

## **No Magic Bullets, Just Tracer Bullets:**

The role of learning resources, social advantage, and education management  
in improving the performance of South African schools

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### **I. Introduction and executive summary**

Are resources the key to increasing the education system's performance, as measured by, say, matriculation pass rates? If one "controls," statistically, for resource availability, is the poor performance of many schools perfectly understandable? Or is there too much emphasis on trying to increase and re-distribute resources, and too little emphasis on the wise management of those resources? Or can *either* resources or good management really do much to improve results, given the widespread social inequalities, poverty, unemployment, community and familial problems and crime? Is it right to expect that the education system, as such, will have much effect on learning, when there are such daunting social-environmental factors impacting on schools? It would seem critical to begin trying to develop rigorous answers to such questions.

Over the past few years, as South Africa attempts to transform its education system, much—perhaps most—of the intellectual attention and bureaucratic effort (in the "systems" area—we are abstracting from the enormous effort devoted to issues such as curricular reform) has gone to the re-distribution or allocation of quantitative resources. For example:

- Effort has gone into educator re-deployment, based on a quantitative norms relating to learner:educator ratios. This required considerable effort, and has led to debate and even legal cases.
- Effort has gone into the drafting of funding norms whose emphasis is mostly the re-distribution of material and financial resources. The norms attempt to lay down specific numeric targets as re-distributive goals for many spending categories.
- Effort has gone into building schools in areas which previously have not been well-provided.
- Much attention and debate focuses on the establishment of the education budgets in dialogues between national parties, inside provincial administrations, and between provincial and national line and fiscal departments. A large amount of time and emotional energy is devoted to this issue.

However, the problem of the *management* of those resources, the under-performance of even rather well-resourced schools, and the high performance of poorly resourced schools, also receives attention:

- As follow-up on the breaking of the news about the drop in matriculation pass rates, the Minister visited schools that are "well-managed" but resource-poor, and are therefore producing good results in spite of resource-poverty. Aside from the symbolic effect of such visits, they motivate a healthy debate about whether the amount of money provided matters more or less than its wise usage, and focus attention on managerial improvement.
- In civil society, the Sunday Times has sponsored exercises that attempt to develop a systematic method to assess relative over-performance using quantitative methods, and to use this to celebrate schools that are "adding-value" beyond the resources they receive.

- A great deal of discourse and planning has gone into the establishment of improved management structures. Examples would be the Education Management Development Institute (EMDI) and the EMD initiative more generically, as well as the current plan to model improved management structures with funding from the national Education Policy Reserve, via a district improvement project. At the provincial level, Gauteng, for example, has devoted attention and effort to strategic management initiatives and innovation both at provincial and district level.

The problem of *contextual poverty*, and how much schools can or cannot do to counter the influence of socio-economic disadvantage, has received much less attention. Except for a few initiatives such as the Primary School Nutrition Programme, there is not much to mention here. Yet, it is an important issue: if the environmental influence is overwhelming, at least one ought to acknowledge this and both the state and the nation ought to be more modest about how much one sector, by itself, can do. Broader anti-poverty initiatives would be called for, and the education establishment ought not to be expected to solve education problems by itself.

In this paper we try to lay out two related ideas. First, we try to dis-entangle the separate and combined effects of the three factors discussed above. This is important from a *policy* point of view, in the sense that it can help guide us as to whether we are devoting the right amount of attention to these factors. Secondly, we lay out a method whereby one can begin to rigorously control, using statistical techniques, for the influence of resources and poverty on a school's performance. The remnant, namely the degree of performance that cannot be explained away via resources and environment must have to do with the quality of management at that school or district. This is important from a *management* point of view, because it can give us a method that allows us to develop, for every single school (and its district, by implication), a *reasonable* (if not taken too rigidly, and developed in a consensual or contractual manner) contractual performance expectation of its management. This can be used by provincial and district managers to begin to hold schools accountable for specific levels of performance that are reasonable—not too high, not too low—given the school's resources and environment. We know that high but not unreasonable expectations, applied in performance-contract terms to every single school and ideally in quantitative terms, are a key performance motivator, and yet one has lacked the means to develop specific performance expectations for every single school. Obviously, one has to take care in the design of and administration around such performance expectations, because of the danger of creaming or skimming of bright pupils from poorer to richer schools, but the importance of setting expectations is clear.

Our method required a) putting together data from the matriculation exams data base, school by school, b) to compare it with the data from the Education Management Information System (EMIS) in order to get a good idea of the quality and quantity of personnel resources each school uses, c) to compare it with data from the School Register of Needs (SRN) to get a good idea of the physical condition of the school, and d) finally to compare it with a socio-economic database commissioned by the national Department of Education, that allows us to assess the poverty of the school's environment. This is the first time that four separate databases have been brought together in South Africa in order to examine the correlation between all these factors, and to try to apportion the effects of these factors on learning. It is a laborious and time-consuming task, which we could develop only as a methodological exercise.<sup>1</sup> To apply it in a real situation would require more work still, but it would be fairly routine work once the basic method is understood.

