the sum of teaching, preparing for classes, correcting homework and extra classes, and divide this sum by the total time reported.

(vi) Do you get time to provide remedial teaching to the students? The questionnaire also includes questions regarding the shape that the remedial attention takes: taking extra class; paying extra attention in the class itself; paying extra attention outside the class; help children by arranging private tuition; helping children in studies at home; other. If the teacher gives remedial attention, I calculate the average amount of extra time allocated to extra attention in class and assign a value of 1 if the teacher dedicates *above average time* to this task. I also use information on teacher wages and a set of observable characteristics including age, experience, gender, rank (head teacher, regular teacher, volunteer teacher), education and teacher training.

The practices that show a relationship on their own with student value added are included in the teacher practices index. To avoid multiple hypothesis testing when looking at the relationship between management and teacher practices, we build an index of these teacher practices in the same way as the management index was built: by standardizing each measure, taking an average of the practices and standardizing the average. To avoid double-counting, we use only the value of the share of time a teacher spends "on task" and omit the share of time a teacher spends teaching, as the latter is already part of the "on task" measure.

than simply why might some teacher practices matter, we only report and explore further the practices which showed a relationship with student value added.

3.2.3 Teacher selection and retention

To explore teacher selection and retention, we use a set of questions collected during enumerator visits that measure each teacher's transfer status in the second year of the APSC project. Although we do not have a full roster of teacher movement across schools in our sample, the second year questionnaire asked the enumerator to classify the status of the teacher in school as one of the following:

(i) whether they were at the school in the beginning of the year and are still currently at the school;

(ii) whether they were in the school in the beginning of the year but have since left;

(iii) whether they were not in the school at the beginning of the year but were transferred in during the school year.

We use this data along with the teacher value added measures to build a "good HR outcome" indicator. For each school an HR outcome is considered good when a high value added teacher is retained in the school (transfer status *i*), or transferred into the school (transfer status *iii*), or when a low value added teacher is transferred out of the school (transfer status *ii*). Using the teacher value added measure described above, we rank teachers within each school and construct an indicator variable to identify the teacher with the highest and lowest value added.[21] We then construct a measure of "good HR outcome" that takes a value of 1 when:

- a high value added teacher is retained in the school,
- a high value added teacher is transferred into the school,
- a low value added teacher is transferred out of the school.

The variable takes a value of 0 otherwise. For this analysis we use the sample from years 1 and 2 and exclude data from years 3 and 4 given only a sample of schools were revisited.

3.3 Combined dataset

The combined dataset of APSC-DWMS data includes 300 schools, 191 private and 109 public schools. Our main analysis includes data for Telugu and Math tests for 15,305

[21] Given the small size of many public schools in our sample, identifying the highest and lowest ranking teacher is the best measure in this context.

students; 12,661 from private schools and 2,665 from public schools.[22] There are a total of 1,171 teachers in our sample; 864 in private schools and 307 from public schools.

4 Results

4.1 Management practices in public schools

4.1.1 Descriptive statistics

We start by presenting the first detailed description of management practices in public schools in a developing country. Table 1 shows the distribution across each of the 20 different practices, across topics of operations and people management.[23] Scores are given on a scale of 1 to 5, where a score 1 means there are no managerial practices in place and a five means best practices have been adopted. A score of 2 suggests the practices are at least informally adopted, that is, the current head teacher in the school follows an informal structure that they put in place, though it is not likely the processes would be followed if (s)he is absent. A score of 3 suggests that a formal practice is in place that would be likely followed by any head teacher. Overall, we observe low levels of management quality across all practices measured. The median school has a score of 1.81 while a school at the 90th percentile has a management score of 2.05, both suggesting weak management practices across the whole support of the distribution.

Separating the overall management index into operations management and people management indices, we observe that schools have substantially lower quality of people management practices (median of 1.26) relative to operations management practices (median of 2.04). Most people management practices stand out as being weak across schools; 50% of schools score the lowest possible score in half of the people management practices measured. On the other hand, most practices in operations management are at least informally adopted across most schools; 50% of schools score above 2 in 11 out of the 14 practices in operations management. While the medians provide a telling picture of the state of operations and people management quality in schools, we also observe that there is a larger variation in operations management (SD of 0.31) than in people management quality (SD of 0.18). The distribution of management scores in Figure 1 reflect these numbers.

Figure 2 shows how public schools in Andhra Pradesh compare to public schools in other

[22] A total of 35,964 observations over four years (unbalanced panel)

[23] The D-WMS, in fact, measures 60 processes — 3 per practice shown here — and the three processes for each practice are averaged to build each practice score. A deeper exploration of these measures can be found in Lemos & Scur (2016).

countries.[24] Public schools in the UK, Sweden, Canada, and the US score between 2.89 and 2.77 and are not statistically different from each other. Their score are closely followed by Germany (2.51), and Mexico (2.27). Colombia and Italy score substantially lower at 2.08 and 2.05 respectively. Scores for India come at the bottom of the ranking, after Brazil (1.91). Public schools in Andhra Pradesh have an average score of 1.75, just above the pan-India scores (1.57).[25]

4.1.2 Teacher practices, student value added and management in public schools

How much does management help explain variation in teacher practices and student value-added in public schools? To explore the relationship between teacher practices and school management, we build a teacher practices index and run the following specification:

$$TPractice_{st} = \alpha + \beta_j MM_s + \delta_{1j}^{'}\mathbf{X_j} + \delta_{2j}^{'}\mathbf{S_{st}} + \varepsilon_{jst} \tag{1}$$

where $TPractice_{st}$ is the index of six classroom practices for teachers in school s in year t measured in the APSC survey.[26] MM_s is the z-score of each management index, X_j is a set of teacher controls (education, teacher training, potential experience, potential experience squared and teacher rank), S_{st} is a set of school controls in year t (school size, year of survey, average student population characteristics). Standard errors are clustered at the school level.

Looking at the results of this analysis, each cell of table 2 shows the coefficient of interest from each regression. Column (1) shows the unconditional correlation of each management index and the teacher practice index, while in column (2) we add school controls and in column (3) we add teacher controls. The coefficient in Column (1) suggests that one standard deviation better overall management is associated with 0.356 standard deviation better teacher practices in public schools. The relationship is 0.284 and 0.561 for operations management and people management, respectively. Including school controls (such as school size) and teacher controls does not significantly change these relationships.

In table 3 we turn to the relationship between management and student value added. We run the following specification:

[24] Cross-country data comes from the Development WMS dataset and the original World Management Survey. Raw D-WMS scores were re-cast to be comparable to the WMS scores for this figure.

[25] Figure B1a shows the average scores for each Indian state interviewed in the original WMS. Andhra Pradesh sits at the median of the scores across the country.

[26] See Appendix A.1 for details on the index construction.

$$StuScore_{ps,t} = \alpha + \beta_2 MM_s + \delta_x^{'}\mathbf{X_j} + \delta_s^{'}\mathbf{SJ_s} + \delta_c^{'}\mathbf{C_{ps,t}} + \theta StuScore_{ps,t-1} + \&\varepsilon_{jst} \quad (2)$$

where $StuScore_{ps}$ is the student test score for student p at school s in year t and $t-1$, and X_j and MM_s are defined as in Equation 1. $SJ_{ps,t}$ is a vector of school-subject controls (year of survey, subject, medium of instruction). $C_{ps,t}$ is a set of student controls (indicators for scheduled caste and parents education status, household asset index and whether the student was a scholarship recipient from the AP School Choice experiment). Standard errors are clustered at the school level. The data is organized such that there is one observation per student-subject-year in the sample.

Column (1) shows the baseline relationship between student value added and school management practices. We find there is a positive and significant relationship: a one-standard deviation in management scores (management SD = 0.25) is correlated with about 0.17 of a standard deviation in student value added. Columns (2) and (3) show that this relationship remains robust to the inclusion of student and teacher controls. Columns (4) and (5) repeat the specification in column (3) but break the overall management score into its sub-components. We observe that a one standard deviation increase in the operations and people indices are significantly correlated with about 0.13 SD and 0.34 SD in student value-added respectively. In column (6) we include both sub-indices in the specification and the operations management coefficient decreases by half and the people management coefficient decreases by a third. The people management index absorbs the significance of the operations management in explaining variation in student value added, indicating that people management is indeed a strong predictor of student value-added in public schools in Andhra Pradesh.[27] Figure 3 presents a visual representation of the management and student value added relationship.

Although we are not making any claims of a causal relationship between management and test scores, the results in Tables 2 and 3 show that there is meaningful variation in management quality across public schools in Andhra Pradesh, which are correlated with independent measures of both teacher practices and student value added. Since the support of the distribution of management scores in the public sectors fall entirely within the range of scores given to schools that use primarily informal practices, this raises the question of whether the management measure is a reflection of management structures put in place or it is simply due to teacher or headteacher characteristics.

To consider this question we explore whether characteristics of the teachers and headteach-

[27] Table **??** shows the results disaggregated by subject, including English.

ers have any predictive power of school management practices. In column (1) of Table 4, we observe that teacher demographics at the school — as measured by share of teachers with a degree, share of teachers with teacher training, average potential experience, average teaching experience and share of male teachers —- do not explain management quality at the school. Focusing only on headteachers, in column (2) we observe headteachers age are positive and significantly correlated with management quality, but other demographics such as gender and tenure in the school are not. Taken together, these results show that teacher and headteacher demographics explain very little of the variation in management quality across schools. We then consider whether management can be explained by the conditions under which headteachers make decisions such as the degree of autonomy and the degree of information that they have; this is shown in columns (3) to (6). In column (3) we add a headteacher autonomy index, which measures whether the headteacher has any autonomy in hiring new additional teachers or changing the academic content. In column (4) we add a headteacher knowledge measure, which measures how much information they have about the strength of quality of the practices in their schools. We observe that both measures are positively correlated with better management quality at the school, suggesting that although management is not explained by demographics, it can be adopted under a suitable set of conditions. Columns (5) and (6) include all variables together and confirm the robustness of the relationships. These results motivate the next section.

4.2 Management differences between public and private schools

Table 5 documents in detail differences in the quality of management practices between public and private schools in Andhra Pradesh.[28] Private schools are better managed than public schools across the majority of individual management practices. In terms of operations management, private schools are better on average as well as in most of the components of the index. Private schools are no better at adopting educational best practices — the practice that measures how well schools support the ability of teachers to discover the latest teaching methods and diffuse them across the school via teacher meetings and collaboration. Private schools are not significantly different from public schools in performance tracking and review of performance, but are slightly worse at performance dialogue. These three practices measure how well key performance indicators in the school are tracked and reviewed. Finally, although private schools tend to have a better variety of school targets, the interconnection of the targets is as well — or poorly — done as in public schools. They also have similar time horizons, and tend to be as non-binding in terms of difficulty of targets. However, the targets do tend to be slightly clearer in private schools.

[28]Table B2 in the Appendix compares school, teacher and student characteristics between the two school types of school in our sample.

People management is where we see the largest private school advantage with a difference of 0.87 — well over two standard deviations above the mean. Figure B2 shows the stark difference between the distributions of public and private schools across an average of the operations and people management indices. All individual practices are significantly and substantially better in private schools, mostly notably two practices are at an advantage by a full point or more on the management scale: the practice on instilling a talent mindset — measuring whether the school values high performers and how well leaders show this, and the practice of making room for talent — measuring whether poor performers can be identified and poor performance addressed. Although some of the difference can be accounted for by the tighter institutional constraints faced by public schools, many of the practices measured are not *de facto* bound by such rules. For example, there may be institutional constraints in terms of hiring and firing teachers, but they do not prevent the headteacher from identifying high and low performing teachers. Even if the rewards are non-financial, such as a certificate of achievement, it could that in settings where employees have higher levels of intrinsic motivation such rewards are also effective incentives. This is the first detailed picture of the internal workings of public and private schools in a developing country, and it is critical to understand where the improvement opportunities exist.

4.3 Private school advantage and school management

Studies have found that students in private schools have higher achievement levels relative to public schools in India, and that much of this can be attributed to student time use and household inputs.(Singh 2015, Muralidharan & Sundararaman 2015) In this paper, we take a step back from looking at individual inputs and focus instead on school management practices in the spirit of **?**, who look at such management as a technology in the production function. In this section we are not seeking to infer causality but rather have a more modest goal: we estimate how much of the level differences of student value added between private and public schools can be explained by differences in management practices across these schools.

To consider this question, we run the following specification:

$$StuScore_{ps,t} = \alpha + \beta_1 PRI_s + \beta_2 MM_s + \delta_x^{'}\mathbf{X_j} + \delta_s^{'}\mathbf{SJ_s} + \delta_c^{'}\mathbf{C_{ps,t}} + \theta StuScore_{ps,t-1} + \varepsilon_{jst} \quad (3)$$

where $StuScore_{ps}$ is the student test score for student p at school s in year t and $t-1$, and X_j and MM_s, $SJ_{ps,t}$ and $C_{ps,t}$ are as defined in Equation 2. PRI_s is a private school

indicator. Standard errors are clustered at the school level. The data is organized such that there is one observation per student-subject-year in the sample.

