Teaching and Teacher Education 47 (2015) 173–183

Contents lists available at ScienceDirect

Teaching and Teacher Education

journal homepage: www.elsevier.com/locate/tate

Teacher coaching in Kenya: Examining instructional support in public and nonformal schools

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HIGHLIGHTS

- Teacher coaching can improve literacy in Kenyan public and nonformal settings.
- The more teachers a coach is responsible for leads to fewer visits per teacher.
- Outcomes are higher for pupils supported by coaches with 10 rather than 15 schools.
- Impact of coaching on outcomes is similar in Kenyan public and nonformal schools.

ARTICLE INFO

Article history:
Received 25 June 2014
Received in revised form
28 December 2014
Accepted 2 January 2015
Available online 27 January 2015

Keywords:
Coaching
Instruction
Kenya
Literacy
Professional development

ABSTRACT

Instructional coaching has improved student outcomes in the United States, and may help to solve Kenya's literacy problems. Coaching is costly, however, and evidence is lacking regarding the most cost-efficient teacher-to-coach ratio. We used student literacy outcome data from more than 8000 students participating in the Kenya Primary Math and Reading Initiative—a randomized controlled trial of instructional interventions in public and nonformal schools—to fill this gap. Coaches in larger public zones made fewer visits per teacher, and teacher-coach ratio and student performance were negatively associated. Using causal methods, we concluded that lower ratios might improve nonformal school outcomes.

1. Introduction

In the United States and other developed countries, vast amounts of money, time, and research are devoted to in-service teacher training. In low-resource settings, however, in-service teacher training often falls fairly low on the list of educational priorities, below building schools, buying textbooks, and training new teachers. Yet this failure to attend to the teacher corps' professional development has real consequences for educational systems. Despite the fact that the Millennium Development Goal of universal primary education has been largely achieved in most countries, educational quality, as measured by student outcomes, has remained stagnant. The teacher is at the core of the process of educating children, and in contexts where teachers are poorly educated and ill-prepared for their roles, effective in-service training and support may help improve outcomes in a sustainable way.

This study focuses on in-service teacher training in Kenya. Kenya has had a gross primary enrollment ratio well above 100% for the past decade (World Bank, 2013), but literacy outcomes remain poor (Mugo, Kaburu, Limboro, & Kimutai, 2011; National Assessment System for Monitoring Learner Achievement, 2010; Onsomu, Nzomo, & Obiero, 2005; Piper, 2010b; Wasanga, Ogle, & Wambua, 2010). In a recent study, just 4.9% and 3.3% of first- and second-grade learners in urban and peri-urban counties met the Kenya National Examinations Council (KNEC) benchmarks for oral reading fluency and comprehension in English and Kiswahili, respectively (Piper & Mugenda, 2012). This low level of literacy performance is not unique to Kenya, as similar challenges are found in many countries in sub-Saharan Africa.

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http://dx.doi.org/10.1016/j.tate.2015.01.001

Outdated and ineffective pedagogy has been cited as one of the central reasons for these poor results. In Kenya, teacher lecture and whole-class oral repetition have been found to be the most common teaching methods, even in the primary grades (Ackers & Hardman, 2001; Dubeck, Jukes, & Okello, 2012; Pontefract & Hardman, 2005). Given large class sizes, lack of sufficient textbooks and materials, and teachers' limited pre-service and nearly non-existent in-service professional development, these findings are not surprising. In order to shift toward research-based pedagogy in this challenging context, teachers need additional pedagogical support. The challenge, in Kenya and other countries in the global South, is to determine how to provide teachers the guidance and support they need within the system's financial constraints. One possible means of supporting teachers in public schools in Kenya is through Teachers' Advisory Centre (TAC) tutors, who report to the Teachers' Service Commission (TSC) under the Ministry of Education, Science and Technology (MoEST).[2] One TAC tutor is assigned to each administrative zone—a geographically clustered group of schools—and supports from 8 to 30 government primary schools with targeted teacher training and instructional support. While TAC tutors have been in place in public primary schools since the late 1970s, the quality and quantity of services they offer vary widely. Similar systems of instructional support exist elsewhere in eastern and southern Africa, including Ethiopia (cluster supervisors), Uganda (coordinating center tutors), and Malawi (primary education advisors).

Enhancing the pedagogical support services that TAC tutors give to teachers will require a better understanding of the existing workload of the TAC tutors and the number of schools for which each tutor can reasonably offer ongoing instructional supervision. The aim of this study is to provide empirical evidence regarding the most effective ratios of coaches to teachers in Kenyan schools. We also discuss how these varying ratios affect the length and quality of coach–teacher interactions. These findings have critical policy implications for the MoEST in its goals to improve the quality of primary-level literacy instruction, as well as for governments and nongovernmental organizations involved in teacher education and support throughout sub-Saharan Africa.