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<sup>1</sup> All this analysis would have been impossible without all the previous hard work that it took to put together the databases on which we relied, for which use we are extremely grateful. We can hope that it is gratifying to those who had the foresight and did the work to see that their databases are put to use.

The study has so far been done for Gauteng and Northern Cape. In this paper we will refer to the Northern Cape study, but will give detailed results only for the Gauteng analysis, since the Northern Cape exercise is covered in detail in a separate paper.

The method has serious limitations which we acknowledge. For example, many of the schools have some data missing, so the numbers included in the study are not as large as ideal. Second, the matriculation exams are a poor measure of learning outcomes, for many reasons, but they are better—far better—than nothing. The better the exam system, the better the results. But note that applying the method we outline here requires an exam system that is census-like rather than based on random samples. We believe it is essential for any serious system of quality assessment to have access to census-type exams. Third, our measure of poverty is too broad, and does not focus on individual children or even schools, but on whole areas. Fourth, the measurement of learning is not itself value-added—in other words, it does not rely on a pre-test and a post-test. Fifth, the study ignores profound problems well-known in the evaluation literature, related to self-selection, the influence of peers in learning, etc. Sixth, the study cannot detect the independent influence of individual vs. school factors. One could get closer by isolating matric classes within schools. Seventh, the study focuses on the overall pass rate, not individual subjects. There may be other problems. We want to be the first to acknowledge problems, since this does not even begin to pretend to be the definitive study on the matter.

In spite of these problems the results are strong enough that their implications cannot be ignored—they pass the economists' inter-ocular test: they hit one right between the eyes. Yet, because it *is* only one study, and it has limitations, its conclusions should not have too much impact on policy until other studies, by other researchers, begin to confirm our findings, and until it is possible to include all (or, say, 95%) of schools in the study. If other studies deny our findings, then we have to go back to square one.

Our policy conclusions—subject to the above warnings—are that:

- Poverty is an important factor that cannot be subsumed under the notion of “resources.” Even controlling for resources, poor children, or schools in poverty-stricken areas, tend to perform much worse than others: **schools in very poor areas tend to have matriculation pass scores some 20 points lower than schools in richer areas**, even if one statistically makes resources “equal.” It is thus wise to be increasingly modest about how much one single sector—education—can achieve until the worst aspects of poverty are dealt with via economic growth, redistribution, targeted anti-poverty programmes, and programmes aimed at increasing social capital.
- Related to poverty but somewhat independent of it, and independent of resources, is the fact that **a school's being in a township, or just being ex-DET, also appears to decrease matriculation pass rates by about 20-30 points**. Again, **even with more or less equal resources**, and controlling for poverty, ex-DET schools appear to under-perform. In both Gauteng and Northern Cape, whether a school is a township or rural school of non tri-cameral origin was the single most important factor in explaining matriculation pass performance, even after taking resource inequality and poverty into account. This suggests that managerial and culture of learning and teaching issues are of extraordinary importance: these factors seem to matter more than resources—certainly more than the “bricks and mortar” and easily quantifiable resources.
- When it comes to resources, the learner:educator ratio seems to matter much less than the quality of the educators. **The qualifications of educators (as measured by the average REQV at the school) seemed, by far, a more important factor than any ratio**, or any other cost-related resource factor. An increase in the education of educators equivalent to one REQV (roughly one year) appears to be associated with an increase in pass rates of about 16 or so points. (Unfortunately this was not independently assessed in Northern Cape, though in this province we did determine that the L:E ratio seems to have a small level of influence on pass rates.) The physical conditions of the school (as assessed in the SRN) did not appear an important factor, if one accounts for all the other ones we have mentioned, though these conditions probably

do play some role. We note that an educator re-deployment process that focuses on the L:E ratio, and pays little or no attention to quality, would seem relative ineffectual, according to our results. A focus on cost of educators (e.g., by focusing on redistributing educators on a cost-per-learner basis), and hence on quality, would seem more indicated. Similarly, attempting to increase the quality of educators, and their ability to handle relatively large classes, would seem indicated. Interestingly, we found little evidence that years of experience matter much, thus calling into question all the criticism of the re-deployment and rationalisation process as resulting in the loss of the most experienced teachers. Thus, the study begins to suggest that a process of vastly improved educator upgrade, support, and productivity supervision, may well be far more important than focusing on L:E ratios and quantitative equality. Other resources—such as computers and the availability of well-stocked media centres—appear of some importance. We doubt that computers and well-stocked media centres are the only important physical resources, and assume that they simply proxy the fact that kinds of resources that are strongly associated with immediate cognitive delivery (books, stationery, etc.) do matter.

- Finally, we found that, as expected, even after taking into account all our measures of poverty, resources, and so forth, we have that some 30% of the performance of schools remains “unexplained.” We take it that this refers to managerial factors. Thus the importance of an emphasis on management. South Africa has done much too little on this score so far, and what little it is doing seems half-formed.

