

Does higher education expenditure generate higher learner achievement? A study of historically disadvantaged schools in Gauteng

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There is a growing body of research that examines the relationship between learner achievement and the resource characteristics of educators. To help policy-makers and researchers use and build on this body of knowledge, I analyse the relationship between six measures of educator and educator-related characteristics: learner-educator ratios, per learner personnel costs, average educator costs, educator qualifications, educator years of experience, and percentage of temporary teachers in a school, using two years of data (1999 and 2002) in the province of Gauteng. The implications of the indeterminate findings in the light of the limitation of the study are detailed and directions for future research are proposed.

Introduction

The 2002 amended regulations on the distribution of educator posts in schools (Department of Education, 2002) formally extended the redress principle introduced for non-personnel expenditure in the South African Schools Act (1996). According to the subordinate regulations, a basket of 'redress' teaching posts are to be distributed to schools, based on the relative poverty of each school. In practice this would mean that the poorest 20% of schools on the provincial index of need would be entitled to 35% of the allocated posts from the redress pool, the least poor would be eligible for 5%. Whilst the real impact of this policy will ultimately hinge on the relative size of the redress pool, the policy principle underlying it demands robust interrogation.

The principle of redress, and its extension into the distribution of educator expenditure, is undoubtedly ethically and politically justifiable (Motala, 2003). But will an 'index of need' approach to the distribution of the teaching posts contribute to improved achievement in historically disadvantaged schools? Would auxiliary resources, such as management support, be required to translate the advantage of additional teaching staff into higher productivity? Should additional criteria be used to determine the distribution of additional posts — criteria such as the capacity of the school to effectively utilise the additional teaching staff? These policy questions are practical illustrations of issues raised in the wider international research debates about the relationship between student outcomes and education personnel funding.

This study analysed the relationship between specific teacher characteristics — particularly those that have direct and measurable cost implications and learner achievement. Drawing together three data sets, the study examined the statistical link between six measures of teacher characteristics and the weighted matriculation pass rate in former Department of Education and Training schools in the Gauteng Department of Education in two separate academic years — 1999 and 2002. Given the findings of earlier studies, the research hypotheses to be tested were: (a) a positive relationship between increased personnel expenditure, as manifest in lower learner-educator ratios and higher average educator qualifications and higher learner achievement, and (b) an effect size sufficiently large to warrant the magnitude of the implied expenditure.

In contrast to a number of earlier studies of the determinants of educational quality (Crouch & Mabogane, 2002; Perry, 1999; Simkins, 2001, Van der Berg, 2002), this study found no decisive and consistent statistical relationship between higher levels of teacher resources and improved learner achievement. The three implications of these findings are discussed. Firstly, whilst the findings were inconclusive, attention needs to be given to unpacking possible explanations for the indeterminacy. Secondly, from a policy perspective, if the aim of the teacher redress policy is to improve input and outcome equity, then the finding of this study suggested the need for caution on the teacher distribution policy. Finally, the findings also point to the need for qualitative studies of the schools, to determine the conditions under

which they could effectively utilise additional teaching staff.

Why focus on teacher resources and costs in particular? Teacher costs make up the lion's share of the public school budget — a share that consumes over 85% of available school funds (Seekings, 2001; Department of Education, 2003). From a school improvement perspective, expenditure on personnel has been shown to be the least cost-effective option for obtaining higher learner performance levels (Fuller & Clarke, 1994; Levin & McEwan, 2001).

What is known about the effects of educator resources?

The question about whether, and to what extent, resources, and teacher resources in particular, make a difference to educational quality, has been the subject of considerable debate. Hanushek (1989; 1997) has persistently argued that there is no systematic evidence of a positive relationship between student achievement and resource inputs. He has argued that what is important is the way in which resources are used, rather than the presence of resources *per se*. Greenwald, Hedges, & Laine (1996) and Hedges, Laine & Greenwald (1994) have challenged Hanushek's findings, using a different meta-analysis approach, leading to opposite conclusions. Within the wider debate about 'whether money matters', a substantial number of studies have specifically focused on the relationship between teacher resources and student achievement. Much of this research centres on the debate about when class sizes count.