2. Background and context

2.1. Teacher coaching and student outcomes

The majority of the research on teacher coaching approaches has been conducted in Western countries. In the United States, teacher coaching became widespread after implementation of 2001's No Child Left Behind Act (Dole, 2004), which increased pressure on low-performing schools to show improvement or risk sanctions. The principal's role in guiding his or her staff members has been an important focus on efforts to improve instruction in the U.S. However, a growing number of studies have pointed to the potential of coaches to support teachers to improve achievement, particularly in the area of literacy. Coaching activities vary widely along a spectrum from general conversations about a curriculum to joint lesson planning to modeling and lesson study (Denton & Hasbrouck, 2009; International Reading Association, 2004).

The theoretical approach to coaching in this study follows Guskey's (1985) model of teacher change. In this model, high-quality teacher professional development leads to changes in pedagogy, which result in improvements in student outcomes. It is after the teachers observe those improvements that changes in teacher beliefs and attitudes occur. This model suggests that teachers require significant support during the implementation stage, as teacher buy-in will not occur until evidence of success is visible to teachers, using informal metrics derived by teachers. One-on-one coaching is one way to provide this direct support. Over time, the instructional change will prove long-lasting, as teachers derive their support for new instructional approaches from personal experiences of success rather than from the influence of the trainer, second-hand anecdotal information, or success stories from elsewhere.

A growing body of research in the U.S. suggests that coaching can have positive effects on teacher pedagogy and student outcomes (Blachowicz, Obrochta, & Fogelberg, 2005; Lovett et al., 2008; Reinke, Stormont, Herman, & Newcomer, 2014; Sailors & Price, 2015; Teemant, 2014; Teemant, Wink, & Tyra, 2011; Vanderburg & Stephens, 2010). Matsumura, Garnier, Correnti, Junker, and DiPrima Bickel (2010) investigated the effects of content-focused coaching (CFC) on new teachers recruited into a district that suffered from a high turnover rate among its teaching staff. Their findings indicated that the coaching program predicted significantly higher school-level gains on the state standardized test for English-language learners compared to schools whose teachers were not provided CFC. A value-added analysis of the Literacy Collaborative program, which included teacher coaching, found that it positively impacted student literacy outcomes (Biancarosa, Bryk, & Dexter, 2010). In South Carolina, coached teachers' pedagogy aligned more closely with state and national best practices (Stephens et al., 2007). A study in Michigan found that a professional development program for first-grade teachers that included coaching outperformed programs involving seminars or seminars plus self-evaluation, in terms of improving pedagogy (Carlisle, Cortina, & Katz, 2011). The success of these programs with pupils in the early primary grades and with second-language learners carries weight for countries like Kenya that are struggling to meet basic literacy goals, and indicates that enhanced coaching programs may prove effective in helping Kenyan teachers improve their pedagogy.

The amount of time coaches or tutors spent one-on-one with teachers appeared to be a critical factor in changing teacher behavior and subsequently improving student outcomes (L'Allier, Elish-Piper, & Bean, 2010; Ross, 1992). In a study of 20 Reading First coaches in the United States, Bean, Draper, Hall, Vandermolen, and Zigmond (2010) identified an association between the amount of time that coaches spent with teachers and teachers' attitudes toward their coaches—i.e., more time improved the relationship. Additionally, the authors concluded that coaches who spent more time working with teachers directly, as opposed to managing other tasks, were more effective in increasing student reading proficiency in first and second grades. Shidler (2009) found that, in the first year of a coaching program designed to support Head Start teachers in literacy instruction, the amount of time coaches spent with teachers was correlated with student knowledge of the alphabet.[3] In a large urban district in the U.S., Elish-Piper and L'Allier (2011) identified a relationship between coaching time and higher scores on the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) assessment among second-grade students. As would be expected, the number of teachers assigned to a coach impacts the amount of direct support that coach can provide to individual

[2] Kenya also has numerous independent *nonformal* schools (also known as *low-cost private schools* or *complementary schools*) that do not receive financial support from the government or pedagogical support from TAC tutors. More about the distinctions between these two school types appears in the Methodology section.

[3] Head Start is a U.S. program designed to improve school readiness through community-based daily instructional support programs for preschool-aged children.

teachers (Atteberry & Bryk, 2011). It is likely that greater amounts of time spent together results in higher degrees of trust between coaches and teachers, which is critical to the success of the relationship (Hershfeldt, Pell, Sechrest, Pas, & Bradshaw, 2012).

