The Impacts of Retention, Expenditures, and Class Size on Primary School Completion in Sub-Saharan Africa: A Cross-National Analysis

Ryan Richard Ruff, *New York University College of Dentistry,*
New York University College of Global Public Health

Abstract Education in Sub-Saharan Africa is increasingly viewed as a means of emancipation and a transformative project for social mobility. Developing nations have pursued policies such as universal or free primary education to increase access to education and improve student outcomes. In this study, direct and indirect precursors to primary school completion in Sub-Saharan Africa are analyzed using national cross-sectional data collected by the UNESCO Institute for Statistics. Results show that imbalanced pupil-teacher ratios and high student retention rates are negatively associated with primary school completion. Additionally, the positive relationship between expenditure increase and completion rates is mediated by a negative contribution to pupil-teacher ratios. Results are compared with existing production function research on educational inputs and student success.

Keywords: Primary school completion, Retention, Expenditures, Class size, Africa

Introduction

Education policy in the post-World War II world continues be framed around issues of social mobility in an effort to eliminate the class divide that continues to dominate the political landscape of the western nation-state. Within this framework, education is seen as a transformative project, the primary goals of which are social ascent and the corresponding opportunities. Although African nations have responded positively to the culture of education-as-transformation, efforts to identify fundamental rights to education under the umbrella of Enlightenment philosophy and concepts of modernity are not without complications (Christie, 2010). Attempts at restructuring educational systems in Sub-Saharan Africa to improve student outcomes and opportunities have therefore become of paramount importance, as was perhaps best demonstrated by the Millennium Development Goal (MDG) of universal primary education by 2015. Later, the Sustainable Development goal of a quality education extended the MDG target to free, equitable, and quality primary and secondary education by 2030. Unfortunately, out-of-school children data from the UNESCO Institute of Statistics indicates that 59 million children were out of school in 2013, of which 30 million lived in Sub-Saharan Africa.

Educational and social reform in Sub-Saharan Africa can serve as a vehicle for fiscal and societal emancipation. State investment in education has had positive impacts on poverty rates, and universal literacy policies have helped to narrow the poverty gap (Hanjra, Ferede, & Gutta, 2009). However, many universal primary education (UPE) and free primary education (FPE) policies have not been successful. In Kenya, a combination of excess demand and poor quality public education has resulted in poor families choosing low-quality private school alternatives, despite access to free primary education (Oketch, Mutisya, Ngware, & Ezeh, 2010), while in Uganda, the existing educational infrastructure has been unable to meet increased capacity demands brought about by UPE policies (Chapman, Burton, & Werner, 2010). Even with effective FPE in Nigeria, the opportunity cost of attendance for poor students is often too great, resulting in students from wealthier households being more likely to attend primary school (Lincove, 2009).

In this study, the direct and indirect effects of select educational inputs on primary school completion in Sub-Saharan Africa were analyzed using path analysis. A UNESCO Institute for Statistics (UIS) database of primary schooling variables was used as the source of cross-sectional data from 2005. Variables of interest included pupil-teacher ratio, grade repetition (retention), and expenditures on education. Models were estimated and modified based on measures of fit. Results were contextualized within existing policy research.

Review of the literature

Production-function research

Research on the relationship between educational inputs and student outcomes aim to identify the best collection of factors that lead to the highest quality schools. Many of the inputs typically considered in production-function research are within the control of schools and policymakers, such as teacher salaries, per-pupil expenditures, or support staff. However, there are also inputs external to the school, including stu-

dent socioeconomic status, parent education, and family size. Hanushek (1995) argues that the relationship between inputs and student performance may not be a systemic one, but since education is a highly complex field, there are particular circumstances in which individual variables might indeed be important for student outcomes. Substantive conclusions drawn from such research should therefore take the contextual scenarios of a country into account if they are to be effective.