In terms of management strategy (which our policy conclusions above suggest is important), we can conclude that it is possible, even now, to develop quantitative evidence, school-by-school, on what a reasonable level of expectation for each school should be (at least in the more advanced provinces—in the others it might take a few years). This can be used in management in various ways. Schools that are performing below expectation, even after controlling for the fact that they are in a poor area or have few resources, can be targeted for managerial rather than resource assistance. These will often be schools that are not really in extremely bad shape, from the point of view of quantitative resources. Schools that are performing reasonably well managerially, given their resources, but if they are in a poor area, can be favoured in terms of resources, because these would be the schools where, since management seems to be rather good and yet the area is poor, then improved resources are likely to have a more liberating effect, and are likely to be well-used, than in schools that are well-off or poor but are badly managed. We would feel confident in making the claim that good analytical and EMIS methodology for developing these targeted management interventions, while not perfect, can be applied in South Africa right now, at least in the more developed provinces. It will, however, require the development of more analytical skills in the staff, or more staff with such skills.

## II. Description of the analysis

As explained previously, the analyses performed for Gauteng and Northern Cape were very similar, and our conclusions in this paper are based on both sets of results. Here we will refer only to the Gauteng analysis, since the NC analysis has been described in some depth in a separate paper.

### II.1. Data

The following variables were considered. Note that the EMIS and exams variables are for 1997 whereas the poverty and SRN variables were measured as of 1996. This inconsistency is not ideal, but is unlikely to affect results by more than a few percentage points.

PASSRATE	Usual Std. 10 pass rate, at school level, from Qdata exams database. On a 0-100 range.
LEARNERS	Total number of learners at the school.

EDUCATOR	Total number of educators at the school.
BUILDCON	Physical conditions of school as per SRN (1-worst, 5-best).
PLATOONI	Whether school platooning (1-yes, 2-no), as per SRN.
LER	Learner:educator ratio.
LCR	Learner:classroom ratio.
TEXTBOOK	Whether textbook supply is adequate, as per SRN (1-yes, 2-barely, 3-none).
STATIONE	Whether stationery supply is adequate, as per SRN (1-yes, 2-barely, 3-none).
MATERIAL	Whether materials supply is adequate, as per SRN (1-yes, 2-barely, 3-none).
MEDIA	Whether resources in media centre are adequate, as per SRN (1-yes, 2-barely, 3-none).
DROPOUT	Ratio of grade 12 to grade 8 enrolment.
MEDIACEN	Number of rooms devoted to media centre(s), as per SRN.
COMPUTER	Number of computers used for instruction, as per SRN.
AGE_1	Average age of educators, as per EMIS.
DEP_1	Number of deputy principals, as per EMIS.
HOD_1	Number of heads of department, as per EMIS.
POST_L_1	Average post ranking of educators, as per EMIS.
PRINC_1	Number of principals, as per EMIS.
QUALIF_1	Average REQV of educators, as per EMIS.
YEARS__1	Average years of teaching experience, as per EMIS (approx. corresp. to years of education).
TOWN	Whether the school is a township school (judging by name and location).
POVIND	Poverty index of area around school, based on the following weights: 70% for the education of the generation aged 25 and older in the area around the school, 30% for the existence of piped water in the houses in the area, and 30% for the existence of electrification in the area, as of 1996. In Soweto and in ex-coloured areas around Johannesburg, and as an experiment on the feasibility of committee-based ratings, we subjectively further rated areas on a range of 1 to 3 to account for within-area differences. For ex-HoR (c) or Soweto (s) schools, we experimented with subjective ranking of the SES gradient within the c or s schools on a 1-3 basis, where 1 is best off and 3 is worst off. For ex-HoR, we assumed that the worst off (3) are marginally better off than the Soweto average, and for 1 we assumed the poverty level was only slightly higher than the overall Johannesburg average of 0.15. Thus, for ex-HoR the POVIND was 0.2 if the subjective judgement was 1, 0.5 if the judgement was 3, and 0.35 if 2. For Soweto, the average poverty level is 0.57. The worst off areas were given 0.7, the middle-areas were given 0.57, and the best-off areas were given 0.45.

## II.2. Basic correlations and regression analyses

The following long table shows the basic correlations amongst all these variables. The most important row is, obviously, the first one, corresponding to the PASSRATE.