In contrast to the studies discussed above, Van Keer and Verhaeghe (2005) compared two coaching models used with fifth-grade teachers—one comprising 35 h of contact and another just 15 h. In terms of student performance on literacy assessments, the less-intensive model was just as effective as the more-intensive model. Given the cost implications of providing more one-on-one training time in a resource-constrained setting like Kenya, this is an encouraging finding. However, we must note that even 15 h of direct coaching is far more than the average Kenyan teacher receives in a year, even under ideal circumstances.

Research on in-school teacher pedagogical support is rare in Kenya and other developing countries. The limited evidence from available studies that we examined suggested that even short-term instructional coaching could lead to teacher behavior change (Piper, 2010a; Piper & Korda, 2011; Piper, Zuilkowski, & Mugenda, 2014). A small intervention in eight classrooms in Thailand that included coaching resulted in greater use of student-centered pedagogies (Tolley, Johnson, & Koszalka, 2012). Other interventions have shown mixed results. In Malawi, a five-month intervention for literacy teachers resulted in changes in attitudes and beliefs about their teaching abilities, though no shifts in instructional practices were observed (Sailors et al., 2014). A large-scale intervention in Ethiopia that focused on improving student-centered pedagogy with elements of coaching support through the cluster supervisor failed to increase student-centered pedagogical practices, although learning outcomes increased modestly (Piper, 2009).

In Kenya, Odhiambo (2005) argued that there are a number of potential positive benefits to teacher observation and feedback, including identifying strengths and weaknesses, increasing knowledge of curricular and pedagogic issues, and improving student outcomes. It appears that to the extent that coaching helped teachers reflect on their own actual practice, and to interact with other professionals intent on improving their practices, the coaching had some positive effect on instructional behavior (Piper, 2009). Coaching may be particularly effective in the global South because of the limited formal education and in-service professional development opportunities available to the average teacher. In Kenya, for example, primary teachers generally have just two to three years of post-secondary education, compared to four or more in the U.S. (Piper & Mugenda, 2012).

2.2. Teacher training and Teachers' Advisory Centres in Kenya

Increasingly, newly trained Kenyan teachers have diplomas or degrees from teacher training colleges or universities, but some older teachers, particularly in rural and remote areas, have only a secondary education. Currently, the minimum program to become a qualified primary grade teacher consists of a two-year tertiary program including a three-week practicum (Pryor, Akyeampong, Westbrook, & Lussier, 2012). Twenty-one public institutions and dozens of private colleges offer teacher training programs (Bunyi, Wangia, Magoma, Limboro, & Akyeampong, 2011). Pre-service training often focuses on academic material, however—such as mathematics content—rather than pedagogical methods, reflecting the weak instructional preparation of teacher candidates (Akyeampong, Lussier, Pryor, & Westbrook, 2013).

The Kenyan government has repeatedly declared its intention to improve instructional quality by increasing the focus on in-service teacher training (see, for example, the Kenya Education Sector Support Program 2005–2010 and the National Educational Sector Plan 2014–2018). In practice, however, in-service training is a rare occurrence for most teachers; one recent study reported that more than 80% of teachers in 72 Kenyan schools in six districts reported having had no in-service training of any type in the preceding 18 months (Ngware, Oketch, & Mutisya, 2014). Nongovernmental organizations and international aid agencies have supported a number of teacher training projects in Kenya, but such programs are generally small-scale and short-term. Traditionally, both in-service and pre-service teacher training have been conducted using face-to-face modalities, but as Internet access improves across Kenya, there is greater interest in and use of distance learning (Maritim, 2009).

In Kenya, the main responsibility for ongoing teacher instructional support lies with the TAC tutor system (Giordano, 2008). Each TAC tutor, generally an experienced teacher or former head teacher, is responsible for supporting a number of government primary schools in an administrative zone. TAC tutors not only conduct classroom observational and teacher training activities, but also handle a wide range of other duties; this divided attention limits their ability to provide high-quality instructional support (Bunyi et al., 2011). One study found that TAC tutors spent 60% of their time on administrative duties and just 40% working with teachers (Kisirkoi, 2011). Other recent research found that more than half of Kenyan teachers reported being observed by any instructional supervisor (including TAC tutors) only once per term (three times a year) (Piper & Mugenda, 2012). Some TAC tutors visit schools less frequently than intended because they generally pay for their own travel. This reduces the amount of direct support that the TAC tutors can provide.