Pupil-teacher ratio

Out of a review of 96 studies on the estimated effects of educational resources in the developing world, 30 investigated teacher-pupil ratios, with eight showing a statistically significant positive relationship and eight a significant negative one. The remaining 14 studies were not significant (Hanushek, 1995). Lamdin (1996) found no significant relationship between class size and student success. More recently, Bhorat and Oosthuizen (2009) found that while pupil-teacher ratios and educational resources did not contribute to secondary school pass rates, proxy indicators for teacher characteristics were strong predictors of improvements in African students' performance. Other research on the effects of pupil-teacher ratios in developing areas concludes that pupil-teacher ratio is the most important factor in education production (Ismail & Cheng, 2005; Hungi & Thuku, 2010). Suryadarma, Suryahadi, Sumarto, and Rogers (2006) found pupil-teacher ratio to have a non-monotonic concave relationship with mathematics performance in Indonesia, indicating a positive effect when performance is low—in other words, low pupil-teacher ratio is more important for previously under-performing students, and tapers off as those students grow closer to average performance. In Thailand, educational resources such as pupil-teacher ratio, school size, spaciousness, and textbook provision were non-linearly related to pupil achievement and had greater positive benefit when resources were scarce (Raudenbush & Bhumirat, 1992), suggesting that in states where education access is of serious concern, even small changes in school inputs may have positive results.

Positive impacts of pupil-teacher ratio are not limited to academic performance. Case and Deaton (1999) examined the effects of pupil-teacher ratio on a variety of school outcomes in South Africa, and found significant effects on enrolment, achievement, and numeracy. Pupil-teacher ratio significantly affects the likelihood of student dropout (McNeal, Jr., 1997), and increases in ratios (more students per teacher) reduce graduation rates and lower the percentage of college bound-students (Sander, 1993). Finally, the Tennessee STAR experiment found that smaller ratios resulted in considerable improvement in early childhood learning and cognition, that effects for minority students were double those for other students in early education, that student performance in small classes in early education persists despite transitions to larger classes in later years, and that small classrooms substantially contribute to the achievement of economically disadvantaged students (Mosteller, 1995).

Educational expenditures

Hanushek (1995) reviewed twelve studies on the relationship between per-pupil expenditures and student performance, finding six statistically significant positive results and six nonsignificant relationships. These results were similar to those of Velez,

Schiefelbein, and Valenzuela (1993). While Hanushek (1995) concluded that, given the negligible impact of per-pupil expenditures, results did not justify policies intending to reduce class size, it was argued that resource disparity is important, and variation in resource distribution in developing countries may serve to shroud positive effects. The watershed *Coleman Report,* released in 1966, noted that individual student characteristics, such as socioeconomic status, were more relevant to student outcomes than school resources, such as per-pupil spending (Hanushek, 1998).

Wenglinsky (1997) noted that the *Coleman Report* set off a trend among educational researchers who, in studying the impacts and relevance of school social environments, increasingly questioned the abilities of schools to affect student performance at all. However, research has found positive relationships between expenditures and student outcomes (Summers & Wolfe, 1977; Greenwald, Hedges, & Laine, 1996; Jacques & Brorsen, 2002; Ram, 2004; Li & Tobias, 2005; Hogrebe, Kyei-Blankson, & Zou, 2008), though Ilon and Normore (2006) concluded that per-pupil expenditures were the least cost-effective means of resource input for student achievement. While some research (Hanushek, 1986; Hanushek, 1989; Okpala, Okpala, & Smith, 2001) concluded that there was no relationship between expenditures and achievement, Ismail and Cheng (2005) have argued that the results from Hanushek (1986, 1989) were based on poor data and inappropriate methodology. Archibald (2006) found positive effects of per-pupil expenditures on reading achievement throughout primary and secondary education, while Eide and Showalter (1998) used quantile regression to show that per-pupil expenditures are important for the tail end of the performance distribution, in other words, students at the lowest end of test score distributions benefit significantly from greater expenditures. Finally, expenditures may act as an endogenous variable to performance, or may have a mediating (indirect) effect through greater access to effective teachers, more successful pedagogy, and a reduction in class size (Wenglinsky, 1997; Elliot, 1998; Sander, 1999).

Grade repetition (retention)