We report the results in Table 6.[29] Column (1) shows the relationship between student value added and the private school indicator controlling for the student's scholarship status and basic school controls including medium of instruction and school size and we find there is a positive and significant relationship. Consistent with the experimental evidence in Muralidharan & Sundararaman (2015), the combination of the positive coefficient on the indicator for private schools and the negative coefficient on the scholarship indicator suggests no overall difference in value added for scholarship recipients. Columns (2) and (3) include student controls and teacher controls respectively, with barely any changes in the coefficients of interest. Column (4) includes the overall management measure and shows a positive and significant relationship with student value added. The private dummy is still, however, substantial and significant.[30] Separating management into the two components and comparing column (5) with column (3) we see that the operations management index is positive and significant, but it explains little of the private dummy.[31]

When we include only the people management index in column (6) it absorbs nearly all the variation from the private dummy. The coefficient on z-people is almost twice as large as the coefficient on z-management and they are significantly different from each other at the 1% level. In column (7) we include both indices and see that the relationship is consistent. The substantially higher quality of people management in private schools seems to account for 60% the variation the private dummy coefficient.

In the next section, we further examine the mechanisms behind how higher people management scores may translate into differences in personnel policy at the school.

4.4 People management practices and personnel policy

4.4.1 Teacher compensation and value added: evidence from teacher wages

To consider the relationship between wages and teacher effectiveness, we run the following specification:

$$LnWages_{jst} = \alpha + \beta TVA_{js} + \delta_1^{'}\mathbf{X_{jst}} + \delta_2 SchoolSize_s + \eta_t + \varepsilon_{jst} \tag{4}$$

where $LnWages_{jst}$ is the log of wages of each teacher j in school s at time t. X_{jst} is a

[29] The results by subject in table **??**

[30] Figure **??** shows a visual depiction of the relationship.

[31] The coefficients on the private dummy are, however, significantly different at the 10% level.

set of teacher characteristic controls (education, teacher training, potential experience and potential experience squared) at time t and we also control for school size as the log number of students. Standard errors are clustered at the school level.

Results are presented in table 7. The Chetty et al. (2014) TVA measure is centered around 0, such that the average teacher has a value of 0, and the distribution falls on a range of -1 to 1. Columns (1) through (4) include the full sample of teachers in public schools in the APSC dataset. Column (1) shows the baseline relationship between teacher value added and wages, and we find that the relationship is not significantly different from zero. Column (2) shows the relationship between teacher characteristics and wages, and suggests wages in public schools are significantly higher for teachers with a degree, teacher training, and higher potential experience (calculated as the difference between age and years of education). We also include controls for gender and teacher position in this specification. Column (3) includes teacher value added and the relationships remain very similar. Including school controls in column (4) also does not substantially alter the results.

Columns (5) through (8) show the same specifications but for all teachers in private schools in the APSC dataset. The standard deviation for TVA in private schools is 0.20. A teacher at the 75th percentile in the private school sample has a TVA value of 0.12, while a teacher at the 95th percentile has a TVA value of 0.32. Column (5) shows that teacher value added is significantly correlated with wages, with a large coefficient of 0.302. Column (6) includes only teacher characteristics and suggests that, similar to public schools, teacher characteristics also impact their salaries, though having a degree seems to matter in private schools. Crucially, when we include teacher value added and all characteristics in the same regression in column (7) we still see a significant correlation between teacher value added and wages. In the fully specified regression in column (8), including school controls, the relationship between TVA and wages suggests that a one standard deviation higher TVA is correlated with approximately 5.7% higher wages.[32] A a teacher who moves from the average TVA value to the 75th percentile value would increase their wage by approximately 3%. A teacher who moves from the average TVA to the 95th percentile, however, would see an increase in wages of approximately 9%. Figure 4 shows a graphical depiction the results, and the strikingly different relationship is clear. In Appendix table **??** we include our measures of management practices and the results on the relationship between teacher value added and wages remain consistent.

These results are broadly similar with those in Das & Bau (2017). They also find no significant relationship between teacher wages and TVA in the public sector, but do find a significant relationship in the private sector. In their sample, one standard deviation

[32] $0.20x0.288 = 0.0576$

increase in TVA is correlated with 11% higher wages. In terms of teacher characteristics, they find that training and seniority are significantly correlated with pay in both public and private schools. We find a different pattern, where private schools reward seniority and training similarly to public schools and reward education twice as much as public schools. However, our sample differs in that the vast majority of the public school teachers in our sample have a college degree (about 80%) while only 65% of the private school teachers do.

4.4.2 Teacher selection and retention: evidence from teacher transfers

Another dimension where private schools can impose better HR practices is in the selection and retention of teachers. We estimate the following relationship:

$$HRoutcome_{js} = \alpha + \beta MM_s + \delta_{hr}^{'}\mathbf{X_{js}} + \varepsilon_{jst} \tag{5}$$

where $HRoutcome_{jst}$ takes a value of 1 ("good") if: a high value added teacher is transferred into the school or is kept in the school (responds "currently in the school") *and* if a low value added teacher is transferred out. It takes a value of 0 otherwise.[33] MM_s is the z-score of management as described in Section 3.1, X_{js} is a set of teacher characteristic controls as in Equation 4. Standard errors are clustered at the school level. Columns (1) and (3) estimate the model using OLS, while columns (2) and (4) use a probit model.

Table 8 reports the results and provides evidence that there is a relationship between better management and better selection and retention of teachers in private schools, but not so in public schools. Although these results include only a small number of public schools and teachers and should be interpreted with caution, they are consistent with the institutional context that public schools are in. There is little room for selection and retention decisions at the school level as much of the teacher hiring and firing is done at a higher administrative level. Private schools, however, seem to be better at selecting and retaining their best teachers, as well as dismissing their worse ones. A one standard deviation better management suggests a 4.4% to 12.4% higher probability of a good HR outcome in private schools.

Taken together, the evidence presented in the previous sub-section can be seen as evidence

[33] A value of 0 is assigned if a high value added teacher is transferred out, or a low value added teacher is transferred in or kept in the school.

that private schools have been able to adopt the "low hanging fruit" labour market practices and set up basic reward systems where the best teachers get appropriately rewarded and in turn deliver better teaching. Figure B2b shows that, indeed, the difference in quality of management between public and private schools is being driven by substantially better scores in people management in public schools. At the margin, however, small differences in quality management at the lower end of the distribution (scores between 1-3) do not seem to translate into better student and teacher outcomes for private schools. That is, once these basic labour market practices are in place, small changes in management quality at the lower end of the distribution are second order. It could be, however, that the effect of better management in this context would only start kicking in at the higher end of management quality, which is non-existent in the current distribution of scores here.

Public schools are institutionally constrained over many hiring and incentives practices, such as performance-based financial rewards. Along the margin than they can affect, however, even very small movements along the management quality distribution are correlated with larger improvements in teacher practices which are correlated with student outcomes. Table A1 we repeat the specifications for public schools as in table 2, and compare the results with the sample for private schools. Each cell of the table shows the coefficient of interest from each regression.[34] The coefficients for private schools are approximately 25 to 40% as large as the public schools coefficients. Consistent with this interpretation, figure 6 is a visual representation of the regressions in columns (1) and (4), and it is clear that the slope for the relationship between management and the teacher practice index is steeper for public schools relative to private schools.

5 Institutions, culture, or skills?

One natural question that arises from our results is whether poor adoption of people management practices in public schools is a product of institutional constraints above the school level, within-school organizational culture, or individual principal skills. Although we lack the data to give this question an appropriate treatment, we can discuss some suggestive evidence that it is likely a combination of these factors.

First, if this was a purely institutional story, we would not expect to see such variation in practices between public schools within the same state. Second, there is evidence in the literature that suggests organizational culture (as measured by questions on leadership vision and strategy, and clearly defined accountability for principals) explains almost half of the difference in management scores between traditional public schools and publicly funded

[34] The relationship between each individual practice and management is in Appendix A.

private schools. Experimental work from Fryer in traditional public schools in Houston cites a change to a "culture of high expectations" as one of the important factors that led to improvements in student achievement. Third, if it is purely a skills story, we would expect private schools to be hiring the best skilled managers. We compare differences in observables on experience, education levels and wages of principals in public and private schools in our sample (Table 5). We find that principals in private schools are paid about four times less, have about 5 years fewer average years of experience, and one fewer year of education and are less likely to have completed teacher training.

6 Concluding remarks

In this paper we investigate the management quality of public schools in a low-capacity setting and consider the extent to which different management practices across schools can help explain the gap in student achievement between public and private schools in India.

The first key finding from our study is that public sector schools present extremely low levels of management quality, but variation across schools are correlated with independent measures of teacher practices and student value added. We find stark differences across public and private schools in quality of management, and indeed the difference is primarily driven by much worse people management in public schools. However, the second key finding from our study is that, in settings where schools are not able to act on the selection/retention channel – such as public schools – the channel of good use of current teachers becomes much more important. In this context, our results suggest that even very small changes in management quality have a strong positive correlation with student value added. An example of such changes would be to simply start using the data collected on student attendance and test performance to inform lesson plans and school targets. The third key finding is that, in contrast, in settings where schools are able to use the selection/retention channel, such as private schools, changes in management at this level become second order. We find that better managed private schools are better able to select and retain better teachers, and we also find evidence of rewards systems being implemented – higher value added teachers tend to earn higher salaries in private schools.

In all, governments spend a substantial amount of public funds seeking to improve educational outcomes. When compared to other policy-actionable items, however, investment in improving managerial practices has a major advantage of being of relatively low capital intensity with potentially high returns – at least in the public sector. Improving management practices at this level is essentially a re-organization of processes and how things are

run (or, often in this case, a simple organization in first place). At higher levels it involves small capital investments such as the purchase of new computers and IT systems, but still nowhere near the amount required for overhauling funding for teachers, for example. Although the capacity building involved in implementing managerial improvements can, of course, be substantial,[35] it needn't be so for the public sector in developing countries. The type of intervention that would improve management in this setting is so basic that a concerted effort from ministries or NGOs could have a meaningful effect.

This is only the first step in a incipient but fast-growing research agenda. More thought needs to be given to the theoretical foundations of where we expect management practices and management processes to have an impact, and why. Exploring the determinants of management itself in developing countries is also a further avenue, especially considering the interesting results from this initial exercise. Finally, delving into wages and regional labour market characteristics would also be an interesting point of study.

[35] High-end consulting companies charge thousands for their expertise, and one academic experiment using managerial practices as the treatment reportedly cost around US$250,000 per firm at the "research cost."

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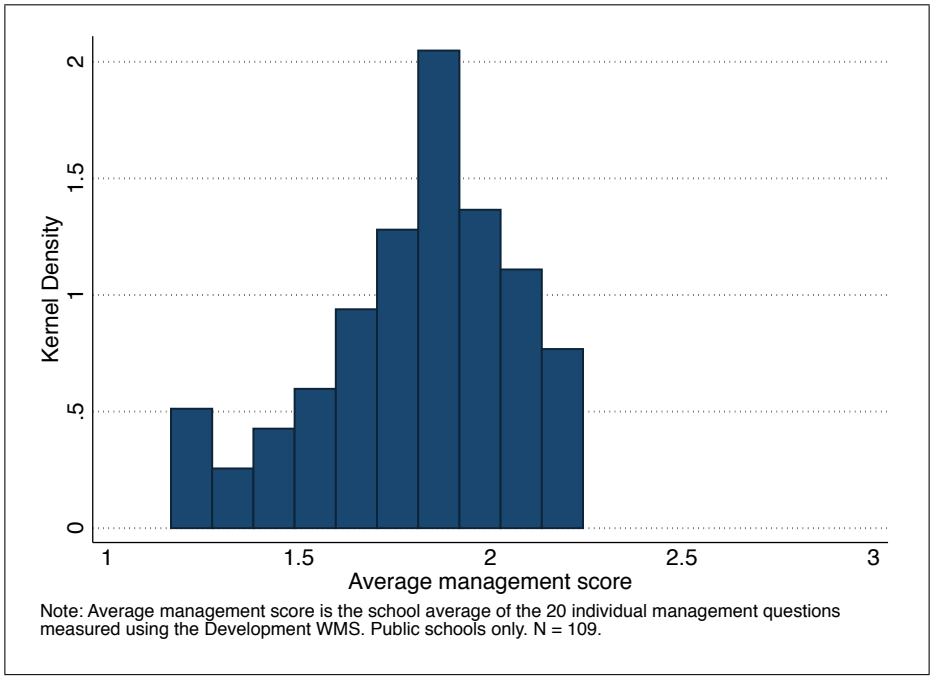
Figure 1: Distribution of management scores in Andhra Pradesh: public schools