The challenge is not only in increasing the amount of time that TAC tutors spend with teachers, but also in creating systems that allow for pedagogical support of any kind. The TAC tutor system in Kenya has suffered in no small part due to the understaffing of education officers in the education system. For example, TAC tutors are often seconded from the TSC to district offices to serve as de facto Quality Assurance and Standards Officers or administrative support to the Sub-county Education Officer. Recent studies in Kenya found that county directors of education and county TSC directors were united in their assessment that the average TAC tutor has been entirely removed from the pedagogical support role (KNEC, 2013). Instead, the TAC tutors are engaged in other activities, including monitoring exams, holding meetings with parents, representing the district and county officials at meetings, supervising materials distribution, preparing candidates for the Kenya Certificate of Primary Education (KCPE), and other tasks that take them away from the classroom. Compounding the problem is the pervasive impression that direct instructional support is less prestigious than administrative duties; TAC tutors may in fact prefer to be assigned away from their pedagogical responsibilities. A recent government task force went so far as to state that the previously effective TAC system has collapsed (Ministry of Education, 2012).

Despite this dismal assessment, TAC tutors in the recent past have been involved in effective large-scale training programs. Between 2001 and 2005, TAC tutors participated in the School-based Teacher Development program (SbTD), funded by the British Department for International Development (DFID), and worked with key resource teachers in each school to support pedagogical improvements. Although SbTD was largely a distance training program, the TAC tutors were expected to visit their schools every two weeks. An evaluation found that the key resource teachers taught in a more interactive manner than peers who were not trained in the SbTD (Hardman et al., 2009). However, the cascade training model was relatively ineffective; non-trained teachers in the same schools did not change their teaching style as much as the directly trained key resource teachers. This finding supports the need for enhanced direct contact between teachers and TAC tutors, rather than continued dependence on intermediary key resource teachers or head teachers.

Given adequate time to focus on enhancing instruction in their assigned schools, TAC tutors may be more successful in aiding teachers in improving literacy outcomes. At this point, however, the quality and benefit of these visits is unclear, given the very short classroom observations that are the prevailing practice in Kenya.

3. Research questions

The need to provide teachers with high-quality instructional support presents Kenya with several policy challenges. For example, the MoEST and TSC are struggling to develop the funding structures necessary to encourage TAC tutors to visit schools. If funding allows, the TSC is considering increasing the number of TAC tutors in the country, but that decision is not based on any evidence about the optimal TAC tutor-to-school ratio. As of 2013, 849 TAC tutors were serving 1052 zones. Given the gap in the literature about the structure and organization of instructional support in Kenya, and the unique opportunity provided by the USAID- and DFID-funded Primary Math and Reading (PRIMR) Initiative to fill that gap, we proposed the following three research questions.

1. Does the number of teachers assigned to the TAC tutor or instructional coach impact the frequency of visits per teacher by the TAC tutor or instructional coach? Does that effect differ in public and nonformal schools?
2. Do students in nonformal schools whose instructional coaches are responsible for 10 schools perform better on literacy assessments than students in schools whose instructional coaches are responsible for 15 schools?
3. Do students in public zones with fewer schools perform better on literacy assessments than students in zones with more schools?

The design of this study allowed for causal inference for the nonformal schools, as coaches were randomly assigned to school clusters of varying sizes. As PRIMR was not able to manipulate zone size or TAC tutor assignment for public schools, the research design does not allow for causal inference for the public school sector. The convergence or divergence of the results for the two school types may nonetheless be informative in the development of Kenya's teacher support policies.

4. Methodology

4.1. PRIMR's TAC tutor and coach system

As limited empirical knowledge exists about the efficacy, frequency, and quality of visits by TAC tutors, the research available to inform policy making surrounding the TAC tutor system is very sparse. As indicated earlier, the PRIMR Initiative was a MoEST program implemented in a total of 1385 schools across Kenya with financial support provided by USAID/Kenya (from 2011 to 2014) and DFID/Kenya (from 2013 to 2015), and led by RTI International in six counties. The 2013 data for this study came from 16 public zones supported by USAID funding (191 schools), 14 public zones supported by DFID funding (147 schools), and 15 nonformal school clusters supported by USAID funding (180 schools). In total, this study utilized data from 518 schools.[4]

[4] The DFID-funded program began implementation after the first term of the 2013 academic year. To create comparable figures for the number of visits, we multiplied the DFID school visits by 1.5 to account for approximately one-third of the classroom observational time being "lost."

PRIMR focused on improving literacy and numeracy outcomes for students in classes (i.e., grades) 1 and 2. The TAC tutor system's ability to support instructional change was a core element and underpinning assumption of PRIMR. PRIMR provided teachers' guides and student books for classrooms and trained TAC tutors in their use. TAC tutors then trained teachers in those same methods. PRIMR required that each TAC tutor fill out an observation form for each classroom visit and provided modest transport reimbursements to TAC tutors based on the proportion of teachers they observed in their zone each month. This arrangement created a substantial incentive for all TAC tutors to visit every class 1 and 2 teacher in their zones every month. As a result, TAC tutors were more likely to visit classrooms than they would have without PRIMR. PRIMR's system resulted in a dramatic increase in the numbers of teachers and lessons observed and the frequency of TAC tutor visits to schools, and more specifically, to classrooms.