It has been argued that modern approaches to educational policy have contributed to rising retention rates, which are correlated with increases in student dropout and are unsuccessful as a remediation strategy for student performance (Roderick, 1995). Retention often carries a perception of student failure, lack of support from teachers and the school, and negative socioemotional effects for the student, such as increased frustration and disengagement. Retention continues to be a common form of intervention for students who have been deemed unprepared for the next level of cognitive and social development, despite the known deleterious impacts on student dropout rate, attitudes towards school, and engagement (Schnurr, Kundert, & Nickerson, 2009). Schnurr et al. (2009) cite multiple examples of research on retention and academic outcomes, with findings indicating small short-lived improvements in achievement (Jimerson, 2001; Gleason, Kwok, & Hughes, 2007) but no long-term improvement for retained students (Holmes & Matthews, 1984; Holmes, 1989; Jimerson, 2001). Further, the long-term impacts of retention on student performance have been shown to be nonsignificant (Jimerson, 1999; Silberglitt, Jimerson, Burns, & Appleton, 2006; Jimerson & Ferguson, 2007). Teachers or ad-

ministrators are typically shortsighted in retention decisions, failing to consider the negative impacts of retention on long-term socioemotional and psychological growth (Roderick, 1995). Additionally, when typical predictors of retention decisions are analyzed together rather than in isolation, only student underage status and environmental factors significantly predict retention (Willson & Hughes, 2009).

Not all research into retention and academic performance has been negative. Wu, West, and Hughes (2008) used propensity score matching to link retained students with promoted students from a multiethnic sample of children in order to assess academic achievement. Depending on the type of score used in analysis, students who were retained were found to either have slower achievement gains in the short-term and faster gains in the long-term or faster gains in the short-term and slower long-term gains. At times, grade repetition has been linked to increases in student learning, but this is an expensive method (Gomes-Neto & Hanushek, 1994; Hanushek, 1995).

The extant literature has shown conflicting results of the impacts of pupil-teacher ratio, educational expenditures, and retention. Occasionally, research has hinted at the unique circumstances in the developing world that mediate the relationship between policy-based inputs and student outcomes. This study combines multiple educational inputs and explores their joint effects on primary school completion, using cross-sectional data from each nation in Sub-Saharan Africa—countries at the forefront of universal education policies designed to reduce inequality and contribute to an egalitarian society.

Methods

Path analysis was used to explore the associations between educational inputs and primary education completion in Sub-Saharan Africa, using data from the UNESCO Institute for Statistics. Path analysis is a quantitative graphical technique that extends the ordinary least squares (OLS) regression model to examine the direct and indirect effects of sets of predictor variables (Foster, Barkus, & Yavorsky, 2006). Path analysis allows for the consideration of multiple dependent variables, and the correlations between independent variables are more easily explored (Foster et al., 2006).

In path analysis, a hypothesis is first formed regarding the relationships between the variables of interest. A path diagram is then created that specifies the direct and indirect relationships between variables considered in the model. Analysis then proceeds to reveal any statistically significant relationships, along with the total, direct, and indirect effects of those relationships. Finally, various tests of model fit are available to demonstrate how well the proposed model fits the available data, and options are available for model modification for enhanced fit. Path analysis is sensitive to model specification: the inclusion or exclusion of extraneous variables may have a substantial impact on path coefficients, which indicate the strength of model relationship (Garson, 2014).

Data

Data for each country in Sub-Saharan Africa were aggregated from two longitudinal datasets, compiled every five years from 1970 to 2005, which are freely available from the UNESCO Institute for Statistics (UIS; see: www.uis.unesco.org/Education). The UIS datasets provide cross-sectional data on primary school completion, enroll-

ment and retention rates, teaching staff, school life expectancy (persistence), and educational expenditures (*n*=45) for each country in Sub-Saharan Africa. Data were obtained in aggregate form and were not stratified by age, race, gender, or grade level. Net enrolment ratios and intake rates were not reported when there was a lack of reliable data, and expenditures on pre-primary education from international sources were classified as negligible when data were missing.

Model

Each path model used primary school student completion (PCOM) as the dependent variable. School input variables (independent variables) included pupil-teacher ratio (PTR), educational expenditures per capita (EDEX), and student retention rate (RET). Analysis assumed that causal effects were unidirectional with no reciprocal or circular effects (Foster et al., 2006), that residuals were uncorrelated, and that variable relationships were linear. Data analysis used LISREL 8.80 (Jöreskog & Sörbom, 1993). Variable relationships impacting student primary education completion were informed by the literature reviewed above and defined by equations (1) and (2), respectively:

(1) $PCOM = b_{11}EDEX + b_{12}PTR + e_1$
(2) $PTR = b_{21}EDEX + b_{22}RET + e_2$

which indicate the relationships to the endogenous variables. In the specified models, only the direct effects on the endogenous variables are considered. Beta coefficients represent the path coefficients (standardized regression coefficients) that are the partial weights when controlling for the other priors of the dependent variable (Garson, 2014). Here, EDEX has a direct effect on PCOM and an indirect effect on PCOM through PTR; PTR has a direct effect on PCOM; and RET has an indirect effect on PCOM. In the preliminary model, EDEX and RET are exogenous variables with no explanation being predicted in the model. PCOM and PTR are endogenous variables.