(a) Distribution of management quality



(b) Distribution of operations and people management

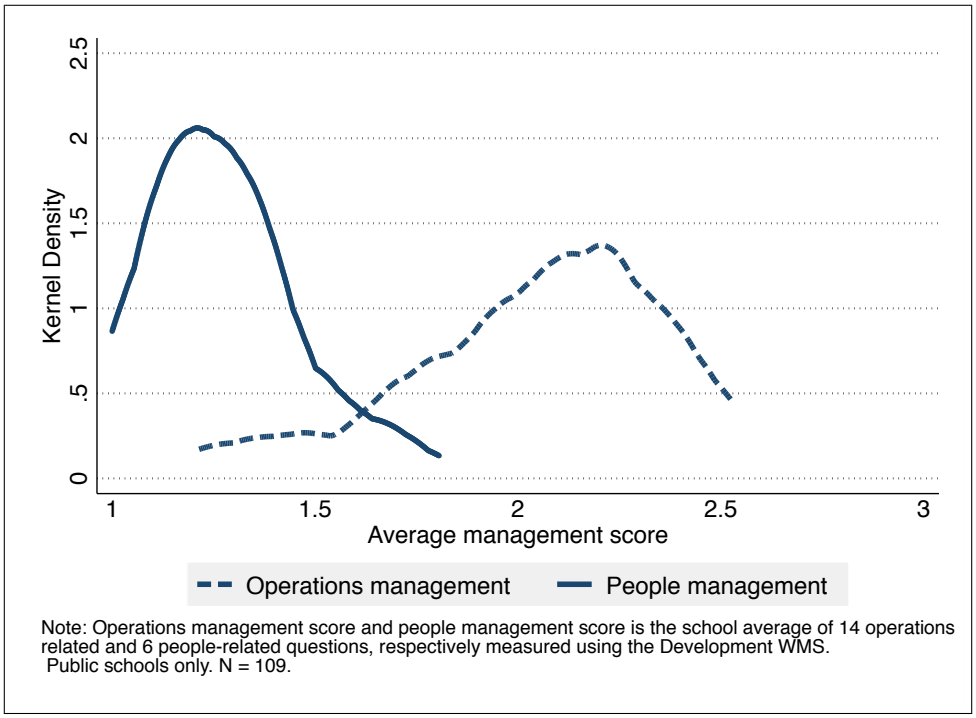
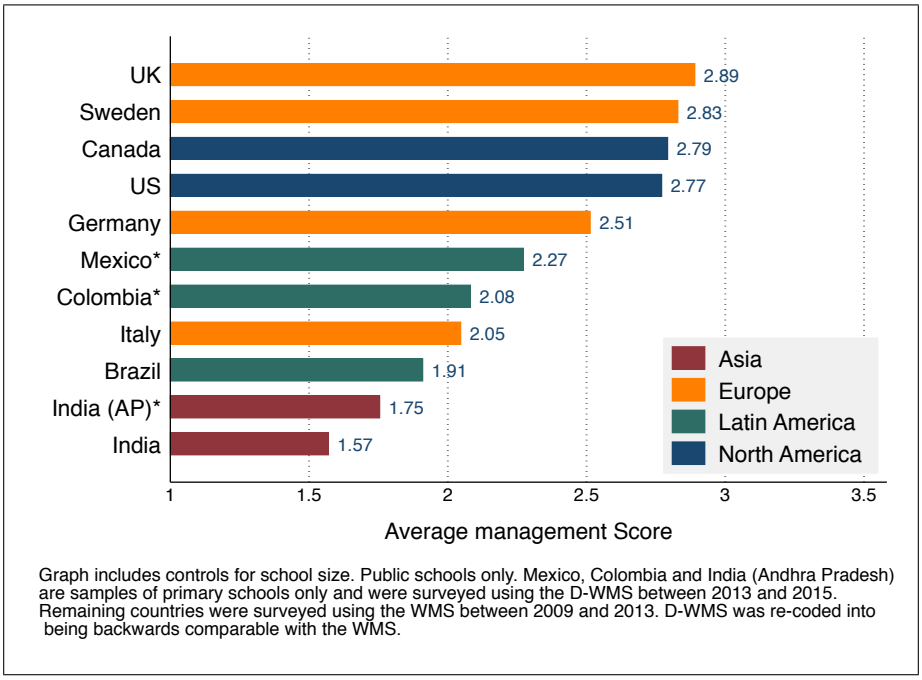
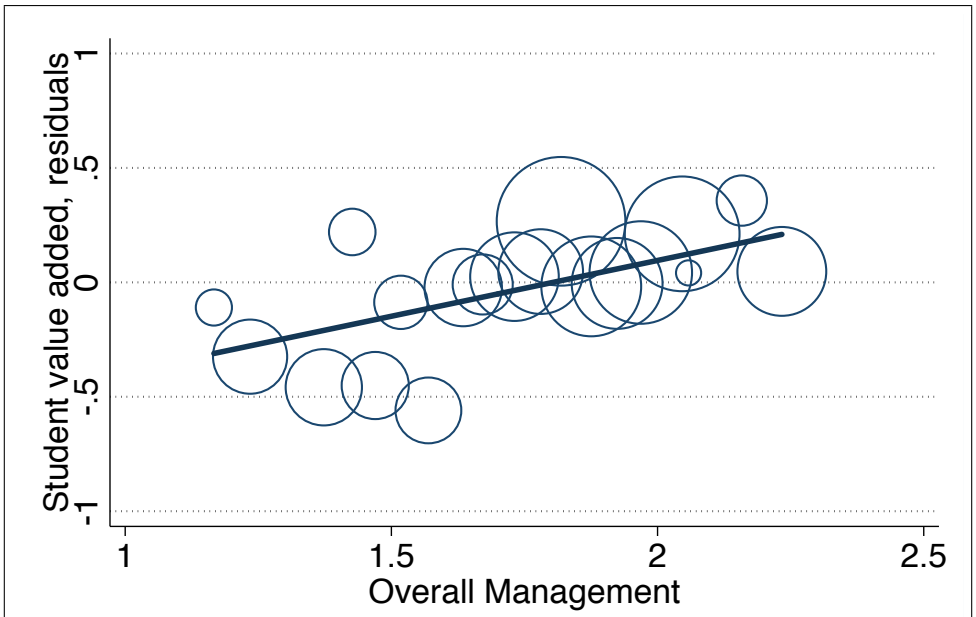


Figure 2: Cross-country rank of school management quality: public schools



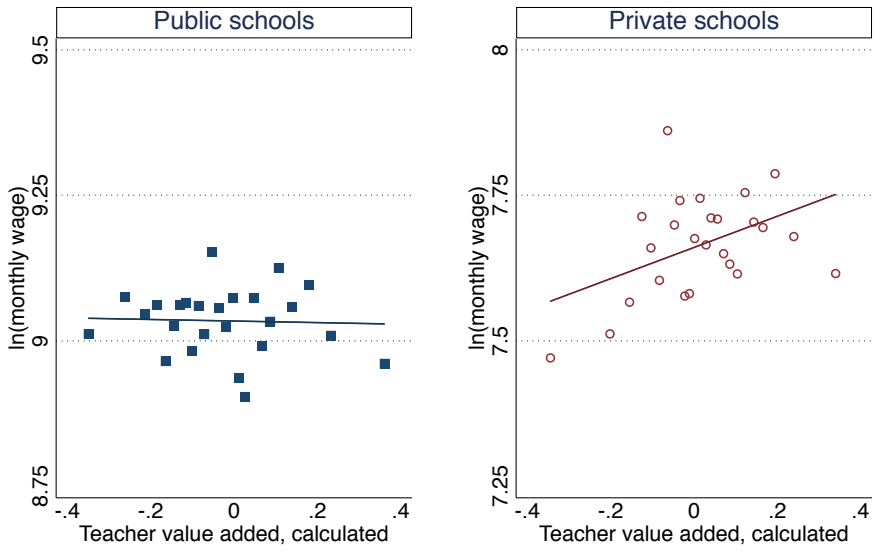
Graph includes controls for school size. Public schools only. Mexico, Colombia and India (Andhra Pradesh) are samples of primary schools only and were surveyed using the D-WMS between 2013 and 2015. Remaining countries were surveyed using the WMS between 2009 and 2013. D-WMS was re-coded into being backwards comparable with the WMS.

Figure 3: Management and student value added in public schools



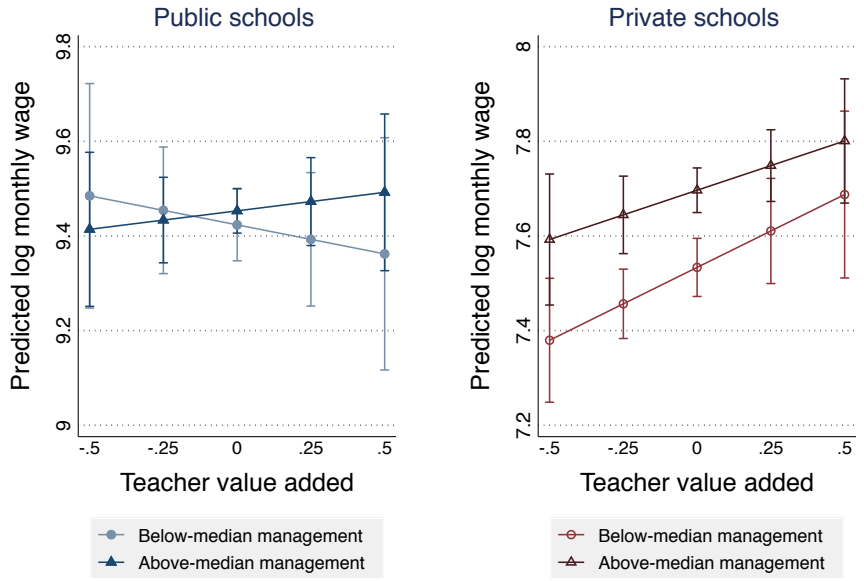
Note: Residuals from a regression of endline test scores on baseline test scores. Public schools only. N=109. Overall management is averaged across schools in bins of 0.05 points, circle sizes indicate number of students in all schools within that bin.

Figure 4: Teacher value added and wages



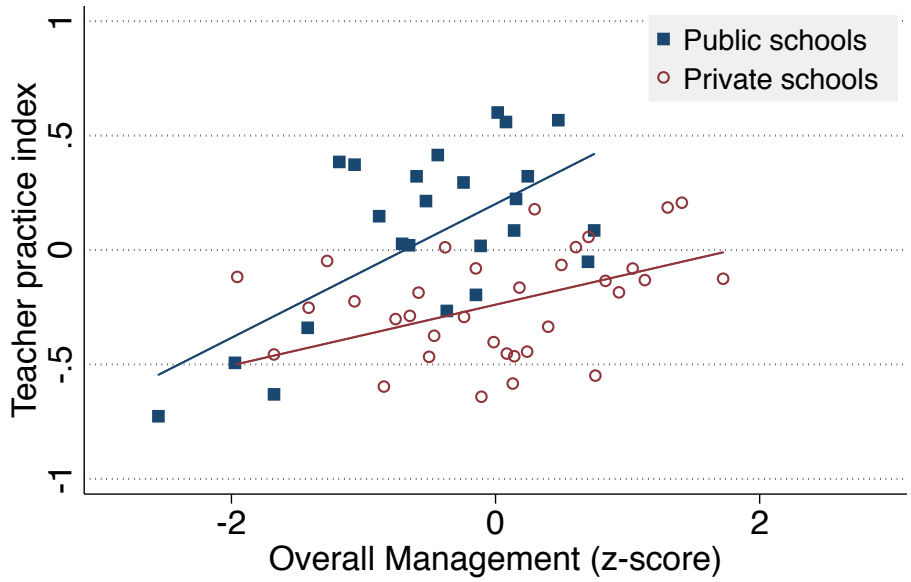
Notes: Teacher value added calculated using Chetty et al.'s vam Stata package and data from the APRESt program collected between 2008-2012. Includes controls for teacher gender, rank, education, training, experience and school size. Total N=299. N private = 190. N Public = 109. Bins = 25.

Figure 5: Teacher value added and wages, by management quality



Note: Marginal effects plot.

Figure 6: Management and teacher practices



Note: Teacher practice index is an index of six classroom practices: makes lesson plans, has textbook/ workbook, checks hygiene daily, % time teaching, % time on task, remedial class: extra attention. z-management is the standardized school average of the z-scores of each individual management practice.