Whilst production-function studies of schooling are relatively new to South Africa, there is nonetheless an impressive range of new studies that address factors associated with effective schools. Since the publication of the Case and Deaton study (1999) a number of projects have been undertaken on the relationship between resources and achievement. The most obvious issue was the level of funding in the former white and black departments and the relationship between levels of spending and achievement. Most educational planners assume that, should the levels of resources provided to the schools from the various ex-departments be equalised, the performance gap would narrow.

Since the completion of the Case and Deaton study, other studies (Crouch & Mabogane, 2002; Perry, 1999; Simkins, 2001; Van der Berg, 2002; Taylor, Muller & Vinjevold, 2003; Fiske & Ladd, 2003) have identified a number of educator variables that have more or less influence on learner achievement. What follows is a summary of the findings from these studies.

Learner-educator ratios

There is an extensive international literature on the relationship between teacher-pupil ratios and learning achievement.¹ In the United States, where the most developed research tradition engaged with questions related to the relationship between quantum of teachers and learners and its impact on achievement exists, no research consensus has emerged. Whilst the non-experimental studies show no definitive positive relationship between teacher-pupil ratios and student performance, some of the best-known experimental studies, such as the

Tennessee STAR project, show positive findings related to lower class sizes. On the African continent, an argument continues to be made that reducing pupil-teacher ratios below 40 does not constitute a cost-effective option to improve the quality of education (ADEA, 2003). In this case, the focus tends to be on primary schooling, with indicators of quality generally linked to issues of internal efficiency rather than learning outcome measures.

In one of the first studies of its kind in South Africa, Case *et al.* (1999) found that lower pupil-teacher ratios had large positive effects on school quality for Africans, as measured by enrolment and school achievement. Another study (Case & Yogo, 1999) similarly identifies low pupil-teacher ratios as being associated with larger and significant outcomes. This particular study attempts to examine the cost-benefit from increased outcome in terms of returns to education for Africans, as measured in higher rates of employment and higher earnings. In contrast, Crouch *et al.* (2002), using data from the late 1990s in the province of Gauteng, found a significant relationship between smaller learner-educator ratios and higher achievement. However the effect size was tiny. In a recent study in the Western Cape (Fiske *et al.*, 2003) it was found that lower educator-learner ratios are statistically correlated with higher achievement on the matriculation examination, even when home background of learners is discounted. Fiske also notes that relative to the teacher characteristics within a particular former Department, a higher learner-educator ratio lowers the pass rate.

Educator qualifications

Alongside educator learner ratios, teacher qualifications are often perceived to be a key determinant of achievement. However, international research does not support this common-sense assumption. Wayne and Young's (2003) meta-analysis of published studies found little evidence of a consistent relationship between higher qualifications and school effectiveness as measured by learner achievement.

Within South Africa, Crouch *et al.* (2002) found that teacher qualifications were strongly correlated to matriculation results. In their words,

learner-educator ratio seems to matter less than quality of the educators. The qualifications of educators (as measured by the average REQV at the school) seems by far, a more important factor than ratio, or any other cost-related resource factor.

The authors of this study have suggested that substantial investment in teacher upgrading, rather than increasing the pool of teachers or decreasing the learner educator ratio, is a promising policy option.

Simkins (2001) cited in Taylor *et al.* (2003) found that teacher qualifications appeared to have an overall positive effect on matric results, but no significant effect on maths and science results. Simkins suggests that the lack of an effect with reference to these subjects can be explained by the problem that the data did not specify if the teachers teaching in the two subject areas had relevant higher education qualifications. In a recent study, Fiske *et al.* (2003) found that even for comparisons among schools within a particular former department, the 'quality' of teachers affects student outcomes. They found that a higher proportion of under-qualified teachers reduces the pass rate.

Educator experience

Crouch *et al.* (2002) again found little evidence that educator experience has a significant effect on achievement. This is consistent with the meta-analysis of the American literature of Wayne *et al.* (2003). Of the 21 studies they reviewed, 19 used information on how many years teachers had been teaching, and most of the determinate results were positive. They note, however, that these findings are too difficult to interpret, given that little is known about whether teachers were hired during a shortage or a surplus, whether experience measures capture differences in teacher motivation during years when child rearing requires more attention; and impact of the dynamic labour market.

