

Infrastructure and education outcomes: Arguments from the literature

In November 2009 then Minister of Education Naledi Pandor issued draft minimum uniform norms and standards for school infrastructure. The draft norms and standards were issued in terms of the South African Schools Act No 84 of 1996. All interested parties were requested to submit comments on the draft norms and standards by 23 December of that year. The draft document stated in paragraph 1.7 that the norms would be "fully adopted" by the end of 2009 and would then be implemented "in a phased manner" starting in 2010. Despite these plans, it is now mid-2011 but finalised norms and standards have still not yet been issued.

The draft document states in paragraph 1.12 that the norms are "meant to facilitate the actualization of key sector policy tenets – equity, quality, relevance, efficiency..." The document thus appears to acknowledge the adequate school infrastructure is necessary if quality education is to be effectively delivered to all children studying in schools covered by the policy. It also notes that adequate infrastructure is necessary to ensure that the schooling environment is safe. Yet at present many South African public schools do not meet the minimum standards set out in the draft document.

The statement that the nature and condition of school infrastructure contributes to school effectiveness in the form of learner achievement and well-being seems obvious from a "common-sense" point of view. If the school environment is comfortable, learners and teachers are more likely to attend school regularly, including because they are less likely to fall ill. Longer time spent on learning this is likely to be associated with better results. Further, if the school environment is physically comfortable and has all the necessary basic facilities, schooling itself is likely to be of a better quality, with better results.

In addition to relying on common-sense, there is a large literature that examines the relationship between various "inputs" to education and school "effectiveness". Much of this literature comes from the United States (US) of America. Much of it uses an econometric approach which uses an "education production function". In this approach a quantitative model is built to test which of a range of "inputs" (independent variables) into education produce the best "output" or "outcome" (dependent variable) of educational performance or effectiveness. Most of the studies use academic performance such as grade marks – most commonly in mathematics and language – as the measure of performance.

Some of the US studies on which the literature is based were done to support advocacy and litigation for equity in school financing. One reason for there being so many studies in the US is that a federal US court found in 1973 in the case of San Antonio Independent School District v. Rodriguez that education was not a right at a federal level. This meant that the battle for equity had to be fought separately in each state (equivalent to our provinces).

The Tennessee Advisory Commission on Intergovernmental Relations (2003: 21) notes that the court challenges have for the most part focused on per pupil expenditure. However, some court rulings have been specific about declaring inadequate school facilities to be an important consideration. Such rulings have found that state constitutions require that children be educated in safe and decent facilities, usually defined as those that are "structurally safe, contain fire safety measures, sufficient exits, an adequate and safe water supply, an adequate sewage disposal system, sufficient and sanitary toilet facilities and plumbing fixtures, adequate storage space, adequate light, be in good repair and attractively painted, as well as contain acoustics or noise control."

The US court cases and the related literature are useful, especially in their emphasis on the fact that it is students from disadvantaged backgrounds who lose out when adequate infrastructure is not provided. Nevertheless, the US literature has some limitations for use in South Africa.

Firstly, many of the studies do not include infrastructure as one of the inputs in their models. One reason for this is that the majority of US schools have basic infrastructure, so it is not considered an important factor.

Secondly, where studies include infrastructure as an input in their models, it is often found not to be "significant" in a statistical sense. One reason for this is that there is often too little variation in the levels of provision of infrastructure across the schools or school districts being compared. This makes it more difficult to achieve statistical significance. Thus the World Bank (no date) notes that while there is disagreement over the importance of infrastructure for educational outcomes, this disagreement is at least partly explained by the fact that facilities are probably more important in "disadvantaged" settings and in developing than developed countries and – related – that the impact diminishes above a certain level of provision and quality.

Thirdly, while infrastructure is found to have less impact on performance than some other factors, many of the factors that have the strongest impact – such as the socio-economic background of students – are not easily corrected by policy in the short term while students are still at school. Infrastructure, in contrast, is something that policy can correct quite quickly. As the Tennessee Advisory Committee on International Relations (2003: 17) notes, while the building and school environment cannot "entirely overcome the burdens that many students bring to the classroom", if better buildings can improve time spent on learning, they should contribute to overcoming some of the burdens.

Despite these shortcomings, because of the dominance of the US literature, its findings have influenced the thinking of many policy makers, as well as institutions, such as the World Bank, that advise policy makers. In particular, an article written by Hanushek in 1995 based on a review of the then available studies is widely quoted as stating that resources in general – including resources spent on infrastructure – do not have a major impact on educational outcomes.

There are several reasons why these statements about Hanushek's 1995 review can and must be challenged.