	PASSRATE	LEARNERS	EDUCATOR	BUILDCON	PLATOONI	LER	LCR
PASSRATE	1.0000	-.1291**	.2058***	.2006***	.0773	-.3611***	-.3694***
LEARNERS	-.1291**	1.0000	.7373***	-.0020	.1071*	.6178***	.3480***
EDUCATOR	.2058***	.7373***	1.0000	.1152**	.1732***	.0167	.0409
BUILDCON	.2006***	-.0020	.1152**	1.0000	.1851***	-.1292**	-.1975***
PLATOONI	.0773	.1071*	.1732***	.1851***	1.0000	-.0984*	-.0813
LER	-.3611***	.6178***	.0167	-.1292**	-.0984*	1.0000	.4879***
LCR	-.3694***	.3480***	.0409	-.1975***	-.0813	.4879***	1.0000
TEXTBOOK	-.2829***	.1630***	-.0231	-.1834***	.0548	.2268***	.1519***
STATIONE	-.0566	-.0025	-.0688	-.1018*	.1130**	.0488	.0635
MATERIAL	-.4310***	.1110**	-.1136**	-.1705***	-.0015	.2475***	.2903***
MEDIA	-.4793***	.0823	-.1269**	-.1867***	.0332	.2170***	.3079***
DROPOUT	-.1767***	-.3526***	-.3605***	-.0051	.0127	-.1807***	-.1173**
MEDIACEN	.2575***	.2920***	.3897***	.2035***	.2229***	-.0169	-.2160***
COMPUTER	.5703***	-.0405	.2395***	.2066***	.0907*	-.2638***	-.2971***
PLATOON	.0930*	.1071*	.1732***	.1851***	1.0000***	-.0984*	-.0813
LEARNED	-.3611***	.6178***	.0168	-.1293**	-.0986*	1.0000***	.4878***
LEARNCL	-.3696***	.3481***	.0409	-.1974***	-.0812	.4879***	1.0000***
AGE_1	.1539***	-.2266***	.0015	.0795	.0963*	-.3512***	-.1848***
DEP_1	.2435***	.3529***	.4435***	.0780	.0783	.0447	-.0147
HOD_1	.2217***	.5556***	.6249***	.0139	.0738	.1197*	.0422
POST_L_1	-.1116*	-.2235***	-.2456***	.0184	.0089	-.0654	-.1118*
PRINC_1	.1322**	-.0061	.0015	-.0029	.0088	.0215	-.0470
QUALIF_1	.6812***	-.1016*	.1628***	.1006*	.0463	-.2658***	-.3271***
YEARS__1	.2332***	-.1486**	.0891	.0375	.1339**	-.3669***	-.2446***
TOWN	-.6489***	.3683***	.0662	-.1162**	-.0803	.4519***	.4419***
POVIND	-.6410***	.3914***	.0681	-.1772***	-.0609	.4699***	.4703***

	TEXTBOOK	STATIONE	MATERIAL	MEDIA	DROPOUT	MEDIACEN	COMPUTER
PASSRATE	-.2829***	-.0566	-.4310***	-.4793***	-.1767***	.2575***	.5703***
LEARNERS	.1630***	-.0025	.1110**	.0823	-.3526***	.2920***	-.0405
EDUCATOR	-.0231	-.0688	-.1136**	-.1269**	-.3605***	.3897***	.2395***
BUILDCON	-.1834***	-.1018*	-.1705***	-.1867***	-.0051	.2035***	.2066***
PLATOONI	.0548	.1130**	-.0015	.0332	.0127	.2229***	.0907*
LER	.2268***	.0488	.2475***	.2170***	-.1807***	-.0169	-.2638***
LCR	.1519***	.0635	.2903***	.3079***	-.1173**	-.2160***	-.2971***
TEXTBOOK	1.0000	.6977***	.5979***	.5526***	-.0002	.0763	-.2482***
STATIONE	.6977***	1.0000	.4856***	.3995***	.0588	.0808	-.1128**
MATERIAL	.5979***	.4856***	1.0000	.8113***	.0267	-.0473	-.3347***
MEDIA	.5526***	.3995***	.8113***	1.0000	.1065*	-.1489***	-.3427***
DROPOUT	-.0002	.0588	.0267	.1065*	1.0000	-.1050*	-.0413
MEDIACEN	.0763	.0808	-.0473	-.1489***	-.1050*	1.0000	.2277***
COMPUTER	-.2482***	-.1128**	-.3347***	-.3427***	-.0413	.2277***	1.0000
PLATOON	.2970***	.3096***	.2357***	.2701***	.0127	.3357***	.1369**
LEARNED	.2268***	.0490	.2476***	.2173***	-.1809***	-.0171	-.2639***
LEARNCL	.1519***	.0634	.2902**	.3079***	-.1171**	-.2160***	-.2972***
AGE_1	-.2386***	-.1485**	-.2286***	-.2100***	.0244	.0599	.1020*
DEP_1	-.0541	-.0625	-.0926	-.0569	-.2464***	.2091***	.1767***
HOD_1	.0607	-.0272	-.0730	-.0840	-.2918***	.3783***	.1465**
POST_L_1	-.0228	-.0214	-.0780	-.0426	.3864***	-.0809	-.0266
PRINC_1	-.0045	-.0292	-.0234	.0178	-.0564	-.0598	.0710
QUALIF_1	-.2183***	-.0567	-.3806***	-.3803***	-.0335	.2011***	.4886***
YEARS__1	-.2325***	-.1308**	-.3012***	-.2807***	.0036	.1336**	.1268**
TOWN	.2981***	.0845*	.4466***	.4709***	-.0758	-.1445***	-.4467***
POVIND	.3197***	.0636	.4495***	.4638***	-.1312**	-.1514***	-.5122***