Other educator variables

Using data from the NEAP study in the United States, Grissmer, Fla-

nagan, Kawata & Williamson (2000) found that, when all else is equal, better paid teachers and higher qualifications did not guarantee higher test scores.² Although beyond the scope of this study, Fiske *et al.* (2003) found that a larger complement of school governing body teachers has a positive and statistically significant effect on achievement. This is to be expected, given the fact that governing body teachers are a proxy for the socio-economic status of learners. To date little has been published on the effect of temporary teachers on achievement, although Christie (pers. comm.) has pointed out that, with increasing teacher shortages this is likely to be an important factor. Whilst not directly on temporary teachers, the Grissmer *et al.* (2000) research did note the positive effect of low teacher turnover on learner achievement.

In sum then, although some inconsistencies have emerged, the South African literature appears to point to the conclusion that teachers are a 'crucial' input into the education process. Schools with more teachers per learners and better-qualified teachers offer higher quality education than do schools with fewer and less qualified teachers.

Research design

Case study

The study examined the relationship between educator resource characteristics and achievement in historically disadvantaged secondary schools in the Gauteng province in 1999 and 2002. The Gauteng province was selected as a case study for the following reasons. Firstly, the racial profile of the province is representative of the South African school population as a whole, notwithstanding under-representation of rural institutions. Secondly, the province has a good reputation for the collection and distribution of high quality school-related data. The total population in the population frame, i.e. former Department of Education and Training secondary schools, was used in the study.

Data

The study merged three data sets: Matriculation Results from the Gauteng Department of Education, Personnel Salary Information System (PERSAL), and Annual School Survey. These data sets have a high degree of validity and reliability. The information they contain is used for high stakes purposes, i.e. issuing of high school graduation certificates, salary instructions, and allocation of teaching posts and non-personnel budgets. The matriculation results are reported for individual candidates and include information on the level at which the candidates entered, higher or standard grade, marks and pass status. This database is aggregated to the examination centre or school. In this case, information is presented in summary format with the number of candidates that entered (by level), number of candidates that wrote, and number of candidates that passed (both senior certificate and exemption). PERSAL, which reflected an annualised statement of comprehensive expenditure by the Department on educator-related expenditure is similarly aggregated to the level of the pay point or school. Additional information on educators, i.e. level of qualifications and number of years of service, is also recorded on the PERSAL system. Information on the number of learners has been obtained from the Annual Survey database. Whilst there is a possibility of error occurring in the aggregation of the PERSAL costs and educator qualifications, it is unlikely as the data have been cleaned and checked by the provincial department of education, which has used them for its own management purposes.

Method

As an approximate control for student social background and other school resources, the study was restricted to Gauteng Department of Education public schools that were formerly registered in the Department of Education and Training in which candidates wrote the matriculation examinations. Two hundred and thirty schools were included in the 1999 and 235 schools in the 2002 data sets.

The outcome measure of interest for the statistical model was the weighted pass rate. Following Fiske *et al.* (2003), the study made use

of a weighted pass ratio. Whilst problematic in a number of respects, the matriculation pass rate, including a higher weighting for those children who received a university level pass, remains the best measure of learner achievement.¹

Six fairly standard measures of educator characteristics were used. They included:

- Learner-educator ratio
- Per learner personnel cost
- Average educator cost
- Percentage of temporary educators
- Educator qualifications, and
- Educator experience

The measures are related in a number of ways. The single biggest cost driver of per learner personnel cost is the learner-educator ratio, with qualifications and experience playing an important, if less significant, role. The average educator cost, the mean of salary and benefits of all teaching staff in any one particular institution, is linked to the mean qualifications or (REQV) and the mean number of years of educator experience.

The basic objective of the data analysis was to assess whether a statistical relationship existed between various educator characteristics and learner achievement. Two approaches were used to assess the relationship, a Pearson Correlation and Multiple Regression Analysis. The latter technique assisted in gauging the effects of the measures of educator characteristic on learner achievement and the influence of measures on each other.