In addition to the public school sector, where PRIMR and the TAC tutors supported 338 schools in 2013, PRIMR also supported 180 schools in nonformal settlements in Nairobi's slums, serving the poorer populations of the city. These nonformal schools were not affiliated with each other through any governance structure the way the public schools were. To manage the implementation of the program in nonformal schools, PRIMR hired instructional coaches to act as TAC tutors and provide the professional development and instructional support to teachers.

In this article, we discuss the tutors and coaches together, as both groups implemented PRIMR in the same way and were required to visit schools on a monthly basis to observe every class 1 and 2 teacher.

4.2. TAC tutor and instructional coach sample

In 2013, PRIMR worked with 15 coaches randomly assigned to clusters of nonformal schools in the slum areas of Nairobi. Nine coaches had 10 schools, and six coaches had 15 schools; 50 additional schools served as control schools. This design allowed us to compare the effectiveness and cost-effectiveness of the PRIMR program at different school-to-coach ratios, randomly assigned. The random assignment allowed us to measure the causal impact of the school-to-coach ratio on student achievement.

For public schools, the PRIMR implementation team randomly selected zones in the six counties and then randomly assigned them to treatment groups that began in 2012, 2013, 2014, or 2015. Schools in zones assigned to start in 2014 served as control schools for the USAID program through the endline data collection in October 2013. Nonformal schools—without official zones—were clustered into groups of 10 or 15 before PRIMR began. The nonformal schools were also randomly assigned to start in 2012, 2013, or 2014. Schools in clusters assigned to start in 2014 served as control schools. The data set investigated in this paper came from 30 public school zones and 15 nonformal clusters.

4.3. Student sample

Student achievement data were collected in January 2012 (baseline), October 2012 (midterm), and October 2013 (endline). In each data collection round, half of the schools in each cluster or zone were randomly selected for assessment. A comparison of schools selected for the midterm assessment to those not selected revealed no differences in the numbers of schools visited by tutors and coaches. As a result, the same schools selected at the midterm in October 2012 were also selected for the October 2013 endline. At the school level, PRIMR utilized simple random selection of students. Five boys and five girls from both class 1 and class 2

were selected from among the students who were present on the day of data collection, for a total of 20 students selected from each school.

The PRIMR research team participated in Institutional Review Board (IRB) reviews in 2011 and in 2013 in order to address any ethical concerns. The randomized selection of zones and clusters to treatment was done through a random number generator, and in order to address the ethical concerns that arise from random selection and assignment to treatment, the zones and clusters assigned to the control condition were provided the treatment (including coach support) starting in January 2014, after the endline data collection. Ethical approval was granted by RTI International's IRB, by the MoEST, by Kenya Medical Research Institute (KEMRI), and by the National Council of Science and Technology in Kenya.

The sample used in this article is presented below, in Table 1. In all, 4385 students were assessed in the PRIMR baseline in January 2012, and 4222 in the PRIMR endline in October 2013. For the endline, this represented 1900 public school students and 2322 nonformal school students. Class 1 and class 2 totals were nearly the same, at 2110 and 2112 respectively. Note that every student was given the option of not participating in the study, and the assessment took place only if the child consented. The few who did not consent were given the same reward (a pencil) as those who did take part.

4.4. Measures

The measures used in this paper were chosen by the MoEST, USAID/Kenya, and KNEC as the key variables for evaluating the impact of PRIMR (Piper & Mugenda, 2013). The first indicator is oral reading fluency (in Kiswahili and English), which was measured by the number of words of an approximately 60-word story that a pupil read correctly in one minute, corrected for speed if the student was able to read the words in less than one minute. The stories used in the endline assessment were equated with the previous assessments. The second indicator is the percentage of comprehension questions answered correctly, for both English and Kiswahili. There were five comprehension questions that referred to particular portions of the passages read. The third indicator is the proportion of the student population that was reading at the KNEC benchmark for reading fluency, which is 65 correct words per minute (cwpm) for English and 45 cwpm for Kiswahili. While these are the KNEC benchmarks for class 2, PRIMR also used them to evaluate class 1 students at the end of the year. Finally, the fourth indicator is the proportion of students who scored 80% or higher on the comprehension task, for both English and Kiswahili. Table 2 presents descriptive statistics for these four indicators at baseline for both public and nonformal schools, and in classes 1 and 2.