Table 1: Summary statistics for management in public schools

	Mean	Standard Deviation	10th pct	25th pct	50th pct	75th pct	90th pct	N
Overall management index	1.81	(0.25)	1.42	1.67	1.84	1.97	2.05	109
Operations average index	2.04	(0.31)	1.58	1.85	2.10	2.26	2.38	109
Standardisation of instructional processes	1.87	(0.33)	1.50	1.67	1.83	2.00	2.33	109
Data driven planning and student transition	1.93	(0.34)	1.50	1.83	1.83	2.00	2.50	109
Personalization of instruction and learning	1.98	(0.34)	1.50	1.83	2.00	2.17	2.50	109
Adopting educational best practices	2.22	(0.64)	1.33	1.83	2.17	2.50	3.17	109
Continuous improvement	1.89	(0.44)	1.50	1.50	2.00	2.33	2.33	109
Performance tracking	2.24	(0.43)	1.67	2.00	2.33	2.50	2.67	109
Review of performance	2.45	(0.54)	1.83	2.00	2.50	2.67	3.33	109
Performance dialogue	2.23	(0.38)	1.50	2.00	2.33	2.50	2.67	109
Consequence management	2.05	(0.42)	1.50	1.83	2.17	2.33	2.50	109
Type of targets	1.87	(0.34)	1.17	1.67	2.00	2.00	2.17	109
Interconnection of goals	2.11	(0.53)	1.50	1.50	2.00	2.50	2.50	109
Time horizon	2.10	(0.61)	1.17	1.83	2.00	2.50	3.17	109
Goals are stretching	1.90	(0.48)	1.17	1.67	2.00	2.17	2.33	109
Clarity of goals	1.73	(0.39)	1.33	1.33	1.67	2.00	2.33	109
People average index	1.26	(0.18)	1.03	1.14	1.25	1.33	1.56	109
Instilling a talent mindset	1.14	(0.28)	1.00	1.00	1.00	1.33	1.50	109
Incentives and appraisals	1.51	(0.36)	1.00	1.33	1.50	1.67	1.83	109
Making room for talent	1.32	(0.27)	1.00	1.00	1.33	1.50	1.83	109
Developing talent	1.41	(0.35)	1.00	1.17	1.33	1.50	2.00	109
Distinctive employee value	1.05	(0.16)	1.00	1.00	1.00	1.00	1.17	109
Retaining talent	1.14	(0.18)	1.00	1.00	1.00	1.33	1.33	109

Notes: Overall management index is the average of the 20 individual management questions measured using the Development-WMS (www.developingmanagement.org). The scores here are the raw D-WMS scores and have not been re-coded into being backwards comparable with the WMS; they are, thus, slightly higher than those in Figure 2. Operations average index and people average index are the average of the 14 operations-related and 6 people-related questions, respectively. See appendix for a more detailed description.

Table 2: Management practices and teacher practices: public schools (key coefficients only)

	Public schools		
	(1) teacher practice index	(2) teacher practice index	(3) teacher practice index
z-management	0.356***	0.416***	0.413***
	(0.065)	(0.070)	(0.067)
z-operations	0.284***	0.340***	0.338***
	(0.053)	(0.058)	(0.055)
z-people	0.561***	0.579***	0.570***
	(0.150)	(0.145)	(0.142)
School controls		Y	Y
Teacher controls			Y
Observations	704	704	704
# schools	109	109	109
Management SD	0.25	0.25	0.25

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Notes: Standard errors are clustered by school. Teacher practice index is an index of six classroom practices: makes lesson plans, has textbook/workbook, checks hygiene daily, % time teaching, % time on task, remedial class: extra attention. Each cell represents a regression of the teacher practices index and the independent variable — z-management, z-operations, or z-people — and reports only the coefficient of interest. z-management is the standardized average of the z-scores of each individual management practice. z-operations and z-people are the standardized average of the z-scores of each individual management practice relating to operations and people, respectively. All specifications include controls for number of students (log). Teacher controls include teacher education, teacher training, potential experience, potential experience squared and teacher position in the school (headteacher, regular teacher, vidya volunteer).

Table 3: Management practices and student value added in public schools

	Pooled Math and Telugu					
	(1) endline test score	(2) endline test score	(3) endline test score	(4) endline test score	(5) endline test score	(6) endline test score
z-management	0.168***	0.172***	0.161***			
	(0.045)	(0.044)	(0.046)			
z-operations				0.125***		0.069
				(0.039)		(0.046)
z-people					0.335***	0.234**
					(0.087)	(0.098)
Baseline score	Y	Y	Y	Y	Y	Y
Student controls		Y	Y	Y	Y	Y
Teacher controls			Y	Y	Y	Y
Observations	7157	7157	7157	7157	7157	7157
# schools	109	109	109	109	109	109
R^2	0.146	0.153	0.159	0.156	0.160	0.163
Analysis level:	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Notes: Standard errors are clustered by school. z-management is the standardized average of the z-scores of each individual management practice. z-operations and z-people are the standardized average of the z-scores of each individual management practice relating to operations and people, respectively. All specifications include controls for number of students (log), year, and subject. Student controls include a female dummy, scheduled caste, religion, parents literacy and labourer status, household infrastructure index. Teacher controls include teacher education, training, experience, and number of school days. **Tests of equality of coefficients:** The coefficients on zoperations and zpeople management in columns (4) and (5) are significantly different at the 1% level. We cannot reject that the two coefficients are significantly different from each other, however, in Column (6). **Timing:** Management data collected in 2013. Student and teacher data collected between 2008 to 2012 under the APRESt program.

Table 4: Correlates of management quality in public schools

	(1) z-management	(2) z-management	(3) z-management	(4) z-management	(5) z-management	(6) z-management
Teacher demographics						
Share of teachers with a degree	0.296					0.034
	(0.365)					(0.296)
Share of teachers with teacher training	0.230					0.179
	(0.615)					(0.449)
Average potential experience	-0.024					-0.025
	(0.022)					(0.021)
Average teaching experience	0.036					0.032
	(0.027)					(0.027)
Share of male teachers	-0.112					-0.241
	(0.206)					(0.194)
Headteacher demographics						
Headteacher age		0.031**	0.029**	0.015	0.016	0.015
		(0.012)	(0.012)	(0.011)	(0.010)	(0.012)
Headteacher is male = 1		0.225	0.198	0.131	0.124	0.131
		(0.179)	(0.177)	(0.170)	(0.171)	(0.173)
Headteacher tenure		-0.010	-0.017	-0.009	-0.014	-0.009
		(0.016)	(0.018)	(0.015)	(0.016)	(0.015)
Headteacher autonomy						
Autonomy index			0.711***		0.497***	0.481**
			(0.186)		(0.189)	(0.187)
Headteacher perception						
Knowledge self score (overall)				0.310***	0.270***	0.282***
				(0.065)	(0.066)	(0.067)
Base controls	Y	Y	Y	Y	Y	Y
Observations	108	109	109	109	109	108
# schools	108	109	109	109	109	108
R^2	0.0414	0.0859	0.178	0.257	0.299	0.335
Analysis level:	**School**	**School**	**School**	**School**	**School**	**School**

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors are clustered by school. z-management is the standardized average of the z-scores of each individual management practice. Headteacher autonomy index measures whether the headteacher has any autonomy in hiring new additional teachers or changing the academy content. Headteacher knowledge self-score is a self-assessment measure on a scale of 1 to 10 of knowledge in overall management practices. Base controls include interviewer dummies, number of students (log), number of teachers (log) and a school infrastructure index. Headteacher refers to the teacher formally appointed as headteacher or the most senior teacher at the school.

Table 5: Public and private schools have different management scores

	Private	Public	Mean Diff	SD Private	SD Public	Private N	Public N
Overall management index	2.15	1.81	0.35***	0.26	0.25	191	109
Operations average index	2.16	2.04	0.12**	0.28	0.31	191	109
Standardisation of instructional processes	2.21	1.87	0.34***	0.42	0.33	191	109
Data driven planning and student transition	2.08	1.93	0.14***	0.39	0.34	191	109
Personalization of instruction and learning	2.25	1.98	0.27***	0.40	0.34	191	109
Adopting educational best practices	2.12	2.22	-0.10	0.43	0.64	191	109
Continuous improvement	2.16	1.89	0.27***	0.36	0.44	191	109
Performance tracking	2.32	2.24	0.08	0.47	0.43	191	109
Review of performance	2.39	2.45	-0.06	0.50	0.54	191	109
Performance dialogue	2.12	2.23	-0.11*	0.36	0.38	191	109
Consequence management	2.23	2.05	0.18***	0.47	0.42	191	109
Type of targets	2.04	1.87	0.17***	0.44	0.34	191	109
Interconnection of goals	2.21	2.11	0.10	0.51	0.53	191	109
Time horizon	2.22	2.10	0.12	0.47	0.61	191	109
Goals are stretching	1.91	1.90	0.01	0.35	0.48	191	109
Clarity of goals	2.00	1.73	0.26***	0.37	0.39	191	109
People average index	2.13	1.26	0.87***	0.26	0.18	191	109
Instilling a talent mindset	2.48	1.14	1.33***	0.42	0.28	191	109
Incentives and appraisals	2.00	1.51	0.48***	0.40	0.36	191	109
Making room for talent	2.31	1.32	0.99***	0.40	0.27	191	109
Developing talent	2.09	1.41	0.68***	0.47	0.35	191	109
Distinctive employee value	1.96	1.05	0.90***	0.37	0.16	191	109
Retaining talent	1.97	1.14	0.83***	0.31	0.18	191	109

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Overall management index is the average of the 20 individual management questions measured using the Development-WMS (www.developingmanagement.org). The scores here are the raw D-WMS scores and have not been re-coded into being backwards comparable with the WMS; they are, thus, slightly higher than those in Figure 2. Operations average index and people average index are the average of the 14 operations-related and 6 people-related questions, respectively. See appendix for a more detailed description.

Table 6: People management explains much of the higher value added in private schools

	Math and Telugu						
	(1) endline test score	(2) endline test score	(3) endline test score	(4) endline test score	(5) endline test score	(6) endline test score	(7) endline test score
Private = 1	0.329***	0.325***	0.375***	0.281***	0.336***	0.112	0.143
	(0.058)	(0.059)	(0.071)	(0.072)	(0.068)	(0.096)	(0.111)
Scholarship = 1	-0.256***	-0.235***	-0.244***	-0.262***	-0.256***	-0.277***	-0.275***
	(0.084)	(0.082)	(0.080)	(0.081)	(0.082)	(0.077)	(0.077)
z-management				0.082***			
				(0.028)			
z-operations					0.064**		0.022
					(0.025)		(0.034)
z-people						0.149***	0.123**
						(0.041)	(0.056)
Baseline score	Y	Y	Y	Y	Y	Y	Y
School controls	Y	Y	Y	Y	Y	Y	Y
Student controls		Y	Y	Y	Y	Y	Y
Teacher controls			Y	Y	Y	Y	Y
Observations	35883	35883	35883	35883	35883	35883	35883
# schools	299	299	299	299	299	299	299
R^2	0.154	0.158	0.162	0.167	0.166	0.168	0.168
Variable mean	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Analysis level:	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Notes: Standard errors are clustered by school. z-management is the standardized average of the z-scores of each individual management practice. z-operations and z-people are the standardized average of the z-scores of each individual management practice relating to operations and people, respectively. All specifications include controls for number of students (log), year, and subject. Student controls include a female dummy, scheduled caste, religion, parents literacy and labourer status, household infrastructure index. Teacher controls include teacher education, training, experience, and number of school days. **Tests of equality of coefficients:** The coefficients on the private dummy are significantly different from each other between columns (3) and (4) at the 1% level, and significantly different from each other between columns (3) and (5) at the 10% level. The coefficients on zmanagement and zpeople management in columns (4) and (6) are significantly different at the 1% level. The coefficients on zoperations and zpeople management in columns (5) and (6) are significantly different at the 1% level. We cannot reject that the two coefficients are significantly different from each other, however, in Column (7). **Timing:** Management data collected in 2013. Student and teacher data collected between 2008 to 2012 under the APRESt program.

Table 7: Teacher value added is strongly correlated with teacher wages in private but not in public schools

	Public				Private			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ln(wages)	ln(wages)	ln(wages)	ln(wages)	ln(wages)	ln(wages)	ln(wages)	ln(wages)
Value added								
Teacher value added	-0.168	-0.168	-0.177	-0.132	0.302***	0.272**	0.271**	0.288***
	(0.188)	(0.194)	(0.192)	(0.198)	(0.108)	(0.110)	(0.109)	(0.110)
Characteristics								
Degree = 1	0.098	0.098	0.097	0.100	0.369***	0.356***	0.355***	0.364***
	(0.079)	(0.080)	(0.080)	(0.080)	(0.036)	(0.037)	(0.037)	(0.037)
Teacher training =1	0.360***	0.360***	0.359***	0.373***	0.261***	0.252***	0.252***	0.256***
	(0.084)	(0.084)	(0.084)	(0.087)	(0.038)	(0.037)	(0.037)	(0.037)
Potential experience	0.031**	0.031**	0.031**	0.030**	0.019***	0.019***	0.019***	0.019***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.005)	(0.005)	(0.005)	(0.005)
Management								
z-management		0.000				0.052*		
		(0.031)				(0.028)		
z-operations			0.006				0.051**	
			(0.024)				(0.025)	
z-people				-0.066				0.043
				(0.088)				(0.049)
Other teacher controls	Y	Y	Y	Y	Y	Y	Y	Y
School controls	Y	Y	Y	Y	Y	Y	Y	Y
# Teachers	279	279	279	279	1053	1053	1053	1053
# Schools	106	106	106	106	189	189	189	189
R^2	0.698	0.698	0.699	0.700	0.316	0.320	0.321	0.317
Variable mean	9.047	9.047	9.047	9.047	7.578	7.578	7.578	7.578
Variable mean (levels, Rs)	11447	11447	11447	11447	2649	2649	2649	2649
Sample:	**Mgmt**	**Mgmt**	**Mgmt**	**Mgmt**	**Mgmt**	**Mgmt**	**Mgmt**	**Mgmt**

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Notes: Standard errors are clustered by school. Teacher value added is estimated using the Chetty et al. (2014) method and `vam` Stata command. z-management is the standardized average of the z-scores of each individual management practice. z-operations and z-people are the standardized average of the z-scores of each individual management practice relating to operations and people, respectively. All specifications include controls for number of students (log). Other teacher controls include a dummy variable for male, and indicators for teacher position in the school (headteacher, regular teacher, vidya volunteer).