Findings

The most striking feature of Table 1 is the substantial gains that had been made between 1999 and 2002 in learner achievement. The over thirty percentage-point gains reflected the fact that much of the improvement in the overall matriculation results had occurred in historically disadvantaged schools. However, the average pass rate statistic continued to mask a very substantial variation (Figures 1 and 2) in performance between schools.

Table 1 Descriptive statistics on learner performance and educator characteristics

	1999		2002	
	Mean	SD	Mean	SD
Weighted pass rate	34.6%	18.5	66.9%	19.0
Learner-educator ratio	33.5	5.9	32.9	5.4
Per learner personnel costs	R2 813	617	R3 665	1 008
Average educator costs	R91 463	10 961	R116 486	12 716
Educator qualifications (REQV)	13.7	0.3	13.7	0.6
Educator experience	12.0	3.2	13.7	3.4
% of temporary educators	8.0%	12	7.5%	7.1
	N = 230		N = 235	

Table 1 also shows that most of the educator cost-related measures had remained stable or increased modestly in line with inflationary trends. For example, there had been very little change in the learner-educator ratio, which continued to be more or less in line with official policy.

The per learner personnel costs (that proportion of the budget spent on each learner that goes towards the payment of educators) had gone up by over 30%. Despite the fact that these secondary schools were all registered in the same former department, Figures 3 and 4 show the wide variation in the levels of educator expenditure between schools. For example, whilst the majority of schools in 2002 fell between R3,200 and R3,600, there were a significant number of schools with per learner personnel costs of R2,800 and below and R4,000 and above.

In contrast to the 30% increase in the per learner personnel cost,

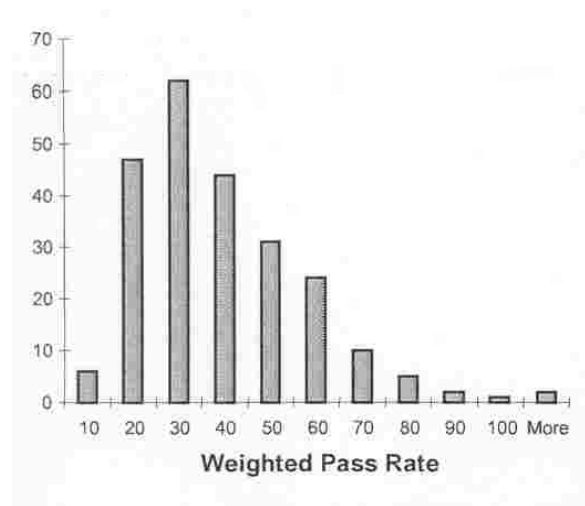


Figure 1 Frequency distribution of learner achievement in former DET schools in Gauteng, 1999

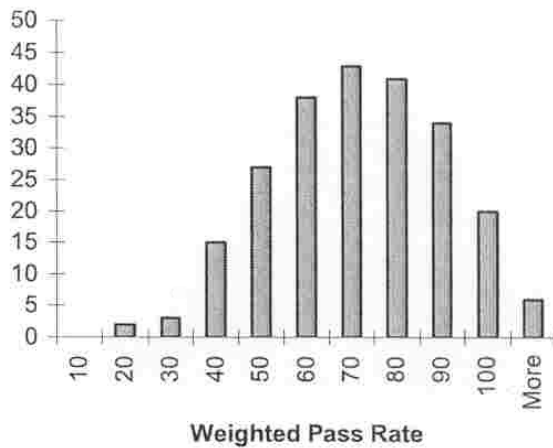


Figure 2 Frequency distribution of learner achievement in former DET schools in Gauteng, 2002

the average educator salary package had increased by only 27% in the same period. The difference can be accounted for in the slightly reduced learner-educator ratio.

Table 1 also shows a number of other interesting trends. The average qualification in the province was higher than the minimum requirement of REQV 13, or a high school diploma and three years of apposite training. Salient is the low level of variability and the consistency between the two years under study. The average number of years of teaching in the sample of schools had increased by almost two — a factor that would contribute to the above inflation increases in the average educators costs. The higher-than-standard proportion of temporary educators (international norms are roughly 5%) had remained consistent, but the spread had changed dramatically. One interpretation of the changing value of the percentage of temporary educators standard deviation from over 12% to just over 7% is that all the schools had a more equitable proportion of temporary educators on their books.