Table 1
Numbers of students assessed in the PRIMR January 2012 baseline and the October 2013 endline, by class and by public or nonformal school.

Assessment period	Classes assessed	Number of students by type of school		Total students assessed
		Public	Nonformal	
Jan. 2012 baseline	Class 1	950	1242	2192
	Class 2	950	1243	2193
	Total	1900	2485	4385
Oct. 2013 endline	Class 1	950	1160	2110
	Class 2	950	1162	2112
	Total	1900	2322	4222

4.5. Data-analytic plan

To answer the first research question, we created a table (presented in the Results section below) with the number of teachers assigned to the TAC tutor or coach compared with monthly classroom visits (determined by approved and validated lesson observation forms), aggregated to the program level. Second, we created scatterplots for each TAC tutor and coach in the sample, comparing the number of teachers in the tutor's zone or the coach's cluster, and the average number of classroom observations he or she made. Third, we used a logarithmic regression model to determine whether the number of teachers in the zone was predictive of the number of visits made per teacher.

PRIMR's design allowed for causal inference of the relationship between number of schools served by nonformal school instructional coaches and student performance, to answer research question 2. We used a dichotomous variable differentiating clusters that had teacher: coach ratios of 10:1 from clusters that had 15:1 ratios to determine the effect of cluster size within the treatment groups. This variable was included as the predictor variable in an ordinary least squares (OLS) regression model predicting the outcome variables of interest. The regressions produced estimates of the causal effect of the 10:1 clusters against the control schools and the 15:1 clusters against the control schools. We followed this with a post-hoc linear hypothesis test to determine whether the effects of 10:1 and 15:1 ratios were statistically significantly different from each other. These results present the causal impact of cluster size on student achievement in nonformal schools.

Research question 3 focused on whether the number of schools in a public school zone had a relationship with the performance of students in that zone. As we could not manipulate the size of the pre-existing zones for the government schools, the estimates presented for this sector are non-causal. We present findings for public schools in zones alongside those for the nonformal schools for the purposes of comparison.

5. Results

Our first research question aimed to determine whether the number of teachers assigned to the TAC tutor or instructional coach impacted the frequency of their visits per teacher. Table 3 presents the teachers per zone and the visits per teacher for TAC tutors and coaches in four categories of schools. These include the public zones for the USAID PRIMR program (10 TAC tutors), the public zones for the DFID PRIMR program (14 TAC tutors), the nonformal clusters in a 10:1 ratio (9 clusters) in the slum areas of Nairobi, and the nonformal clusters in a 15:1 ratio in the slum areas of Nairobi (6 zones). The table also includes figures for the zones for an information and communication technology (ICT) program[5] implemented in one county in which TAC tutors worked only with class 2 teachers in a subset of schools (6 TAC tutors). Table 3 shows that the public school TAC tutors in the larger zones had very similar numbers of teachers per zone and averaged 2.6 and 2.8 classroom visits per year. The ICT program's TAC tutors had very few teachers supported by PRIMR, 10.7 on average, and had 10.3 visits per teacher per year. Some coaches had 20 teachers per cluster and others had 30, but Table 3 shows that the visits per teacher differed very little between the two groups (12.2 and 11.2, respectively).

[5] The PRIMR ICT program was a randomized controlled trial of three ICT interventions in Kisumu County, Kenya. The three ICT interventions were each implemented in two zones. TAC tutor support structures were similar in the three intervention groups.

Table 2
Descriptive statistics for key PRIMR variables at baseline, by public/nonformal and grade.