Table 8: Management and selection and retention of high value added teachers

	Public		**Private**	
	(1) good HR outcome indicator	(2) good HR outcome indicator	(3) good HR outcome indicator	(4) good HR outcome indicator
main				
z-management	-0.035	-0.071	0.044**	0.124***
	(0.033)	(0.087)	(0.012)	(0.035)
Teacher controls	Y	Y	Y	Y
# Teachers	53	52	484	484
# Schools	26	26	152	152
Model:	**OLS**	**Probit**	**OLS**	**Probit**
Analysis level:	**Teacher**	**Teacher**	**Teacher**	**Teacher**

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Notes: Standard errors are clustered by school. A "good HR outcome" takes a value of 1 if a high value added teacher was transferred in or was already in the school, and it also takes a value of 1 if a low value added teacher is transferred out. It takes a value of 0 if a high value added teacher is transferred out, a low value added teacher is transferred in or was already in the school. Subjects included are math and Telugu. We classify highest value added teacher and lowest value added teacher as "high/low" value added. Teacher value added is estimated using the method in Chetty et al. (2014). z-management is the standardized average of the z-scores of each individual management practice. All specifications include controls for number of students (log). Teacher controls include teacher education, teacher training, potential experience, potential experience squared.

Appendices

A Data construction

A.1 Teacher variables: constructing teacher practices

For teacher characteristics and practices variables we use the data from questionnaires that were administered by enumerators to all teachers in the schools. There were over 20 practices measured by the APSC survey, each of which we correlated with student value added to identify the most effective ones. There were six practices in particular that showed a correlation with student value added in either the public or private sector. We describe each teacher practice and how it is coded below:

(i) Do you prepare a lesson plan before teaching?

(ii) Do you have a copy of the textbook? Do you have a copy of the workbook? (having both = 1)

(iii) How often are the children observed for health/hygiene related habits? (daily=1)

(iv) How much time do you spend in a typical day on each of the following activities? Teaching activity; preparing for classes; correcting homework; maintaining order and discipline; administrative/paper work; breaks during school; getting children to attend school; mid-day meals; extra classes; others. The first variable I use from this set of questions is the amount of time dedicated to teaching divided by the total time reported by the teacher.

(v) We also define a variable as "time on-task": the sum of teaching, preparing for classes, correcting homework and extra classes, and divide this sum by the total time reported.

(vi) Do you get time to provide remedial teaching to the students? The questionnaire also includes questions regarding the shape that the remedial attention takes: taking extra class; paying extra attention in the class itself; paying extra attention outside the class; help children by arranging private tuition; helping children in studies at home; other. If the teacher gives remedial attention, we calculate the average amount of extra time allocated to extra attention in class and assign a value of 1 if the teacher dedicates *above average time* to this task. We also use information on teacher wages and a set of observable characteristics including age, experience, gender, rank (head teacher, regular teacher, volunteer teacher), education and teacher training.

But how do these practices correlate with student value added? To explore the relationship between the set of teacher practices measured in the APSC survey and student outcomes, we estimate the following relationship:

$$StuScore_{ps,t} = \alpha + \beta TPractice_{jst} + \delta_x^{'}\mathbf{X_j} + \gamma_c^{'}C_{st} + \theta StuScore_{ps,t-1} + \varepsilon_{jst} \qquad (6)$$

where $StuScore_{ps}$ is the student test score for student p at school s in year t and $t-1$. $TPractice_{jst}$ is one of six teacher practices for teacher j in school s in year t measured in the APSC survey. X_j is a vector of teacher characteristic controls (teacher education, teacher training, potential experience, potential experience squared and teacher rank), C_{st} is a vector of school controls in year t (log of school size, year of survey, average student population characteristics). Standard errors are clustered at the school level. The data is organized such that there is one observation per student-teacher-year in the sample.

Table A1 shows the regression results for public and private schools separately in a table of coefficients: each cell represents a separate regression.[36] Columns (1) and (4) show the raw correlation between each practice and student value added for public and private schools respectively. Columns (2) and (5) show the results including school and teacher controls, and columns (3) and (6) include district fixed effects. We classify the two first practices as "teacher preparedness": making lesson plans before classes and having a copy of the textbook and workbook. We classify the next four practices as "teacher effort": checking students' hygiene daily, the share of their workday they spend in teaching only and on teaching activities (teaching, preparing classes, correcting homework and extra classes), and if they dedicate extra attention to remedial students in class.

An initial look at the results shows that the majority of teacher effort and preparedness practices are strongly and positively correlated to student value added in public schools while only one practice seems to have a similar relationship in private schools. Discussing each teacher practice in turn, we start with whether the teachers make lesson plans: there is no significant relationship between this practice and student value added in public schools, but there is a significant relationship in private schools. The coefficients in the private school results that if a student's teacher reports preparing lessons plans prior to class they have 0.08 higher test scores. The average test score for a private school student in our sample is 0.496, so this is an economically substantial relationship. Next, whether the teacher has a copy of the textbook and of the workbook is correlated with higher student value added in public schools but not in private schools. The magnitude of the relationship is striking: 0.187 higher endline test scores if the teacher answers positively to the questions. Similarly, students whose teachers report providing daily hygiene checks have about 0.287 higher test scores in public schools. Neither of these practices have a relationship that is significantly different from zero in private schools. In terms of share of time spent in teaching activities, we consider time only teaching and time on teaching *activities* – or, "on-task". We find a significant correlation in public schools for both variables when I account for school and teacher characteristics, but only find a significant relationship in private schools in the raw correlation for time on-task. Finally, teachers reporting to offer remedial classes does not have a significant relationship with student value added in either school type, though provision of above-average time to paying extra attention in class to remedial students has a significant relationship with student outcomes in public schools. The results are strikingly robust to the inclusion of controls and district fixed effects.

These teacher practices were the only practices out of all measured that showed a correlation with student value added, but of course they could also be correlated with each other, and the effectiveness of any one practice could also be different to the effectiveness of a bundle

[36] For brevity, we have omitted all the non-significant results, but they are available upon request.

of practices. To consider these issues we first check the correlation between practices and report the pairwise correlation in Table A2. The correlation between each pair of practices is not very high for the majority of the practices, with all but one pair of practices scoring about 0.20 and below. The one practice with high correlation is, naturally, the share of time spent teaching and on task since the former includes the latter. The other two sets of practices with relatively higher correlation are makes lesson plans and has a copy of the textbook/workbook, which is also intuitive — teachers who have a copy of the textbook/workbook presumably could find it easier to make lesson plans. having a copy of the textbook/workbook is also correlated with checking hygiene daily, which in India is a common measure of attention and care for the students.

Although their pairwise correlation is not too high, it could be that practices matter as a bundle. To consider this, we add all practices in a multiple regression of the same form as Equation 6, but instead of entering each practice alone we include all at once. We omit share of time teaching from this regression as it is included in the % time on-task variable. Table A3 reports the results of a multiple regression including all the practices that were shown to have a positive correlation with student value added individually in either public or private schools. Column (1) starts with the pooled sample of all schools and reports the raw marginal relationship of each teacher practice with student value added, including a dummy variable control for private school. Columns (2) and (3) add school and teacher controls, though none of the coefficients move much. Columns (4) and (5) show the results for only the sample of public school and only the sample of private schools, including all controls. Comparing with the results above, the coefficients on makes lesson plans is no longer significant in the pooled sample nor in the private sector sample, where it was significant before. The has textbook/workbook is not significant on average, but it remains significant in the public school sample as it was in the earlier results — though now the coefficient has doubled. The measure of teaching caring, checks hygiene daily, is significant throughout though it seems to be driven by a strong relationship in private schools. The variable that measures the share of time teachers spend on-task is marginally significant in the pooled sample but not in the sub-samples by sector. Finally, remedial attention in class is significant in the pooled sample and in the public school sample, but not in the private school sample.

In all, most of the practices that show a relationship on their own with student value added survive inclusion along with the other practices. To avoid multiple hypothesis testing when looking at the relationship between management and teacher practices, we build an index of these teacher practices in the same way as the management index was built: by standardizing each measure, taking an average of the practices and standardizing the average. To avoid double-counting, we use only the value of the share of time a teacher spends "on task" and omit the share of time a teacher spends teaching, as the latter is already part of the "on task" measure.

A.2 Teacher variables: constructing teacher value added

Value-added models (VAMs) of student achievement have increased in popularity in the past decades, and, with some controversy, have been used by researchers, policy markers

and school boards to assess and rank teacher quality. There has been a prolific discussion on how to best calculate teacher value added, a literature that started in the early 1970s with Hanushek (1971), and grew substantially since then. Using such value added estimation methods as measures of "teacher quality" is highly controversial, particularly if they are used with the aim of ranking teachers solely on this metric and possibly attaching pay-per-performance schemes to these results.[37] Although this important debate is ongoing, the aim of this paper is not to contribute directly to the discussion of measurement of teacher value added and its merits as a proxy for teacher quality, but rather to understand how better school management practices are related to current available measures of teacher value added as a proxy for labour productivity in the education sector.

Notwithstanding the debate on the usage of teacher value added, the recent literature on the *quality of the measure itself* in terms of producing a relatively unbiased estimator of a teacher's causal impact on student *test scores* over the period of a school year is less contentious. In a thorough test of the six most common approaches to measuring teacher value added, Guarino et al. (2014) simulate a dataset of a hypothetical school system and with knowledge of the true parameters of their data, they test the ability of the following models to assess teacher quality: (a) Dynamic OLS (DOLS); (b) Arellano and Bond Approach; (c) Pooled OLS on the gain score; (d) Average Residual (AR) approach; (e) Fixed Effects on the gain score; (f) Empirical Bayes and related estimators. They carefully describe the assumptions implied in each method, and how they could be violated in practice. They suggest that if I consider that violations of the assumptions will invariably happen given the "real world" data generating mechanisms, which estimator performs best becomes an empirical question. They put this to the test and conclude that the DOLS method is best among the six studied methods, with AR also performing well but inferior to DOLS in some settings.[38]

The DOLS model is expected to control for a student's ability and previous inputs through the lagged test score, but teacher effects are assumed to be constant over time. It is also computationally challenging to estimate and not as efficient as methods such as the Empirical Bayes methods used by Kane & Staiger (2008), Chetty et al. (2014). In a more recent paper, Chetty et al. (2014) expand the model by allowing teacher quality to vary across time. Using data from a large urban school district in the US, they show that "value-added models that control for a student's prior-year test scores provide unbiased forecasts of teachers' causal impacts on student achievement." This model was subsequently used in replication exercises by Rothstein (2014) using data from North Carolina and Kane et al. (2014) using data from Los Angeles.[39]

[37] Among many parties to this argument, Hanushek (2009) advocates for "deselecting" - or, firing - the most ineffective teachers. Gordon et al. (2006) also support measuring teacher effectiveness using teacher value added measures as a key component, though also including subjective evaluations by principals, peers and parents. Rivkin et al. (2005) suggest that "there is a strong reason to believe that a closer link between rewards and performance would improve the stock of teachers." Naturally concerns such as fairness of the measure, possible measurement error and "teaching to the test" tactics are raised; as in Baker et al. (2010) and Corcoran (2010).

[38] Singh (2015) uses the DOLS method in his context using the Young Lives dataset also from Andhra Pradesh.

[39] Although Rothstein (2014) argues that there are issues with the methodology, Chetty et al. post responses and further analysis to refute the claims. Raj Chetty's website for this project,

Our preferred specifications will use the method by Chetty et al. (2014), but we provide comparison tables with the AR and DOLS methods as well to reassure the reader the coefficients are not substantially different, though we gain efficiency in using this method.

We rely on the panel data characteristic of the data to employ teacher value added models in building the key dependent variable. To be clear, we use teacher value added in the sense that Kane & Staiger (2008) suggest: rather than looking at teacher value added with the goal of estimating the underlying education production function that requires large, detailed datasets and strong assumptions,[40] we will more simply use the measure as one that helps in assessing the "average difference" a teacher made on the test score results of the students in her class throughout the year she was teaching them.[41] In particular, we explore the how school management within public and private schools affect student test scores through their effect on teacher value added in primary schools in Andhra Pradesh.