Table 2 indicates that no single educator characteristic was strongly correlated to learner achievement. A surprising finding, although not statistically significant, was the negative relationship between achievement and personnel costs and the positive relationship to learner-educator ratio.

These trends emerge even more clearly in Table 3, which shows the results of the multiple regression analysis of learner achievement and educator cost and related measures.

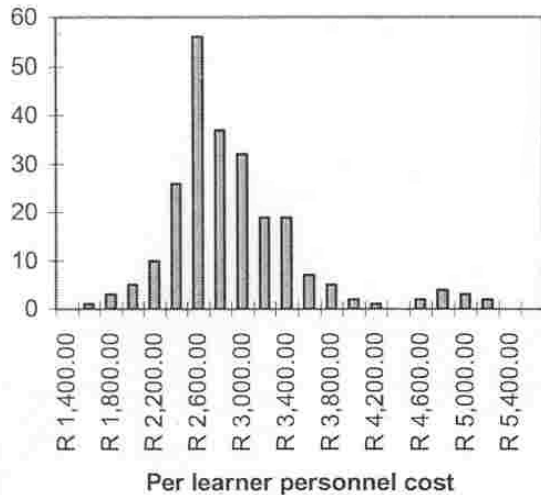


Figure 3 Frequency distribution of per learner personnel cost in former DET schools in Gauteng, 1999

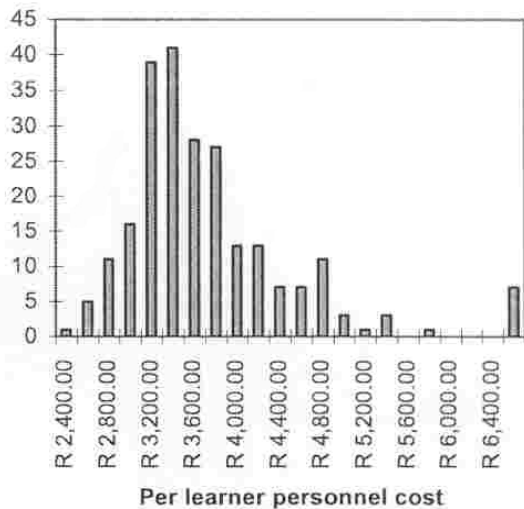


Figure 4 Frequency distribution of per learner personnel cost in former DET schools in Gauteng, 2002

Table 3 reveals that only two educator characteristics are statistically related to learner achievement. Confirming the Crouch (2002) finding, we found that educator qualifications (REQV level) are linked to higher weighted passed rates in 1999. In 2002, the data showed a statistically significant relationship between learner achievement and the proportion of temporary teachers. The higher the proportion of temporary educators employed at any given school, the lower the achievement. Whilst the two statistically significant findings are important, the absence of consistent findings across 1999 and 2002 suggested a level of indeterminacy and did not point to strong policy implications.

As indicated in the regression analysis, whilst not statistically significant, Figures 5 and 6 show an alarming trend. The scatter plot graphs for both 1999 and 2002 show a negative relationship between improved learner achievement and higher expenditure. Schools with the higher personnel costs were on average performing worse than schools with the lower levels of personnel expenditure.

Discussion of results

Given the frequency distribution in both learner achievement data and educator characteristics (with the exception of educator qualifications)

Table 2 Pearson correlations of educator characteristics and learner achievement

	1999	2002
Learner achievement	1	1
Per learner personnel cost	-0.20457	-0.13786
Learner-educator ratio	0.072294	0.105377
Average educator cost	-0.18743	-0.10602
Percentage of temporary educators	0.050378	-0.09807
Educator qualifications	0.176469	0.012082
Educator experience	-0.1638	-0.13691

Table 3 Multiple regression of educator characteristics and learner achievement

	Coefficients		t statistic	
Intercept	-100.395		74.0611	
Per learner personnel cost	-0.0113	-1.63988	0.000614	0.194484
Learner-educator ratio	-0.75734	-1.12697	0.475157	0.9067
Average educator cost	0.00053	0.19656	-0.00015	-0.86465
% of temporary educators	-0.00405	-0.03946	-0.50486	-2.63388**
Educator qualifications	14.07882	3.3748**	0.447424	0.217516
Educator experience	-0.49221	-0.99413	-0.67487	-1.39424
R square	0.10688		0.055743	
N	232		234	

** $t < 1.9$ or > -1.9

we would have expected to find a consistent positive statistical relationship between increased expenditure and higher achievement. In particular, given South Africa's history of under-funding historically black schools, and because of previous research, we would have assumed that increased funding would translate into higher achievement.