Type of school	Class	Indicator	Language	Mean	Standard deviation	Standard error	95% confidence interval	
Public	1	Oral reading fluency (correct words per minute)	English	21.22	19.78	1.08	19.08	23.35
			Kiswahili	15.17	14.13	0.77	13.64	16.70
		Reading comprehension (% correct)	English	9.61	16.39	1.09	7.45	11.77
			Kiswahili	16.60	16.82	1.03	14.56	18.65
		Fluent reader (% of students)	English	6.21	20.11	1.08	4.06	8.37
			Kiswahili	3.86	16.04	0.79	2.29	5.42
		Comprehending at 80% (% of students)	English	2.18	12.16	0.73	0.73	3.63
			Kiswahili	2.93	14.06	0.88	1.19	4.68
	2	Oral reading fluency (correct words per minute)	English	45.85	28.20	1.69	42.48	49.22
			Kiswahili	28.52	17.10	0.95	26.63	30.42
		Reading comprehension (% correct)	English	26.39	27.33	1.37	23.66	29.19
			Kiswahili	35.54	24.07	1.41	32.73	38.35
		Fluent reader (% of students)	English	27.31	38.36	2.16	23.02	31.60
			Kiswahili	15.69	31.31	1.59	12.52	18.85
		Comprehending at 80% (% of students)	English	13.53	29.45	1.49	10.56	16.50
			Kiswahili	14.43	30.26	1.68	11.09	17.78
Nonformal	1	Oral reading fluency (correct words per minute)	English	43.20	35.76	1.43	40.37	46.04
			Kiswahili	24.28	18.91	0.70	22.89	25.66
		Reading comprehension (% correct)	English	23.28	33.88	1.40	20.49	26.06
			Kiswahili	27.86	28.82	0.94	25.99	29.73
		Fluent reader (% of students)	English	20.84	48.91	1.73	17.41	24.28
			Kiswahili	8.22	33.06	1.03	6.18	10.25
		Comprehending at 80% (% of students)	English	9.25	34.88	1.28	6.72	11.78
			Kiswahili	6.67	30.03	0.86	4.96	8.37
	2	Oral reading fluency (correct words per minute)	English	69.95	41.20	1.56	66.85	73.05
			Kiswahili	37.49	21.07	0.78	35.94	39.04
		Reading comprehension (% correct)	English	48.56	42.36	1.52	45.54	51.58
			Kiswahili	49.51	35.36	1.24	47.05	51.97
		Fluent reader (% of students)	English	56.23	60.78	1.98	52.30	60.16
			Kiswahili	31.14	56.73	1.69	27.80	34.49
		Comprehending at 80% (% of students)	English	32.00	57.15	1.70	28.62	35.38
			Kiswahili	28.72	55.43	1.82	25.10	32.33

To answer research question 1 regarding how the number of teachers in a zone impacted the number of visits, we created a scatterplot comparing the number of classroom visits each TAC tutor and coach completed and the number of teachers assigned to the tutor or coach within the zone or cluster (see Fig. 1). The figure suggests a relationship between the number of teachers in a zone and the average number of visits to each teacher. Given the fundamental differences in the jobs of the TAC tutors and instructional coaches, we have color-coded those groups differently in Fig. 1. Symbols for TAC tutors are colored gray, and those for instructional coaches are colored white.

We next fit a logarithmic equation in our regression models to further examine this relationship. The model did not include control variables as controls did not significantly increase precision. The model, in Fig. 1, shows that the number of teachers a TAC tutor or instructional coach was responsible for in his or her zone predicted 47% of the variation in the number of visits per teacher. The logarithmic model indicates that there is a negative relationship between the number of teachers per zone and the average visits per teacher, and that the slope of that negative relationship differs based on the number of teachers in the zone. The regression model hides some variation between the average number of visits per teacher for teachers in the ICT public schools and those in the other public schools, as well as the differences in nonformal schools, which we address in the Discussion section below.

Our second research question capitalized on the causal nature of the PRIMR research design and examined whether there were statistically significant differences in the magnitude of the PRIMR causal effect for key literacy outcomes between nonformal school students in clusters of 10 schools and those in clusters of 15 schools. Recall that the randomized controlled trial design for this portion of the PRIMR sample allowed us to estimate the causal impact of the

Table 3
Teachers per zone or cluster and visits per teacher for PRIMR-supported TAC tutors and coaches.

	Teachers per zone	Visits per teacher
Public zones in USAID-funded counties	43.2	2.6
Public zones in DFID-funded counties	49.4	2.8
Public zones in technology program	10.7	10.3
Nonformal 10:1	20.0	12.2
Nonformal 15:1	30.0	11.2

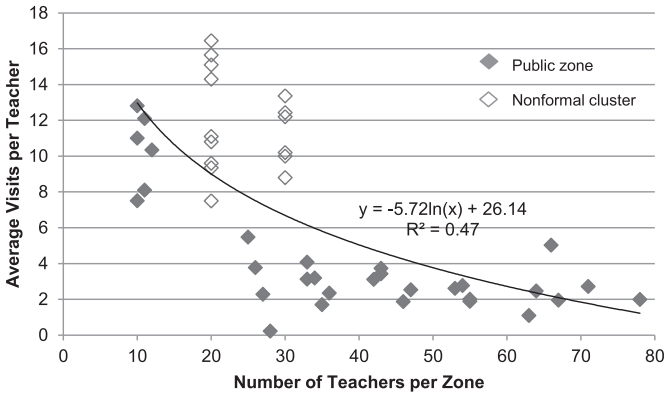

Fig. 1. Teachers per zone and average visits per teacher. Scatterplot comparing the number of teachers per zone with the average visits per teacher in 2013, differentiating between nonformal clusters and public zones. Fitted logarithmic regression curve estimating the relationship between the number of teachers per zone and the average visits per teacher.