For the sake of clarity, we reproduce here the essence of the statistical model underlying the teacher value added model from Chetty et al. (2014) in Equation 7. It shows how the authors suggest estimating teacher value added to extract the teacher effect, μ_{jt} from a panel of student-level data. $A_{i(t)}$ and $A_{i(t-1)}$ are the standardized end-of-year test score for student i in years t and $t-1$. Controlling for students' prior year test scores (or, lagged test scores) captures "most of the sorting of students to teachers that is relevant for future test achievement."[42] Further, there is some consensus in the literature that including a student's prior test scores is the best proxy available for the cumulative learning and other characteristics (such as parent's input and individual motivation) up to the point where the "new" teacher is matched with the student.[43] The test scores from the APSC data are subject-specific test scores administered by the APSC project team for English, Telugu, Science and social studies and Hindi. As only Math and Telugu tests are administered in all the primary school grades (1 through 5 in Andhra Pradesh) we primarily use these two subjects but also include some results using English. The vector X_{it} includes student and classroom characteristics as controls, namely gender, caste, religion, whether parents are labourers and whether parents are literate. Each student can be matched to a teacher, year, class and subject.

$$\begin{aligned} A_{i(t)} &= \alpha A_{i(t-1)} + \beta X_{it} + \quad \nu_{it} \\ &\qquad \text{where} \quad \nu_{it} = \mu_{jt} + \theta_c + \varepsilon_{it} \end{aligned} \tag{7}$$

where the residual term ν_{ijt} is expressed by Chetty et al. (2014) as a composite of teacher value added (μ_{jt}), exogenous class shocks (θ_c) and idiosyncratic student-level variation (ε_{it}).[44] The individual "teacher effect" is not assumed to be fixed over time but rather

http://www.rajchetty.com/chettyfiles/value_added.htm, has all the working papers and responses.

[40] See Todd & Wolpin (2007)

[41] Kane & Staiger (2008)

[42] Chetty et al. (2014)

[43] For example, Guarino et al. (2014)

[44] Chetty et al. (2014) note that their approach is similar to Kane & Staiger (2008), except that it accounts for drift. In Kane & Staiger (2008), the authors use "the student residuals ν to form empirical Bayes estimates of each teacher's value added." Essentially, this approach uses the noisy estimate of teacher value added multiplied by an estimate of its reliability, that is, the mean residual multiplied by ratio of

is allowed to fluctuate stochastically over time. They do not place restrictions on the stochastic process except that they must follow a stationary process.[45]

In short, Chetty et al. (2014) predict each teacher's value added in a school year based on the mean test scores of students she taught in other (prior and later) years. However, their innovation is that they allow teacher quality to vary over years by essentially regressing student scores in year t on the average scores in other years, "allowing the coefficients to vary across different lags." They then estimate the autocovariance of scores across classrooms taught by each teacher non-parametrically and use that information to account for "drift" in teacher quality.

They construct the estimator in three steps: The first is to run the regression in Equation 7 to recover the residuals, ν_{ijt}. They use variation across students taught by the same teacher, which is a departure from previous techniques that used both within-teacher and between-teacher variation. The second step is to estimate mean test score residuals in classrooms in year t based on mean test score residuals in prior years. If we let the mean residual test score in the class teacher j teaches in year t be $\overline{A}_{jt} = \frac{1}{n}\Sigma_{i\in\{i:j(i,t)=j\}}\nu_{it}$, and $\mathbf{A}_j^{-t} = (\overline{A}_{j1}, ..., \overline{a}_{j(t-1)})'$ is the vector of mean residual scores prior to year t in classes taught by teacher j, then a regression of $\overline{A}_{jt}$ on $\mathbf{A}_j^{-t}$ results in a set of coefficients that are the best linear predictors of $\overline{A}_{jt}$ based on prior scores.[46] The third step is using the coefficients recovered from the "best linear predictor" to predict the teachers' value added for year t, using a leave-year-out approach.

Their results using US data suggest that a 1 standard deviation improvement in teacher quality leads to higher test scores of approximately 0.14 SD for maths and 0.1 SD in English. In their measure, they scale teacher value added such that "the average teacher has value added $\mu_{jt} = 0$ and the effect of a 1 unit increase in teacher value added on end-of-year test scores is 1."[47] It is this methodology that we use to calculate teacher value added in the context of the data available for this paper.[48]

We have opted to use Chetty et al. (2014) as the measure of teacher value added for this paper, but have also checked the main results using Chetty et al. (2014)'s measure, the DOLS method, and the average residual (AR) method. Tables and figures available upon request.

(signal)-variance to (signal + noise)-variance. In a simulation exercise, however, Guarino et al. (2014) found that empirical Bayes estimates were not the most reliable estimators among the six most common studied. Another common approach is to treat two of the components of ν_{it}, namely the teacher and classroom effects as fixed effects, for example, as in Gordon et al. (2006), Rockoff (2004).

[45] As Chetty et al. (2014) explain, it thus requires an assumption that mean teacher quality does not vary across calendar years and that the correlation of teacher quality, class shocks and student shocks across pairs of years depends only on the time elapsed between the years. Formally: $\mathbb{E}[\mu_{jt}|t] = \mathbb{E}[\varepsilon it] = 0$, $Cov(\mu_{jt}, \mu_{j(t+s)}) = \sigma_{\mu s}$, $Cov(\varepsilon_{it}, \varepsilon_{i(t+s)}) = \sigma_{\varepsilon s}$ $\forall t$.

[46] We mention the OLS equivalent here for ease of exposition, but the technique used by Chetty et al. (2014) is analogous to the OLS regression method and describe it in detail in their paper.

[47] Chetty et al. (2014)

[48] To implement their method we used the accompanying Stata command `vam`.

A.3 Figures and tables

Table A1: Teacher practices and student outcomes (key coefficients only)

	Public schools			Private schools		
	(1) student test score (endline)	(2) student test score (endline)	(3) student test score (endline)	(4) student test score (endline)	(5) student test score (endline)	(6) student test score (endline)
Makes lesson plans	-0.051	-0.070	-0.060	0.106**	0.112**	0.079*
	(0.084)	(0.089)	(0.096)	(0.052)	(0.050)	(0.044)
Observations	1773	1773	1773	6922	6922	6922
# schools	81	81	81	162	162	162
Has textbook/workbook	0.145*	0.121	0.159*	0.039	0.008	-0.029
	(0.084)	(0.087)	(0.086)	(0.047)	(0.048)	(0.048)
Observations	1773	1773	1773	7012	7012	7012
# schools	81	81	81	162	162	162
Checks hygiene daily	0.198**	0.218**	0.203**	0.062	0.055	0.027
	(0.083)	(0.086)	(0.088)	(0.052)	(0.045)	(0.045)
Observations	1773	1773	1773	6969	6969	6969
# schools	81	81	81	162	162	162
% time teaching	0.729***	0.845***	0.860***	0.179	0.157	0.107
	(0.250)	(0.284)	(0.283)	(0.150)	(0.139)	(0.120)
Observations	1773	1773	1773	7002	7002	7002
# schools	81	81	81	161	161	161
% time on task	1.334***	1.612***	1.589***	0.398**	0.210	0.165
	(0.333)	(0.333)	(0.343)	(0.188)	(0.188)	(0.169)
Observations	1773	1773	1773	7002	7002	7002
# schools	81	81	81	161	161	161
Remedial: extra attention	0.268	0.296**	0.326**	0.194	0.074	0.034
	(0.177)	(0.134)	(0.147)	(0.142)	(0.144)	(0.142)
Observations	1088	1088	1088	4121	4121	4121
# schools	55	55	55	137	137	137
Baseline score	✓	✓	✓	✓	✓	✓
School controls		✓	✓		✓	✓
Teacher controls		✓	✓		✓	✓
District FE			✓			✓
Variable mean	0.049	0.049	0.049	0.497	0.497	0.497
Analysis level:	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Notes: Each cell represents a regression of each individual classroom practice and the outcome variable. All regressions control for baseline test scores, so the interpretation here can be of student value added. The table presents only the coefficient of interest. School controls include: log of school size (number of students), year of survey, subject, student characteristics and class-specific average student characteristics (share female, from scheduled caste, Christian, Muslim, with illiterate parents and with labourer parents). Teacher controls include teacher education, training, and rank. Standard errors clustered by school.

Table A2: Pairwise correlation between teacher practices - APSC data

	Makes lesson plan	Has textbook & workbook	Checks hygiene daily	share of time teaching	share of time on-task	Remedial time: extra attention
Lesson plans	1					
Textbook/workbook	0.2113	1				
Checks hygiene daily	0.023	0.1848	1			
% time teaching	0.0968	0.0697	0.1514	1		
% time on task	0.0922	0.0762	0.1375	0.7779	1	
Remedial attention	-0.0256	0.0258	0.041	0.0267	0.0062	1

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.

Notes: This table includes data for 287 schools.

Table A3: Student value added and teacher practices

	Pooled: all schools			**Public**	**Private**
	(1) student test score (endline)	(2) student test score (endline)	(3) student test score (endline)	(4) student test score (endline)	(5) student test score (endline)
Makes lesson plans	0.043	0.063	0.048	-0.025	0.096
	(0.041)	(0.043)	(0.042)	(0.101)	(0.058)
Has textbook/workbook	0.031	-0.002	-0.010	0.342***	-0.018
	(0.038)	(0.040)	(0.039)	(0.093)	(0.068)
Checks hygiene daily	0.129***	0.101**	0.105***	0.105	0.100**
	(0.043)	(0.040)	(0.040)	(0.091)	(0.043)
% time on task	0.237	0.348*	0.352*	0.718	0.303
	(0.187)	(0.192)	(0.191)	(0.456)	(0.207)
Remedial: extra attention	0.316***	0.196*	0.205*	0.331***	0.159
	(0.105)	(0.118)	(0.115)	(0.112)	(0.129)
Baseline control	✓	✓	✓	✓	✓
Private dummy	✓	✓	✓		
School controls		✓	✓	✓	✓
Teacher controls			✓	✓	✓
Observations	22762	21720	21720	2956	18764
# schools	287	263	263	85	178
R^2	0.166	0.177	0.179	0.211	0.168
Dep. variable mean	0.421	0.421	0.421	0.049	0.497
Analysis level:	**Student**	**Student**	**Student**	**Student**	**Student**

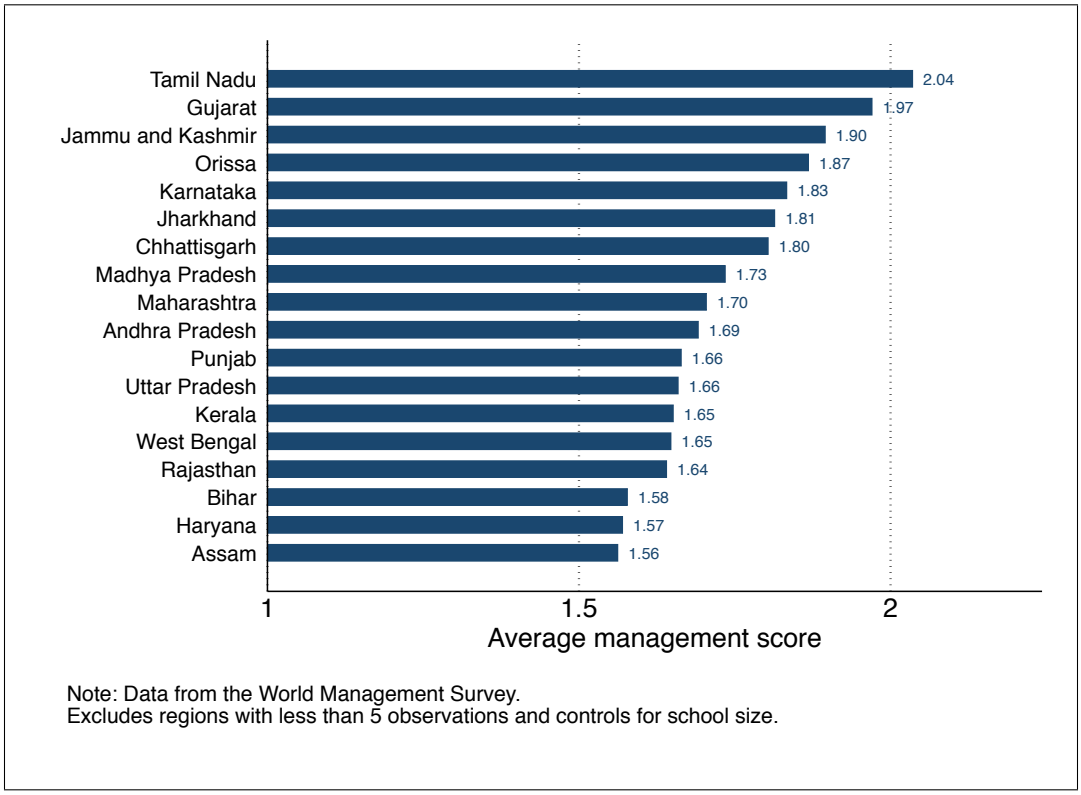
* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.