	PLATOON	LEARNED	LEARNCL	AGE_1	DEP_1	HOD_1	POST_L_1
PASSRATE	.0930*	-.3611***	-.3696***	.1539***	.2435***	.2217***	-.1116*
LEARNERS	.1071*	.6178***	.3481***	-.2266***	.3529***	.5556***	-.2235***
EDUCATOR	.1732***	.0168	.0409	.0015	.4435***	.6249***	-.2456***
BUILDCON	.1851***	-.1293**	-.1974***	.0795	.0780	.0139	.0184
PLATOONI	1.0000***	-.0986*	-.0812	.0963*	.0783	.0738	.0089
LER	-.0984*	1.0000***	.4879***	-.3512***	.0447	.1197*	-.0654
LCR	-.0813	.4878***	1.0000***	-.1848***	-.0147	.0422	-.1118*
TEXTBOOK	.2970***	.2268***	.1519***	-.2386***	-.0541	.0607	-.0228
STATIONE	.3096***	.0490	.0634	-.1485**	-.0625	-.0272	-.0214
MATERIAL	.2357***	.2476***	.2902***	-.2286***	-.0926	-.0730	-.0780
MEDIA	.2701***	.2173***	.3079***	-.2100***	-.0569	-.0840	-.0426
DROPOUT	.0127	-.1809***	-.1171**	.0244	-.2464***	-.2918***	.3864***
MEDIACEN	.3357***	-.0171	-.2160***	.0599	.2091***	.3783***	-.0809
COMPUTER	.1369**	-.2639***	-.2972***	.1020*	.1767***	.1465**	-.0266
PLATOON	1.0000	-.0986*	-.0812	-.0578	.1007*	.1368**	-.0960*
LEARNED	-.0986*	1.0000	.4878***	-.3512***	.0450	.1196*	-.0654
LEARNCL	-.0812	.4878***	1.0000	-.1848***	-.0149	.0422	-.1116*
AGE_1	-.0578	-.3512***	-.1848***	1.0000	-.0257	-.0324	.1902***
DEP_1	.1007*	.0450	-.0149	-.0257	1.0000	.5037***	-.0822
HOD_1	.1368**	.1196*	.0422	-.0324	.5037***	1.0000	-.1454**
POST_L_1	-.0960*	-.0654	-.1116*	.1902***	-.0822	-.1454**	1.0000
PRINC_1	.0365	.0217	-.0473	.0566	.1875***	.1297**	-.0641
QUALIF_1	.0670	-.2659***	-.3272***	.1860***	.2349***	.2294***	-.0253
YEARS__1	-.0686	-.3669***	-.2446***	.7698***	.0469	.0699	.1662***
TOWN	-.0033	.4520***	.4419***	-.1471**	-.0766	-.0024	-.1231**
POVIND	-.0092	.4701***	.4704***	-.2223***	-.0895	.0119	-.1080*



	PRINC_1	QUALIF_1	YEARS__1	TOWN	POVIND
PASSRATE	.1322**	.6812***	.2332***	-.6489***	-.6410***
LEARNERS	-.0061	-.1016*	-.1486**	.3683***	.3914***
EDUCATOR	.0015	.1628***	.0891	.0662	.0681
BUILDCON	-.0029	.1006*	.0375	-.1162**	-.1772***
PLATOONI	.0088	.0463	.1339**	-.0803	-.0609
LER	.0215	-.2658***	-.3669***	.4519***	.4699***
LCR	-.0470	-.3271***	-.2446***	.4419***	.4703***
TEXTBOOK	-.0045	-.2183***	-.2325***	.2981***	.3197***
STATIONE	-.0292	-.0567	-.1308**	.0845*	.0636
MATERIAL	-.0234	-.3806***	-.3012***	.4466***	.4495***
MEDIA	.0178	-.3803***	-.2807***	.4709***	.4638***
DROPOUT	-.0564	-.0335	.0036	-.0758	-.1312**
MEDIACEN	-.0598	.2011***	.1336**	-.1445***	-.1514***
COMPUTER	.0710	.4886***	.1268**	-.4467***	-.5122***
PLATOON	.0365	.0670	-.0686	-.0033	-.0092
LEARNED	.0217	-.2659***	-.3669***	.4520***	.4701***
LEARNCL	-.0473	-.3272***	-.2446***	.4419***	.4704***
AGE_1	.0566	.1860***	.7698***	-.1471**	-.2223***
DEP_1	.1875***	.2349***	.0469	-.0766	-.0895
HOD_1	.1297**	.2294***	.0699	-.0024	.0119
POST_L_1	-.0641	-.0253	.1662***	-.1231**	-.1080*
PRINC_1	1.0000	.1664***	.0670	-.0478	-.0136
QUALIF_1	.1664***	1.0000	.2386***	-.5394***	-.5670***
YEARS__1	.0670	.2386***	1.0000	-.2290***	-.2708***
TOWN	-.0478	-.5394***	-.2290***	1.0000	.8074***
POVIND	-.0136	-.5670***	-.2708***	.8074***	1.0000

NOTE: \* = significant at the .05 level, \*\* = significant at the .01 level, \*\*\* = significant at the .0001 level.

All of these correlations have the expected sign. However, some surprise in their weakness. The condition of buildings is weakly related to the PASSRATE, and so is whether the school platoons, and the experience of educators (YEARS\_1). Surprisingly high correlations are the availability of materials in general and for the media centres specifically, the availability of computers, and the qualifications of educators. The variables for whether the school is in a township or non-tricameral rural area, and for poverty, show extremely high correlations with the PASSRATE. Note that one has to be careful about interpreting the sign of the correlations, since for some variables, such as the availability of media centre materials, more is worse (e.g., 1=good, 2=medium, 3=bad). (In principle these might have been better treated via some dummy variables, and indeed this might be in the agenda for further research.)