A second model was also tested, as specified in equations (3) and (4):

(3) $PCOM = b_{12}PTR + b_{13}RET + e_1$
(4) $PTR = b_{11}EDEX + b_{13}RET + e_2$

For model two, the direct effect from EDEX to PCOM was dropped, and a direct effect from RET to PCOM was added. These changes reflect a hypothesized non-significant relationship between educational expenditures and primary school completion, as well as a proposed direct relationship between retention and completion. In the latter case, it was hypothesized that retaining students may have a direct impact on primary school completion. This relationship could either be negative (particularly in developing states, where children's school attendance places burdens on the more rural, agrarian families) or positive (through the benefit of additional instruction). Both of these possibilities have been highlighted in previous research. Note that specified models only explore the form, and not the cause, of these relationships.

Results

Path coefficients for the first model are presented in Figure 1. As shown, the coefficients contributing to primary school completion are from EDEX to PCOM (0.18)

and PTR to PCOM (-0.49). Contributions to pupil-teacher ratio effects include EDEX to PTR (-0.35) and RET to PCOM (0.34). Squared multiple correlations indicated that 33 percent of the variance of student primary school completion is explained by the model. Of the path coefficients, all are statistically significant at $\alpha = .05$, with the exception of EDEX to PCOM. Total effects from Model 1, as well as direct and indirect effects, are presented in Table 1.

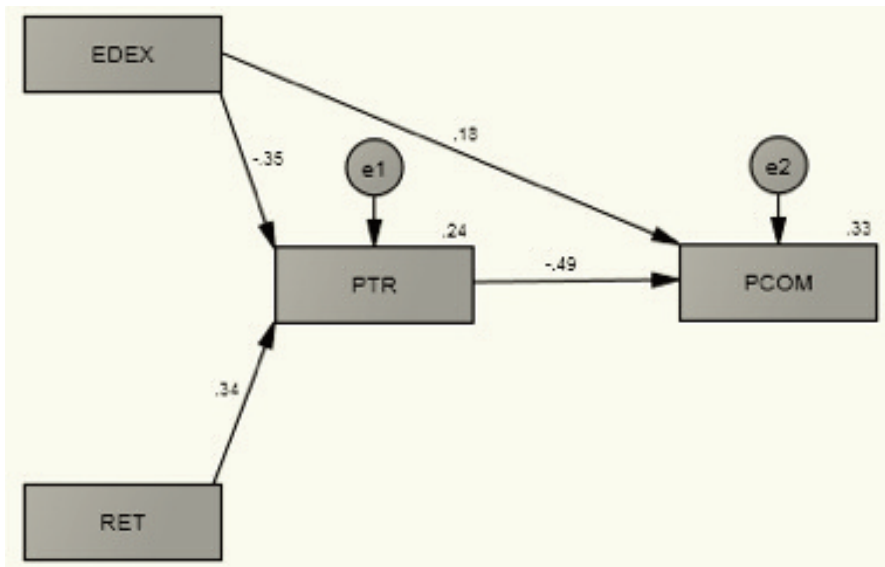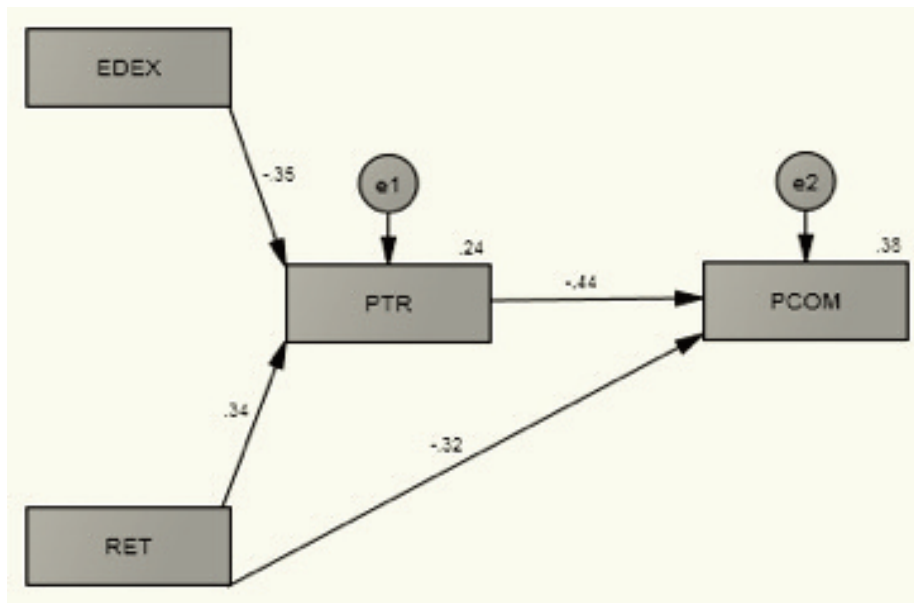**Figure 1. Path coefficients for Model 1**