Firstly, in the review itself Hanushek states clearly that the findings are relevant for developed countries, but not for developing countries. He writes as follows:

- "One of the clearest divergences between the findings in developing and industrial countries is the effect of facilities, suggesting that differences in the school environment are of some importance in developing countries. Twenty-two of the thirty-four investigations support the provision of quality buildings and libraries."
- "Some evidence suggests that minimal levels of basic school resources, such as the availability of textbooks, the provision of minimal facilities, and so on, are important in student achievement (Lockheed and Verspoor 1991; Lockheed and Hanushek 1988; Harbison and Hanushek 1992). These findings are not uniform in the statistical analyses, but they are common enough to receive more attention than most of the other findings. Why then do we not see policies instituted to provide these minimal resources, particularly if there is *reasonably strong* evidence about their importance?" [Emphasis added]

Further, as suggested by the second quote above, some of Hanushek's own work proves the importance of infrastructure. For example, Glewwe (2002) cites the 1980's study by

Harbison and Hanushek of primary school children in rural northeast Brazil which found that the facilities index (comprised of ten characteristics of buildings) was significantly associated with performance in reading and mathematics. Hanushek (1995) also cites the summary estimate of Hanushek, Gomes-Neto, and Harbison (1994) that each US\$1 improvement in facilities in situations where they are lacking produces a cost saving of more than US\$3.

Secondly, the method used by Hanushek to draw out findings across the studies has been criticised as too crude. A subsequent review by Hedges et al (1995) that examined the same studies that Hanushek reviewed, but using a more sophisticated method, found that his conclusions could be questioned even for developed countries. Crampton (2009) goes further to develop an alternative approach to the standard education production which allows for only a single output. Her more sophisticated model, using official national US data, finds that while human capital has the strongest impact on school performance, infrastructure is second most important.

Third, there are several easily available studies even from the US that do find that infrastructure has an impact of school performance.

Fourth, studies in developing countries have found that infrastructure does have major impact on educational outcomes. Murillo and Román's (2011) study of Latin America uses the education production function approach across 15 Latin American countries and finds that availability of basic infrastructure and services (water, electricity, sewage), didactic facilities (sport installations, laboratories, libraries), and the number of books in the library and computers in the school affect performance, although the extent of the effect varies between countries. This finding holds even after controlling for the family's socio-economic and "cultural" characteristics, the socio-economic characteristics of the area, and the country's level of development.

The main exception to this finding in Murillo and Román's study is Cuba. This is explained by the fact that Cuba has very low levels of infrastructure deficits and low levels of inequality in provision across schools. This is similar to the situation in developed countries, where most schools have access to basic services and there is very little variance. It contrasts with the situation where, overall, 11% of schools in the Latin American region as a whole are not connected to an electricity supply, 21% do not have access to potable water, 40% do not have sewage systems, more than half do not have a telephone, and 31% do not have sufficient toilets for children.

Bhorat and Oosthuizen (2008) use the education production function approach in South Africa for data relating to the year 2000. They find that while the impact of resources on educational performance is "not strong", the strength of the impact varies according to the particular resource. For example, a higher ratio of non-standard classrooms is associated with lower performance, while school libraries and computers are strongly associated with higher performance. Availability of telecommunications and electricity also has clear impact, despite the fact that more than 70% of schools have these services, which would tend to dampen the statistical effect. Having classrooms not made of bricks and mortar has strong impact for poorer areas, but not for better-off. Access to a telephone and electricity are important across the income distribution, as is the presence of sports facilities.

While the literature and most of the studies focus on academic performance, some studies also investigate other impacts. Branham (2004: 1113) argues that students enrolled at schools that lack decent infrastructure "perceive that they are not special, that school is not important, that no one really cares, and as a result will be more likely to stay home". The Tennessee Advisory Commission on Intergovernmental Relations cites two "comprehensive" compilations of research findings on the relationship between school facility condition and student achievement and behaviour. The first is a 1979 study by Carol Weinstein based on

U.S
JK

141 published studies and 21 conference presentations. The second is a 1982 study by Carroll McGuffey based on 97 published studies. The reviews find the following factors to be correlated with improved educational outcomes: age of the facility; condition of the facility; temperature; visual/lighting; colour of the indoor facilities; external noise; and air quality. Many of these would be covered by norms and standards.

References

Bhorat Haroon & Oosthuizen Morne. 2008. Determinants of Grade 12 Pass Rates in the Post-Apartheid South African Schooling System. *Journal of African Economies* 18(4): 634-666.

Branham David. 2004. The Wise Man Builds His House Upon the Rock: The Effects of Inadequate School Building Infrastructure on Student Attendance. *Social Science Quarterly* 85(5): 1112-1128.

Crampton Faith E. 2009. Spending on school infrastructure: does money matter? *Journal of Educational Administration* 47(3): 305-322.

Glewwe Paul. 2002. Schools and Skills in Developing Countries: Education Policies and Socioeconomic Outcomes. *Journal of Economic Literature* . XL: 436-482.

Hanushek Eric A. August 1995. Interpreting recent research on schooling in developing countries. *The World Bank Research Observer*: Washington.

Hedges Larry V, Laine Richard D & Greenwald Rob. 1995. An Exchange: Part I: Does Money Matter? A Meta-Analysis of Studies of the Effects of Differential School Inputs on Student Outcomes. *Educational Researcher* 23(3): 5-14.

Murillo F Javier & Román Marcelo. 2011. School infrastructure and resources do matter: analysis of the incidence of school resources on the performance of Latin American students. *School Effectiveness and School Improvement* 22(1): 29-50.

Tennessee Advisory Commission on Intergovernmental Relations. 2003. *Do K-12 School Facilities affect Education Outcomes?*

World Bank. No date. *Determinants of Primary Education Outcomes in Developing Countries.*

U.S
/