However, bivariate correlations such as those above can only take us so far. How much influence do these variables have if taken jointly and in groups? The following table shows what percentage of the PASSRATE variation is explained by various groupings of variables.

Percentage of variation in PASSRATE explained by various groupings of variables		
Model including factors for	Specific variables	Percentage of variation in pass rate explained*
Poverty only	Poverty index	41%
Poverty (and management, as proxied by "township")	Township dummy variable	42%
Poverty (and management, as proxied by "township"?)	Poverty index, township dummy variable	47%
Resources only	Educator qualifications, media centre materials, L:E ratio, computers, stationery, textbooks, post level of educators, number of Dep. Principals**	67%
Resources, poverty	Same as below, but no township dummy variable	72%
Resources, poverty (and management, as proxied by "township")	Poverty index and township dummy variable, computers, media materials, learner:educator ratio, qualifications and post level of educators, presence of heads of department**	75%

\*Adjusted R<sup>2</sup>

\*\*As picked out by a stepwise process simply trying to maximise explanatory power without lowering significance of any one variable.

In the best of cases, putting together all the factors we could account for, some 75% of variability is "explained" away. This means that somewhere around 25% of performance variability would seem to be "managerial," namely, not accounted for by poverty and resources. However, since that model includes a "township" index, and since this represents, to some degree, managerial practices (ex-DET), the "Resources, poverty" model might be the one we could look at as explaining the maximum amount of variation, and this

explains about 72% of variation. Furthermore, it is clear that at least part of management practices are already correlated with all the other variables in the model. Thus, one can conclude that about 1/3, or at least 20% but probably not more than 40% of the performance variation of schools is due to management factors taken in isolation from other factors.

We can see that resources, by themselves, explain a larger proportion of variation than poverty factors taken by themselves. However, the poverty factors are much more important in terms of statistical reliability and policy relevance, with the exception of one resource variable that really stands out. To show this, we show the most complete regression model we were able to estimate.

Factors affecting pass rate, Gauteng 1996 and 1997*		
Variable	Coefficient	t-value
Constant	-127.1	
Township	-25.5	8.3
Avg. qualification of educators	16.3	7.9
Media centre resources**	-7.19	4.8
Average post of educators	-12.0	5.2
Computers	.314	3.8
Poverty index	-21.5	3.4
Deputy principals	2.74	2.5
n		401
R <sup>2</sup>		0.76

\*Some factors apply to 1996, others to 1997, see variable list.

\*\*Note that the media variable has to be interpreted with caution as it is a semi-categorical variables. See data list.

When confronted thus against each other in the same table, the poverty and socio-economic variables (and management, to the extent that “township school” reflects management problems associated with the ex-DET) tend to displace all the resource variables save one, in the sense that the t-values and the coefficients for the township and poverty variables are so much higher than the resource variables’ coefficients and t-values: being in the poorest township tends to imply a pass rate that is 47 (25.5+21.5) points lower than would be the case in the best-off suburb, even supposing equality of resources (to the degree this can be statistically “controlled” via multiple regression). Note that the learner:educator ratio does not show up in the equation, and the average post of educators has the wrong sign. Similarly for the other key resource variables, save for the one signalling the qualifications of educators. For example, the presence of a deputy principal—important as it may be in reality—can only be shown to be associated with an increase in the pass rate of about 2.7 points, all other things being equal. One more computer devoted to instruction is associated with an increase in the pass rate of only 1/3 of a point. Whether the media centre is adequately supplied or not does seem to have a significant impact on pass rates, but the variable is semi-categorical, so not too much should be made of this coefficient.

One more year of REQV (roughly corresponding to years of training) amongst the educators, however, is associated with a 16 point increase in the pass rate. **This is really quite extraordinary.** We believe this is significant because we found the strength of this factor surprising, considering the fashionable opinion in South Africa. It tends to imply,

exaggerating for effect, that all of the disadvantage of being in a poor township school could be overcome via whatever knowledge and behaviours teachers with 3 more years of training exhibit over other teachers (since  $3 \times 16 = 48$  approx. =  $25.5 + 21.5$ ). In reality we know things are not so simple, since these behaviours are themselves correlates of management issues and “culture of learning” issues, and since in any case a variance of three years of training is quite extraordinary. (Currently the average is 13.99, with 50% of schools falling between 13.57 and 14.45. Thus, an increase of 3 is not a trivial matter.) To some degree, it would seem as if parents in townships already know this, and, by voting with their feet towards urban and suburban schools, tend to seek educators that are not only better trained, but operate in an environment that is associated with a higher degree of “culture of learning.” It is, unfortunately, impossible to disentangle how much of this strong effect really is pre-service training per se vs. the other generic behaviours associated with educators who are more highly trained. The fact that the qualifications variable has so much significance above and beyond the poverty and township factors suggests that perhaps there really is something to be said, after all, for the much-decried “paper qualifications.” It is obvious that this should be looked at further. It also appears, in retrospect, that much of the fashionable opinion against “paper qualifications” may be due largely to international research, rather than to rigorous SA-specific research. All the more importance thus attaches to an ongoing program of rigorous SA-specific research before opinions become dogma. We could be wrong about the impact of qualifications, and do not wish to be seen as immediately revisionist of the fashion, but at least this should highlight the importance of further serious work on these issues before opinions solidify.