Table 1. Total, direct, and indirect effects of retention, expenditure, and pupil-teacher ratio on primary school completion (Model 1)

		RET	EDEX	PTR
Total effects	PTR	0.34	-0.35	
	PCOM	-0.16	0.35	-0.49
Direct effects	PTR	0.336	-0.352	
	PCOM	0.000	0.179	-0.485
Indirect effects	PTR	0.000	0.000	
	PCOM	-0.162	0.171	0.000

The likelihood ratio Chi-square test for the first model indicates that the model is of inadequate fit ($\chi^2 = 7.831$, $df = 2$, $p = 0.020$). While small differences between model-implied and observed covariance matrices can result in a significant Chi-square statistic, the additional goodness of fit indices of Root Mean Square Error of Approximation and Comparable Fit Index also support the conclusion of inadequate fit (RMSEA = 0.254; CFI = 0.835).

For the second model, the non-significant structural loading from EDEX to PCOM was dropped. Additionally, a direct path from RET to PCOM was added to the model. Results from the second model with path coefficients are given in Figure 2.

Figure 2. Path coefficients for Model 2

Coefficients leading to primary education completion include PTR to PCOM (-0.44) and RET to PCOM (0.34). Coefficients contributing to pupil-teacher ratios include EDEX to PTR (0.35) and RET to PTR (0.34). Squared multiple correlations show that 38 percent of the variance of primary school completion is accounted for, a slight improvement over Model 1. All path coefficients are statistically significant and are of moderate magnitude. Total, direct, and indirect effects for Model 2 are presented in Table 2.

**Table 2. Total, direct, and indirect effects of retention, expenditure,
and pupil-teacher ratio on primary school completion (Model 2)**

		RET	EDEX	PTR
Total effects	PTR	0.336	-0.352	
	PCOM	-0.463	0.153	0.435
Direct effects	PTR	0.336	-0.352	—
	PCOM	-0.316	0.000	-0.435
Indirect effects	PTR	0.000	0.000	—
	PCOM	-0.146	0.153	0.000

The likelihood ratio chi-square test for Model 2 indicates that there is adequate fit for this specified model ($\chi^2 = 3.840$, $df = 2$, $p = 0.147$). The Comparable Fit Index also indicates a good model fit (CFI = 0.948), although the Root Mean Square Error of Approximation was not ideal (RMSEA = 0.14). Because of the enhanced fit indicated by the chi-square test and the CFI, together with the statistically significant loadings on the variables of interest, we conclude that the second causal model is of adequate fit.

Discussion

There are a number of plausible reasons for considering expenditures, pupil-teacher ratio, and retention as viable mechanisms to influence primary school completion, particularly in Sub-Saharan Africa. Increases in educational expenditures can result

in more opportunities being available to school districts to hire more teachers and at a higher rate, which can result in more qualified teachers and lead to higher completion rates. Expenditures can positively influence completion directly through greater access to education, especially for those typically denied access due to socioeconomic factors. Lower pupil-teacher ratios can contribute to greater freedom given to teachers, allowing for increased individualized attention and structural support for students in need. Finally, student retention in the primary grades often has a negative association with primary school completion. This may be a result of negative socioemotional impacts upon students, a slowing of the completion process, or economic demands on families external to the school.