Notes: All regressions control for baseline test scores, so the interpretation here can be of student value added. School controls include: log of school size (number of students), year of survey, subject, student characteristics and class-specific average student characteristics (share female, from scheduled caste, Christian, Muslim, with illiterate parents and with labourer parents). Teacher controls include teacher education, training, and rank. Standard errors clustered by school.

B Extra results

Figure B1: Pan-India WMS scores, by state

(a) Average management scores



(b) Deviation from average management scores

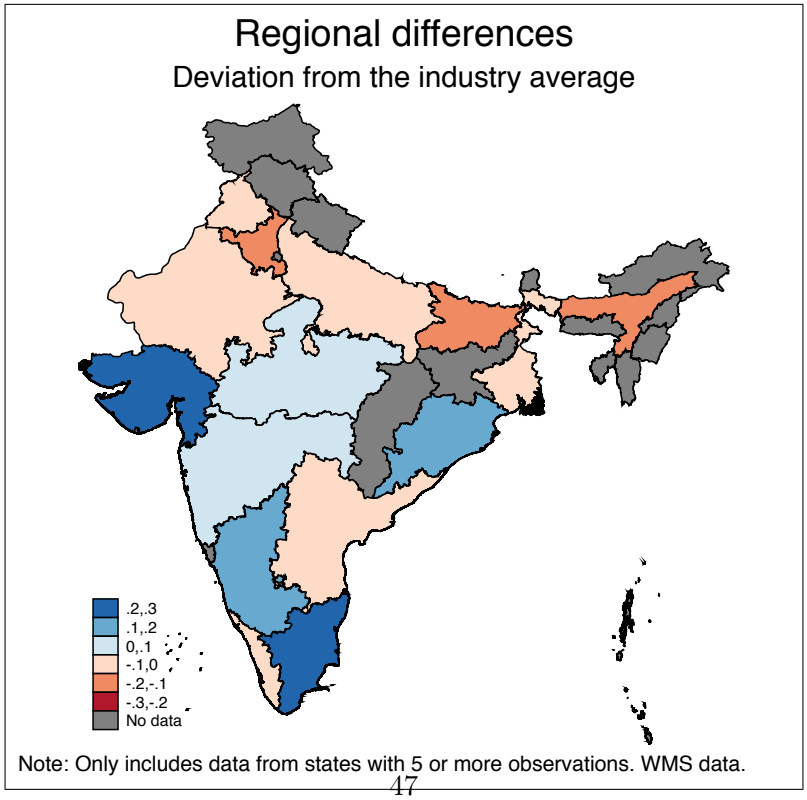
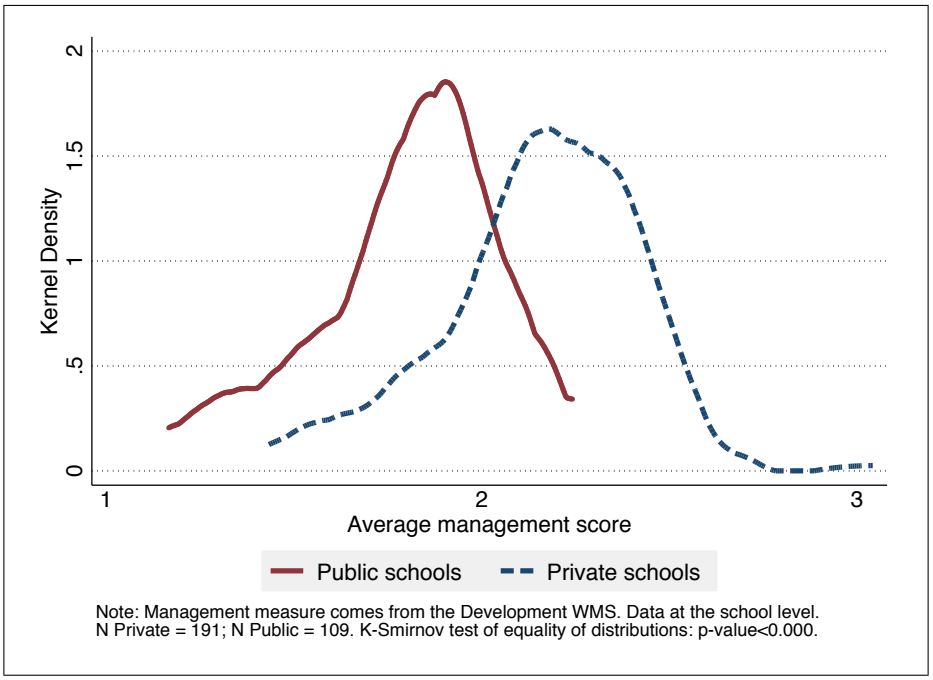


Figure B2: Distribution of management scores in Andhra Pradesh

(a) Distribution of management quality by school type



(b) Distribution of operations and people management

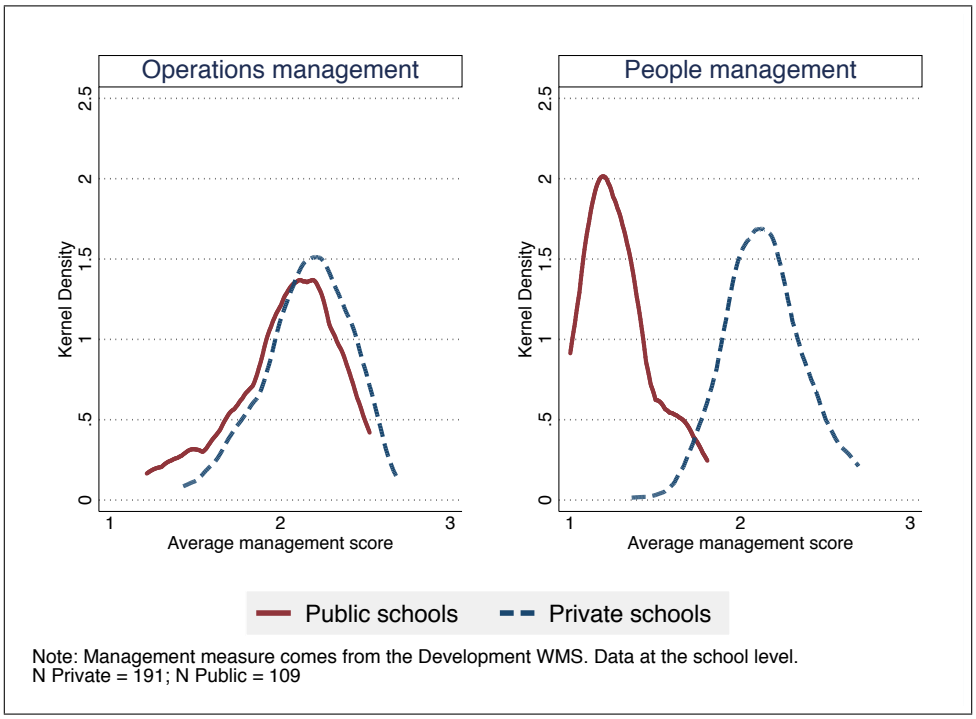


Table B1: Management practices are strongly correlated with student value added in public schools

	Math				**Telugu**				**English**			
	(1) endline test score	(2) endline test score	(3) endline test score	(4) endline test score	(5) endline test score	(6) endline test score	(7) endline test score	(8) endline test score	(9) endline test score	(10) endline test score	(11) endline test score	(12) endline test score
z-management	0.141***				0.184***				0.157			
	(0.042)				(0.053)				(0.097)			
z-operations		0.104***		0.029		0.149***		0.111*		0.135*		0.138*
		(0.036)		(0.038)		(0.045)		(0.058)		(0.079)		(0.069)
z-people			0.356***	0.313***			0.317***	0.156			0.182	-0.011
			(0.083)	(0.087)			(0.095)	(0.118)			(0.194)	(0.165)
Baseline score	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Student controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Teacher controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	3602	3602	3602	3602	3555	3555	3555	3555	2260	2260	2260	2260
# schools	109	109	109	109	109	109	109	109	105	105	105	105
R^2	0.164	0.160	0.171	0.172	0.162	0.160	0.154	0.163	0.0987	0.0994	0.0874	0.0994
Analysis level:	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Notes: Standard errors are clustered by school. z-management is the standardized average of the z-scores of each individual management practice. z-operations and z-people are the standardized average of the z-scores of each individual management practice relating to operations and people, respectively. All specifications include controls for number of students (log), year, and subject. Student controls include a female dummy, scheduled caste, religion, parents literacy and labourer status, household infrastructure index. Teacher controls include teacher education, training, experience, and number of school days.
Timing: Management data collected in 2013. Student and teacher data collected between 2008 to 2012 under the APRESt program.

Table B2: Public and private schools are starkly different on observables

	Private	Public	Mean Difference	SD Private	SD Public	Public N	Private N
School Characteristics							
Number of students	209.69	65.51	144.18***	135.30	40.28	109	191
Number of teachers	13.61	3.67	9.93***	8.10	5.87	109	191
Student-teacher ratio	15.98	21.58	-5.60***	6.58	7.33	109	189
Medium of instruction: telugu	0.41	1.00	-0.59***	0.47	0.00	109	191
School Infrastructure							
Average school infrastructure index	2.00	0.94	1.06***	2.99	2.06	109	191
– available water	1.00	0.97	0.02	0.03	0.13	109	191
– functional toilet	0.95	0.75	0.20***	0.20	0.39	109	191
– functional girls toilet	0.91	0.55	0.36***	0.27	0.49	109	191
– functional electricity	0.95	0.71	0.24***	0.20	0.41	109	191
– functional computers	0.64	0.03	0.61***	0.47	0.17	109	191
– functional library	0.91	1.00	-0.09***	0.27	0.00	109	191
– functional radio	0.33	0.79	-0.47***	0.46	0.34	109	191
Student Characteristics							
% Female students	0.47	0.54	-0.07**	0.21	0.23	104	179
% students from Scheduled Caste	0.17	0.40	-0.23***	0.20	0.36	104	179
% Muslim students	0.11	0.08	0.04	0.21	0.16	109	191
% Christian students	0.03	0.09	-0.06**	0.08	0.19	109	191
% students with both parents literate	0.66	0.53	0.13***	0.26	0.33	109	191
% students with both parents as laborers	0.25	0.48	-0.23***	0.24	0.32	109	191
Average Household Asset Index	3.58	3.19	0.39***	0.57	0.62	109	182
Endline score (school average)	0.38	0.05	0.33***	0.40	0.48	109	191
Teacher Wages							
Monthly wage (000 Rs)	2.45	12.27	-9.82***	2.95	6.15	1081	282
Teacher Characteristics							
Male	0.24	0.44	-0.20***	0.43	0.50	1089	310
Age	27.89	37.80	-9.90***	8.04	8.36	1090	310
Teaching experience	5.47	12.73	-7.27***	6.20	7.20	1087	309
Years of education	14.65	15.85	-1.21***	2.25	1.90	1083	310
–Matriculation	0.06	0.02	0.04***	0.23	0.13	1090	310
–Higher secondary	0.28	0.13	0.15***	0.44	0.34	1090	310
–College or Masters degree	0.65	0.85	-0.20***	0.47	0.35	1090	310
Completed teacher training	0.33	0.94	-0.61***	0.46	0.23	1090	310
Teacher teaches all subjects = 1	0.12	0.76	-0.65***	0.31	0.38	1090	310
(mean) potexp	8.24	16.95	-8.71***	7.99	8.11	1090	310
Teacher practices							
Teacher prepares lesson plan = 1	0.43	0.67	-0.25***	0.48	0.46	1088	309
Teacher has textbook/workbook = 1	0.38	0.36	0.02	0.47	0.46	1090	310
Teacher observes hygiene daily = 1	0.51	0.75	-0.24***	0.49	0.42	1087	310
Share of time used on teaching	0.55	0.56	-0.01	0.15	0.14	1088	310
Share of time used on teaching activities	0.73	0.70	0.03***	0.12	0.10	1088	310
Remedial action: + attention in class = 1	0.03	0.07	-0.04	0.18	0.25	738	184

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Data at the school level, averaging over four years of data. Includes only schools for which we collected management data. Teachers includes all teachers in the school (inclusive of head teachers).

Table B3: Public and private schools have different head teacher characteristics

	Public	**Private**	**Mean Difference**	**SD Public**	**SD Private**	**Public N**	**Private N**
Monthly wage (000 Rs)	12.45	2.96	-9.49***	5.75	3.65	122	539
Potential experience	17.16	10.73	-6.43***	7.66	9.37	133	541
Teaching experience	12.70	7.68	-5.02***	6.69	7.70	133	538
Years of education	15.94	14.88	-1.06***	1.92	2.25	133	540
–Matriculation	0.02	0.06	0.05***	0.12	0.25	133	541
–Higher secondary	0.13	0.23	0.10**	0.34	0.42	133	541
–College or Masters degree	0.86	0.71	-0.15***	0.35	0.46	133	541
Completed teacher training	0.95	0.36	-0.59***	0.22	0.48	133	541
Age	38.10	30.58	-7.52***	7.75	9.03	133	541
Male	0.37	0.31	-0.06	0.48	0.46	133	541

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Data at the school-year level. 97% of schools have reported a single head teacher for the school year. Includes only teachers identified as head teachers in the survey, or if no teacher was identified as the head teacher, we assigned the highest paid teacher/most senior teacher as the headteacher.