It is comforting that the results obtained for Northern Cape for the “township” and “poverty” variables are within the 95% confidence ranges of those for Gauteng. We did not have as much information on resources for Northern Cape as for Gauteng, so the “township” and “poverty” variables loom larger for Northern Cape (but they are within the same confidence range). We have more control variables in Gauteng, and a much bigger sample of schools, which gives us more confidence in the Gauteng results: if the results confirm each other, well and good; if they contradict each other, we should rather take the Gauteng results as more reliable.

It might be said that some of the resource variables appear so weak in the model because they are so correlated with all the other resource variables that the others are simply already proxying for it, and thus they appear not to have any independent explanatory power. This does not appear to be the case, however. We guarded against this by independently regressing the L:E ratio against a few of the other key resource variables appearing in the model, and even the township variable, and the  $R^2$  for this regression was 0.21. Similarly for the condition of buildings, and the  $R^2$  was only 0.07. Thus, we feel confident that when apparently key variables have got left out of important equations, this is not because their influence is masked by all the other variables in some simple manner, but because in some important fashion (which may need further research) they really are not contributing much once the other factors are accounted for. (This can be ascertained also by looking at the correlation matrix above.)

### **II.3. Policy suggestions of the research**

These are amongst the highest, statistically strongest results produced on South African education, at least as far as we know. (We would be grateful for suggestions as to literature

we may not have access to.) They tend to call into question both the old received wisdom (i.e., that it is numerical resources, such as reducing the L:E ratio, that matters) as well as the more recent countervailing wisdom (i.e., that resources don't matter so much, it is management and culture of learning that matters).

The L:E ratio, which is the resource variable those obsessed with resources largely focus on, indeed appears relatively slight in its effect, and so do other physical resources associated with the physical infrastructure per se (whether there is platooning, the learner:classroom ratio, the condition of the school). But the qualifications variable, and some strongly cognitive resources such as the adequacy of materials for media centres and the presence of computers if used for instruction, do stand out, calling into question the opinions that say that a) “paper qualifications” do not count for much, and b) that resources in general do not count for much. Our results also show that it is difficult to fight the negative effect of poverty with “mere” resources, unless they are well-managed, and unless one pays more attention to the qualitative nature of the resources (even as rudely measured as the REQV), but more importantly if one pays attention to whatever qualitative behaviours are associated with educators with high REQVs. The results also show that even though we have achieved what, by international standards seems like very high R<sup>2</sup>s, this means that 30% of learning achievement variance is *still* “unexplained” by poverty and resources, and is probably due to differences in quality of management.

To summarise: if one *does* pay attention to a) the “quality” factors (for example, educator quality as measured not only—but partially—by formal qualifications), b) to management intensity and quality, and c) to the redistribution and proper supply of resources strongly associated with learning (books, media centre materials, media centres, computers for instructional support and assistance, etc.), and one stops worrying so much about the L:E ratio and “bricks and mortar” inputs, then it would appear as if there is a real fighting chance against the poverty of the environment.

We can illustrate some of these factors thus. On average, an increase in REQV of 1 costs the state some R 14.000 per year (though there has been a tendency in recent years to reduce the automatic association of training to salary). A matric failure costs the state at least R 3.500, if the learner repeats, or more, if one considers that it is the matric itself that has labour market value, and previous years of preparation are to some degree wasted if there is a matric failure. In a class of 30, an improvement in 16 percentage points in matric passes due to an increase of 1 in the educator's REQV translates to saving about 5 learners from repeating, or a saving of some R 17.500. Improved REQVs thus seem well worth the cost, *if* (big if, though) they are associated with whatever other behaviours go along with the qualifications to produce the results we are documenting. It is clear that paper achievement of higher REQVs *in itself* is of questionable utility. Furthermore, note that in the range where we are, the L:E ratio seems to make little difference. If the class size can be increased by 5, this represents a reduction of 10%-15% or so in the numbers of educators needed, which more than compensates for the extra cost of having more qualified ones. Thus, if more qualified educators do help improve matric passes, and if the L:E ratio is indeed as relatively unimportant as these results suggest, then the state should rather pay for fewer more-qualified educators than for more less-qualified ones, and this could produce not only an improvement in quality but a cost savings.

We must stress that these calculations are merely illustrative of how one can use these sorts of results to help shape policy decisions. For now the results are too tentative to serve as a firm base for policy. However, the evidence seems to be pointing in a consistent direction. More provinces (ideally, say, one different from Gauteng and Northern Cape, a poorer one with low levels of qualifications, such as North West) should be analysed before we can become more sure of what we are saying.