Retention was found to have a significant negative direct and indirect relationship with student primary school completion, indicating that student retention across Sub-Saharan African nations is moderately associated with students failing to complete primary school. Further research into the causes of this association is needed. For example, the negative relationship between retention and completion may be representative of the growing opportunity costs for school attendance for agrarian families in the developing world, such as those reported on by Lincove (2009). Comparatively, findings may be a result of the negative socioemotional impacts of retention on at-risk youth.

Effects of pupil-teacher ratios indicate that as the number of students per teacher goes up, the likelihood of primary school completion for students goes down. From the model, the direct relationship between pupil-teacher ratio and primary school completion was one of strongest associations in the data. Particularly as countries continue working toward free/universal primary education policies, the burdens placed on existing educational infrastructure will grow. Policies intended to reduce the instructional burden on teachers may allow them greater time to focus on the individual learning preferences of each student, and may result in greater academic achievement for both regular students and those at risk.

The relationship between educational expenditure and primary school completion is intriguing. Results from the first model showed no statistically significant direct relationship between increases in expenditure and student outcomes, but there were indications of an indirect relationship through the mediating effect of pupil-teacher ratio. In the second, reduced model, however, the total effect of increases in educational expenditure was small (0.15). For students' primary school completion, educational expenditures may not be a viable policy action when expenditures are unconditioned by other criteria, such as how monies are spent. These results for educational expenditures reflect those of Colclough and Lewin (1993), who drew similar conclusions from an analysis that explored the correlates of under-enrolment. Here too, expenditure variables were found to be unimportant.

Contrary to expectation, expenditures have a moderate, negative association with pupil-teacher ratio—as expenditures go up, teachers face larger classrooms. It is possible that, in countries with FPE/UPE policies, increases in expenditures are dedicated to increasing educational access for children who have been denied those opportunities in the past. This process increases enrolment in primary schools and places additional instructional burdens upon teachers. However, increases in expen-

ditures may simultaneously be responsible for the hiring and retaining of more qualified teachers. Although it has a negative impact on pupil-teacher ratio, student outcomes are still positively affected, as the more highly qualified teachers are possibly able to maintain a high level of instruction in the face of large classrooms. This would explain the small indirect association of educational expenditures positively impacting primary student completion. Elliot (1998) found this same type of indirect relationship when investigating student achievement.

There are often issues with using expenditure indicators as explanatory variables, as they can be difficult to link to student outcomes with any validity. Problems lie in the practical application of increases in educational expenditure. At times, it is difficult to determine if those increases are directed toward individual per-pupil expenditure or toward the creation of additional educational structures to satisfy demand, such as more schools or more teachers. This may be a sufficient explanation for the non-significant results typically found when directly measuring the relationship between expenditure and student success. There are also many possible unseen impacts on student outcomes that are masked by educational expenditure. Impacts of this nature may be difficult to measure. For example, increases in expenditure might reflect higher teachers' salaries, which may instill in teachers a notion of professional empowerment and a drive to succeed, in turn leading to improved student outcomes.

Future studies of educational inputs in Sub-Saharan Africa would be well served by supplementary qualitative research into teachers' perceptions of and reactions to policy change. Although educational expenditures are difficult to define when analyzing student outcomes, they are still important to consider as potential mediating variables with indirect effects. Considering the difficulties of identifying reasonable proxy variables to represent the mediating effects of expenditures on outcomes, especially when data are lacking, educational expenditure itself can help serve as this proxy. Further, class size is an important consideration when studying increases in expenditure, particularly in the developing world. If total class enrolment is held constant while expenditures rise, and if completion rates increase, then expenditure likely represents an increase in quality.

Limitations

The presented findings suggest a number of interesting relationships across the nations of Sub-Saharan Africa that are in line with the results of previous research. However, additional study with variables not considered by the model would be helpful. There may be alternative inputs that significantly contribute to primary school completion for students in Sub-Saharan Africa that were not considered here.

Because of the aggregated, cross-national focus of this study, the sample size was small and available covariates were limited. While the ecological perspective of this approach provided a number of thought-provoking relationships, the individual policy environments within each country are understandably lost. Additionally, results are associations only and cannot be considered causal, due to the lack of longitudinal data. Future research using hierarchical linear modeling within the individual countries of Sub-Saharan Africa, using data from regional or local school districts, as well as exploring the effects of inputs on school completion over time, would be useful.

Furthermore, research of this nature would benefit from a more contextualized, ethnographic support study to explore the local experiences of students and teachers.

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