Whilst two variables were significantly correlated to achievement results, the absence of stable findings across the two years means that we should be less confident of the policy importance of the individual findings. The indeterminate findings beg the question: why is there no consistent positive relationship between educator characteristics and learner achievement?

To answer this question, we need to approach it from both sides. Fleisch (2001; 2003) found that the parsimonious explanation for the improvement in the worst performing 70 secondary schools in Gauteng province, the vast majority of which were formerly registered in the Department of Education and Training, was the increasing use of 'learner selection' or 'screening'. In other words, the school level achievement results are often distorted by school-level exclusionary strategies. By deliberately excluding matriculation repeaters, over-age learners and weak Grade 11 learners, some historically disadvantaged schools are able to artificially boost their pass rates. By implication, whilst more generous allocation of teaching resources may make a difference, unless we find a way to discount the effects of 'screening', this will be difficult to show.

On the other side of the equation, the per learner personnel costs, learner-educator ratio, and educator experience may be distorted in ways that muddy the analysis. Although more systematic research is needed, a preliminary analysis suggests that under-performing schools have high personnel costs. In the past few years, enrolment in under-performing schools has declined. Anecdotal evidence points to the impact that the dissemination achievement results are having, i.e. parents may be withdrawing their children from poorly performing schools. Whilst the post-provisioning system would inevitably reduce the number of educators in schools with falling enrolments, this managerial process may be lagging. This would result *de facto* in under-achieving schools having lower learner-educator ratios and thus higher per learner personnel costs. The school rightsizing process could also explain the higher-than-average mean educator cost and higher educator experience. As the process of educator rightsizing

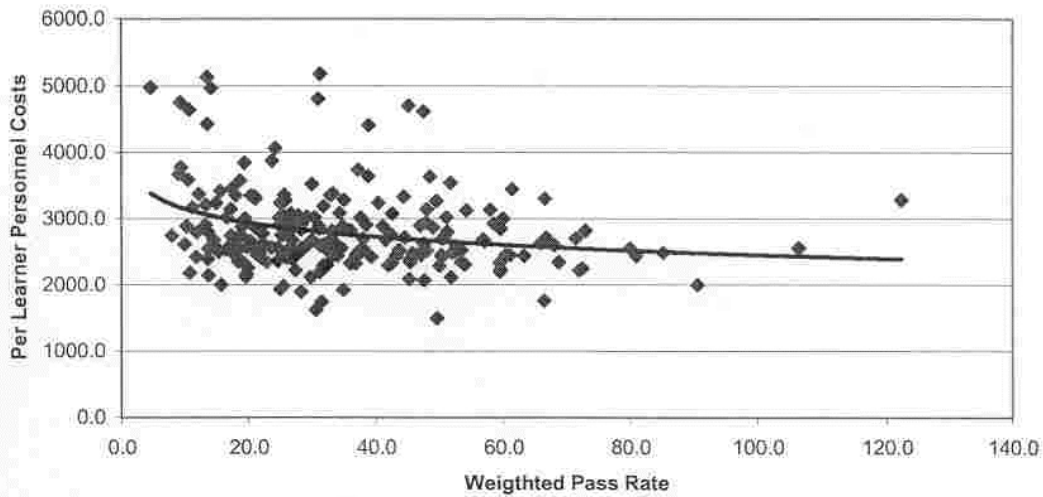


Figure 5 Scattergraph of learner achievement and per learner personnel costs in former DET schools in Gauteng, 1999