#### II.4. Management implications

If we have a way to more or less rigorously “predict” or “expect” the likely performance of a school given its resources and its environment, we then also have a way to compare this prediction to reality. We can say, that is, *by how much a school over- or under-performed relative to expectation*. We can then use this information as a way of knowing on which schools to target managerial attention. Evidently, to the degree that resources and environmental conditions predict that the school should be achieving fairly well, and it is not, there would appear to be a managerial or culture-of-learning problem. These problems should be solved or, in the extreme, if they cannot, perhaps one should consider closing the school, to break the vicious cycle of mistrust and mismanagement, and start afresh either somewhere else, or with a purposefully turned-over personnel in the same physical plant.

It is interesting to compare, say, the top 10% of achievers listed on a simple sort of pass rates, vs. the top 10% over-achievers listed on the basis of how much higher their pass rate is than their predicted pass rate. We emphasise that we were able to do this only for the secondary schools for which we had a complete data set, with not one single important field missing, and this was only about 66% of the schools reporting exam results. Obviously, for this kind of result to become a serious managerial tool, one would have to make sure that 100% of the schools are completing 100% of the data, or close to it. The following table shows the key results.

Characteristics of top 10% of performers		
Characteristic	Top 10% by straight pass rate sort	Top 10% by sorting on pass rate minus predicted pass rate
Average pass rate	99.9%	79.5%
Average predicted pass rate	88.1%	49%
Average over-performance (pass rate - predicted pass rate)	11.8	30.5
Percent of schools that are apparently ex-DET	0	43%
Average poverty level	.15	.43
Qualifications (average REQV)	14.5	13.9
Computers	18.3	3.3
Media centres (1=adequate, 2=bare, 3=none)	1.35	2.13
Building conditions (1=very poor, 5=excellent)	3.69	3.79
Platooning (1=yes, 2=no)	1.8	1.78
Learner:classroom ratio	15.7	24.3
Learner:educator ratio	18.5	21.0

A few things stand out. First, the relative over-performers appear to be doing a truly heroic job. Since they do not achieve the 100% pass rates that everyone seems to be looking for to celebrate, they would tend to get over-looked, but their achievement may be more heroic than those of some schools scoring 100% pass rates. Their average pass rate is “only” 79.5%. But their predicted pass rate is only 49%! Thus, they are achieving 30.5 percentage points above what one might have expected. The “straight” achievers are also over-performers, but only by 12 points. It is interesting to note some of the other characteristics of relative over-performers vs. “straight” good performers. First, over-performers are much poorer: the average poverty level is 0.43 vs. 0.15. Similarly, amongst the “straight” good performers there are no township or ex-DET schools (surely there must be a few, but remember that we had to remove some schools because of incomplete data), but amongst the real over-performers, 43% are township or, rather, ex-DET schools. It is interesting to note that things such as physical conditions of buildings, and the L:E ratio, are not that much different among the over-performers (though, oddly, the L:C ratio is, but this is probably a relatively accidental fact, given that the L:C ratio does not tend to appear in the regressions). Over-performing schools are, however, much less provided for with computers and media centres, and the qualifications of the educators are considerably lower (considering that the variation in qualifications in the sample is very low in any case). Since these are the quality factors that strongly predict pass rates, it is their relative deprivation of these factors, yet their ability to achieve nonetheless, that makes them stand out as over-performers. These are schools where the injection of things such as better media centres, computers, and more training for the educators could probably boost the pass rate right up to 100%, or nearly so.

We would not want to present specific data for specific schools for several reasons. (They would be available to provincial authorities.) First, to protect their privacy. Second, because the data are not complete and, as noted, we therefore had to remove some schools from the analysis. And, third, because some of the indices are not as perfect as one might hope for (e.g., the poverty index). Thus, the exercise has to be seen at this stage as a methodological exercise. However, the method is clear, and productive. To perfect it would require a considerable amount of work, but it is predictable, straight-ahead work. It would involve, for example, determining the poverty levels that apply to the schools on a more rigorous basis, for example, taking into account more fine-grained, ground-truth information than we were able to supply.

On the basis of an exercise such as the one we have developed, but more rigorous and more time-consuming, then, one could develop a reasonable level of expectation for every single school. This level of expectation should be high, but not impossibly so, say 10% or 15% above the predicted value. This level of expectation could be used to begin to hold parents, learners, educators, and principals, accountable for performance. The difference between expectation and real results could be used in two ways. First, the relative under-performers would seem to need more managerial and qualitative help, since they are under-performing even when taking into account their poverty of resources and their environmental circumstances. Second, the relative over-performers could probably have their performance enhanced more by the addition of a few key resources than by management help or generalised resources. The results tend to indicate that “quality oriented” resources, such as improving educator qualifications and above all the real behaviours associated with teachers

who currently have high qualifications, and inputs such as computers and well-equipped media centres, rather than bricks and mortar, would be appropriate.

### **III. Future steps**

To make this kind of analysis an ongoing reality, some of the limitations already noted above would have to be overcome. The most important ones to be overcome are the lack of complete data for all the schools, and the development of better poverty indicators. The other methodological aspects are refinements (e.g., controlling for self-selection bias) that can be dealt with as time allows and as ability grows, or will in any case take some time to develop (e.g., developing a better exam system). Implementing and using an approach such as we have suggested will also require that provinces either devote the right levels and amounts of internal analytical talent (by using the right personnel to do the work, even if it means making more appointments, or by out-sourcing it if that is the only way).