Table B4: Management practices are correlated with teacher practices in the classroom (key coefficients only)

	Public schools			**Private schools**		
	(1) teacher practice index	(2) teacher practice index	(3) teacher practice index	(4) teacher practice index	(5) teacher practice index	(6) teacher practice index
z-management	0.356***	0.416***	0.413***	0.168***	0.165***	0.141***
	(0.065)	(0.070)	(0.067)	(0.050)	(0.048)	(0.047)
z-operations	0.284***	0.340***	0.338***	0.158***	0.154***	0.132***
	(0.053)	(0.058)	(0.055)	(0.046)	(0.044)	(0.043)
z-people	0.561***	0.579***	0.570***	0.183**	0.175**	0.147**
	(0.150)	(0.145)	(0.142)	(0.075)	(0.075)	(0.072)
School controls		Y	Y		Y	Y
Teacher controls			Y			Y
Observations	704	704	704	1296	1278	1278
# schools	109	109	109	191	190	190
R^2	0.0944	0.105	0.114	0.0707	0.0861	0.110
Variable mean	-0.076	-0.076	-0.076	-0.151	-0.151	-0.151
Management SD	0.25	0.25	0.25	0.25	0.25	0.25
Analysis level:	**Teacher**	**Teacher**	**Teacher**	**Teacher**	**Teacher**	**Teacher**

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Notes: Standard errors are clustered by school. Teacher practice index is an index of six classroom practices: makes lesson plans, has textbook/workbook, checks hygiene daily, % time teaching, % time on task, remedial class: extra attention. Each cell represents a regression of the teacher practices index and the independent variable — z-management, z-operations, or z-people — and reports only the coefficient of interest. z-management is the standardized average of the z-scores of each individual management practice. z-operations and z-people are the standardized average of the z-scores of each individual management practice relating to operations and people, respectively. All specifications include controls for number of students (log). Teacher controls include teacher education, teacher training, potential experience, potential experience squared and teacher position in the school (headteacher, regular teacher, vidya volunteer). **Tests of equality of coefficients:** The coefficients for the overall management index and operations management index are not significantly different between public and private schools. The coefficients for the people management index are significantly different at the 10% level.

Table B5: Management practices and student value added: private schools

	Pooled Math and Telugu: private schools only					
	(1) endline test score	(2) endline test score	(3) endline test score	(4) endline test score	(5) endline test score	(6) endline test score
z-management	0.050*	0.040	0.037			
	(0.030)	(0.029)	(0.028)			
z-operations				0.023		-0.022
				(0.026)		(0.038)
z-people					0.094**	0.127*
					(0.045)	(0.065)
Baseline score	Y	Y	Y	Y	Y	Y
Student controls		Y	Y	Y	Y	Y
Teacher controls			Y	Y	Y	Y
Observations	28807	28807	28807	28807	28807	28807
# schools	190	190	190	190	190	190
R^2	0.0650	0.131	0.135	0.134	0.136	0.141
Analysis level:	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Notes: Standard errors are clustered by school. z-management is the standardized average of the z-scores of each individual management practice. z-operations and z-people are the standardized average of the z-scores of each individual management practice relating to operations and people, respectively. All specifications include controls for number of students (log), year, and subject. Student controls include a female dummy, scheduled caste, religion, parents literacy and labourer status, household infrastructure index. Teacher controls include teacher education, training, experience, and number of school days. **Tests of equality of coefficients:** The coefficients on zoperations and zpeople management in columns (4) and (5) are significantly different at the 10% level. We cannot reject that the two coefficients are significantly different from each other, however, in Column (6). **Timing:** Management data collected in 2013. Student and teacher data collected between 2008 to 2012 under the APRESt program.

Table B6: Management practices and student value added: private schools

	Math				Telugu				English			
	(1) endline test score	(2) endline test score	(3) endline test score	(4) endline test score	(5) endline test score	(6) endline test score	(7) endline test score	(8) endline test score	(9) endline test score	(10) endline test score	(11) endline test score	(12) endline test score
z-management	0.048				0.033				0.137***			
	(0.034)				(0.029)				(0.047)			
z-operations		0.039		0.020		0.014		-0.058		0.119***		0.090
		(0.031)		(0.048)		(0.026)		(0.037)		(0.044)		(0.059)
z-people			0.072	0.050			0.126***	0.190***			0.176**	0.078
			(0.054)	(0.082)			(0.047)	(0.065)			(0.069)	(0.093)
Baseline score	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Student controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Teacher controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	14253	14253	14253	14253	14554	14554	14554	14554	10791	10791	10791	10791
# schools	188	188	188	188	186	186	186	186	183	183	183	183
R^2	0.117	0.117	0.117	0.117	0.152	0.152	0.157	0.158	0.241	0.241	0.239	0.241
Analysis level:	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**	**Student**

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Notes: Standard errors are clustered by school. z-management is the standardized average of the z-scores of each individual management practice. z-operations and z-people are the standardized average of the z-scores of each individual management practice relating to operations and people, respectively. All specifications include controls for number of students (log), year, and subject. Student controls include a female dummy, scheduled caste, religion, parents literacy and labourer status, household infrastructure index. Teacher controls include teacher education, training, experience, and number of school days.
Timing: Management data collected in 2013. Student and teacher data collected between 2008 to 2012 under the APRESt program.

Table B7: Correlates of management quality: private schools

	(1) z-management	(2) z-management	(3) z-management	(4) z-management	(5) z-management	(6) z-management
Teacher demographics						
% teachers with a degree	0.569***					0.509**
	(0.192)					(0.196)
% teachers with teacher training	0.145					0.138
	(0.208)					(0.206)
Average potential experience	0.011					0.008
	(0.020)					(0.019)
Average teaching experience	-0.018					-0.019
	(0.030)					(0.028)
% male teachers	-0.081					-0.133
	(0.241)					(0.216)
Headteacher demographics						
Headteacher age		-0.002	-0.004	-0.005	-0.005	-0.007
		(0.008)	(0.008)	(0.007)	(0.007)	(0.007)
Headteacher is male = 1		0.388**	0.393**	0.376**	0.378**	0.371**
		(0.178)	(0.179)	(0.168)	(0.169)	(0.168)
Headteacher tenure		0.010	0.011	0.006	0.007	0.011
		(0.009)	(0.009)	(0.008)	(0.008)	(0.008)
Headteacher autonomy						
Autonomy index			-0.254		-0.090	-0.053
			(0.160)		(0.149)	(0.168)
Headteacher perception						
Knowledge self score (overall)				0.191***	0.187***	0.171***
				(0.042)	(0.043)	(0.045)
Base controls	Y	Y	Y	Y	Y	Y
Observations	188	188	188	188	188	187
# schools	188	188	188	188	188	187
R^2	0.128	0.111	0.122	0.210	0.211	0.251
Analysis level:	**School**	**School**	**School**	**School**	**School**	**School**

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Standard errors are clustered by school. z-management is the standardized average of the z-scores of each individual management practice. Headteacher autonomy index measures whether the headteacher has any autonomy in hiring new additional teachers or changing the academy content. Headteacher knowledge self-score is a self-assessment measure on a scale of 1 to 10 of knowledge in overall management practices. Base controls include interviewer dummies, number of students (log), number of teachers (log) and a school infrastructure index. Headteacher refers to the teacher formally appointed as headteacher or the most senior teacher at the school.

C Summary of the D-WMS survey tool

Table B8: Operations management

	Process implementation	**Process usage**	**Process monitoring**
	formulating, adopting and putting into effect management practices	carrying out and using management practices frequently and efficiently	monitoring the appropriateness and efficient use of management practices
Topic	**Questions**		
2. Standardization of Instructional Planning Processes	How do you ensure that all students of a given grade are learning the same topics in the same way within a similar timeframe?	Why did you and the teachers decide on the current curriculum, textbooks and other materials and lesson plans used throughout the year?	How do you keep track of what teachers are doing in the classrooms?
3. Personalization of Instruction and Learning	How much does the school try to identify individual student needs and accommodate these needs within in the classroom?	How do you make sure students and parents are engaged in the students' learning?	How do you keep track of what teachers are doing in the classrooms to ensure that different student needs are taken care of?
4. Data-driven Planning and Student Transitions	What type of information about the individual students is available to teachers at the beginning of the academic year?	What do you think are the main points of transition/promotion for students and how is this communicated to your teachers?	Does the school use any data to consider student promotions through critical transitions (such as grade promotions or unit progressions)?
5. Adopting Educational Best Practices	How do you encourage the teachers to incorporate new teaching practices into the classroom?	How do you make sure the teachers are using the new techniques you are trying to introduce?	By what means and how often are these learnings shared across teachers and subjects and how often?

Table B9: Monitoring management

	Process implementation	**Process usage**	**Process monitoring**
Topic	**Questions**		
6. Continuous Improvement	When you have a problem in the school, how do you come to know about them and what are the steps you go through to fix them?	Who is involved in improving/suggesting improvements to the process so these issues do not happen again?	Who is involved in resolving these issues, that is, in deciding what course of action will be taken to resolve the issue?
7. Performance Tracking	What kind of main parameters do you use to track school performance and what documents are you using to inform this tracking?	How often are these main parameters measured?	If I were to walk through your school, how could I tell how it is doing compared to its main parameters?
8. Performance Review	How often do you have meetings to review the parameters?	Who is involved in these meetings and who gets to see the results of these meetings?	After reviewing these parameters, what is the action plan, that is what steps do people take after leaving the meeting?
9. Performance Dialogue	Can you tell me about a recent review meeting you have had?	What kind of data or information about the parameters do you normally have with you?	What type of feedback do you get during these meetings and how do you get to solving the problems raised?
10. Consequence Management	After a review meeting, how are people aware of their responsibilities and actions that must be taken?	How would you make sure this problem does not happen again?	How long does it typically go between when a problem starts and you realize this and start solving it?

Table B10: Target management

	Process implementation	Process usage	Process monitoring
Topic		**Questions**	
11. Balance of Targets/Goal Metrics	What goals do you have set for your school?	Can you tell me about any specific goals for departments, teachers and staff?	How are your school goals linked to student outcomes and to the goals of the school board system (government/ICSE/CBSE)?
12. Interconnection of Targets/Goals	How do you learn of the goals the school system expects of you?	If I were a teacher or another member of the school, what kind of goals would I have?	How do you communicate to your teachers and staff what their goals are?
13. Time Horizon of Targets/Goals	Which goals would you say get the most emphasis?	What kind of time-scale are you looking at with your goals?	Could you meet all your short term goals but miss your long-run goals?
14. Stretch of Targets/Goals	How are your goals benchmarked?	Do you feel that all the departments/areas have goals that are just as hard or would some areas/departments get easier targets?	On average, how often would you say that the school meets their goals?
17. Clarity and Comparability of Goals	What are the goals based on?	If I asked one of the teachers directly about their individual goals, what would they tell me?	How do people know about their own performance when compared to other people's performance?

Table B11: People management

	Process implementation	Process usage	Process monitoring
Topic		**Questions**	
18. Building a High Performance Culture/ Rewarding High Performers	Can you tell me about the criteria that you use in your appraisal (evaluation) system?	What types of monetary or non-monetary rewards are given to teachers and how are these linked to the ranking teachers get?	By what means and how often do you evaluate and rate your teachers?
19. Making Room for Talent/ Removing Poor Performers	What criteria do you use and how often do you identify your worst teachers?	If you had a teacher who is struggling or who could not do their job properly, what would you do? What if you had a teacher who would not do their job, as in slacking off, what would you do then?	How long does it take to address the issue once you come to know that a teacher is performing badly?
20. Promoting High Performers	What criteria do you use and how often do you identify your best teachers?	What types of career and teacher development opportunities are provided?	How do you make decisions about promotion/progression of teachers and additional opportunities within the school, such as performance, years of service, etc.?
21. Managing Talent	Who decides how many and which teachers (full-time regular members of staff) to hire?	Where do you seek out and find teachers and how do you ensure you have the teachers you need for the subjects you have?	How do you decide which teachers should be hired?
22. Retaining talent	When one of your best teachers wants to leave the school, what do you do?	Could you give me an example of what you would be able to offer to try and keep that best teacher in your school?	How would you know if your best teachers are happy working in this school?
23. Creating a Distinctive Employee Value Proposition	What are the professional benefits of working at your school?	How do teachers come to know that working at your school is better than others?	How do you check to see if teachers are aware of the benefits of working at your school?