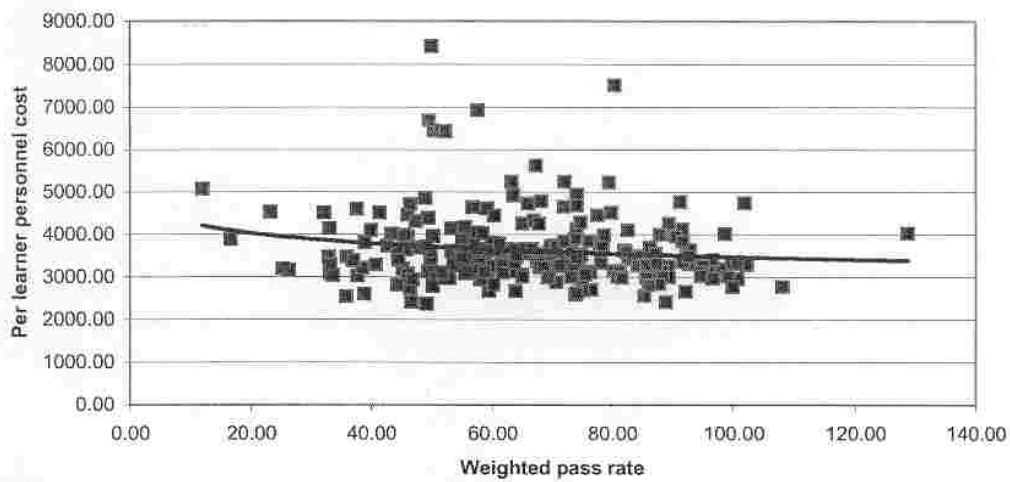


Figure 6 Scattergraph of learner achievement and teacher cost in former DET schools in Gauteng, 2002

takes place in schools with declining enrolments, the principle of last-in-first-out would be used. The implication of this labour relations principle is that the schools with declining enrolment also tend to be staffed by older educators, who have higher average salary costs.

Conclusions

What the findings of this study have shown is that there is no simple or linear relationship between spending on professional personnel and learner achievement. In the case of Gauteng in 1999 and 2002, a large number of schools that consistently performed poorly had the highest per learner salary costs. The poor performance of relatively expensive schools may be explained by factors other than expenditure itself. As Fleisch (2003) notes, there is a strong relationship between poor performance and lower enrolment in schools. Redeployment, which would inevitably adjust the personnel expenditure in line with the norm, takes a number of years to filter into the personnel expenditure. This explains the unusual and counter-intuitive results — that the poorest performing schools are the most costly.

Given the relatively expensive policy associated with the implementation of the redress educator pool in an effort to promote input equity, it is imperative to understand when (and under what circumstances) increasing expenditure on personnel translates into higher achievement in disadvantaged schools. We suggest that such increased expenditure would need to be targeted at institutions that are best able

to deploy additional educators to achieve improved learner outcomes. Increasing educator salaries or reducing learner educator ratios cannot be seen as effective policy levers to improve achievement. Spending wisely can improve schools, but only if and when the schools have the capacity to utilise the resources. A blanket unconditional increase in spending — whether on educator upgrading or reduced class size — will not have the desired result.

In addition to similar studies in other provinces on the relationship between educator characteristics and learner achievement, this study indicated the need for in-depth qualitative studies of the factors in the poorest schools that enable them to effectively utilise the additional educators. Such a study would follow approaches suggested recently by Miles and Darling-Hammond (1998).

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Notes

1. Whilst the indicator used in this study is learner-educator ratio, there is good reason to pursue alternative indicators, such as class size. Whilst there may be little evidence of a substantial effect of learner-educator

ratio, class size may prove to be fruitful. There is a growing body of knowledge that suggests that smaller classes may have a direct and substantial impact on achievement (Finn, 2003). In secondary schools, with relatively low learner-educator ratios, it is often possible to find learners being taught in very large classes. This anomaly is related to non-teaching teacher staff (such as the principal), poor planning and the legitimate requirement to provide for learners in low demand subjects such as smaller languages (Seekings, 2001).

2. Fiske and Ladd (2003) used the weighted dependent variable because they found that the ordinary pass rate does not reflect variability at the high end of the system, as almost all of the top 10% of schools report 100% pass rates.

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