10:1 and 15:1 school-to-coach ratios. Fig. 2 shows the causal gains (not the mean scores) attributable to PRIMR for the 15:1 ratio clusters. The dark gray additive bars were created to show whether the impact of PRIMR was larger for students in 10:1 clusters than in 15:1 clusters. If those differences were statistically significant, we would know that students benefited statistically significantly more by being in a 10:1 cluster.

None of the differences by cluster size showed statistical significance at the .05 level, although three of the differences were significant at the .10 level (signified by a "~" in Fig. 2). All three of the outcomes for which we identified a differential impact at the .10 level were in Kiswahili, namely oral reading fluency (effect size .10 SD), reading comprehension percentage score (effect size .10 SD), and the proportion of students reading at the KNEC benchmark (effect size .10 SD). There were no statistically significant differences in the impact of 10:1 and 15:1 clusters for the English outcome variables.

We sought the answer to research question 3 by fitting regression models within the sample of public schools (funded by USAID), using the number of schools in the zone as the predictor variable and the key PRIMR variables of interest as the outcome variables. Although the size of each TAC tutor's zone was not randomly assigned, this simple regression analysis allowed us to determine whether the results suggested that larger zones were associated with lower outcomes, as we would expect and as the randomized nonformal school analysis would suggest. Table 4 presents our findings. Zone size was associated with lower student outcomes in several of our regression models, as expected. Zone size was a statistically significant predictor of English oral reading fluency in class 1 (p-value .07) and class 2 (p-value .07), of Kiswahili oral reading fluency in class 2 (p-value .03), of English comprehension in class 2 (p-value .06), of Kiswahili comprehension in class 2 (p-value .04), of the proportion of students reading at benchmark in English in class 1 (p-value .02), of the proportion reading at benchmark in Kiswahili in class 2 (p-value .02), and of the proportion of students reading at benchmark in Kiswahili in class 2 (p-value .04).

The magnitudes of these relationships are nontrivial. For example, in English class 2, the difference in oral reading fluency was 0.9 cwpm, on average, per additional school. If we assume a size difference of five schools, parallel to the case for the nonformal school trial, this results in a 4.5-cwpm gap explained by the difference in zone size. For the Kiswahili class 2 comprehension percentage score, the difference in comprehension rates associated with five more schools in a zone was 4.6%. However, several of the models did not show any statistically significant differences across zone size. In summary, where the models showed a statistically significant difference, students in larger zones performed lower on literacy tasks in both English and Kiswahili.

Table 4
Associations between numbers of schools in public zones and student literacy outcomes (standard errors in parentheses).

Item	Language	Class	Coefficient	T	p-value	R^2
Oral reading fluency (correct words per minute)	English	1	−0.66 (0.36)	−1.82	.074~	.009
		2	−0.91 (0.50)	0.50	.073~	.008
	Kiswahili	1	0.10 (0.29)	0.34	.734	.000
		2	−0.73 (0.32)	−2.26	.028*	.014
Reading comprehension (% correct)	English	1	−0.07 (0.30)	−0.24	.812	.000
		2	−0.85 (0.44)	−1.92	.060~	.008
	Kiswahili	1	−0.30 (0.37)	−0.80	.425	.003
		2	−0.92 (0.44)	−2.07	.042*	.012
Fluent reader (% of population)	English	1	−0.81 (0.34)	−2.36	.022*	.012
		2	−0.40 (0.56)	−0.70	.484	.001
	Kiswahili	1	0.39 (0.30)	1.30	.198	.004
		2	−1.17 (0.50)	−2.34	.022*	.011
Comprehending 80% or higher (% of population)	English	1	−0.10 (0.18)	−0.48	.630	.000
		2	−0.54 (0.47)	−1.15	.257	.002
	Kiswahili	1	0.20 (0.25)	0.80	.429	.002
		2	−1.06 (0.51)	−2.08	.041*	.009

6. Discussion

The findings in this paper address three research questions. First, we investigated whether the number of teachers in each zone had an impact on the number of visits per teacher. The results show that for both public school TAC tutors and nonformal instructional coaches, those with more teachers did observe more classrooms overall, but made fewer visits per teacher. This is, at least in part, a response to the incentives within the PRIMR program, which reimbursed TAC tutors based on the *proportion* of the teachers in their zone that they observed on a monthly basis. This shows, therefore, that the PRIMR incentive program was relatively effective in increasing classroom visits, particularly in comparison to control schools, where classroom visits were nearly nonexistent (Piper & Mugenda, 2012). On average, the TAC tutors in the PRIMR Initiative observed their assigned teachers 4.2 times each in 2013,

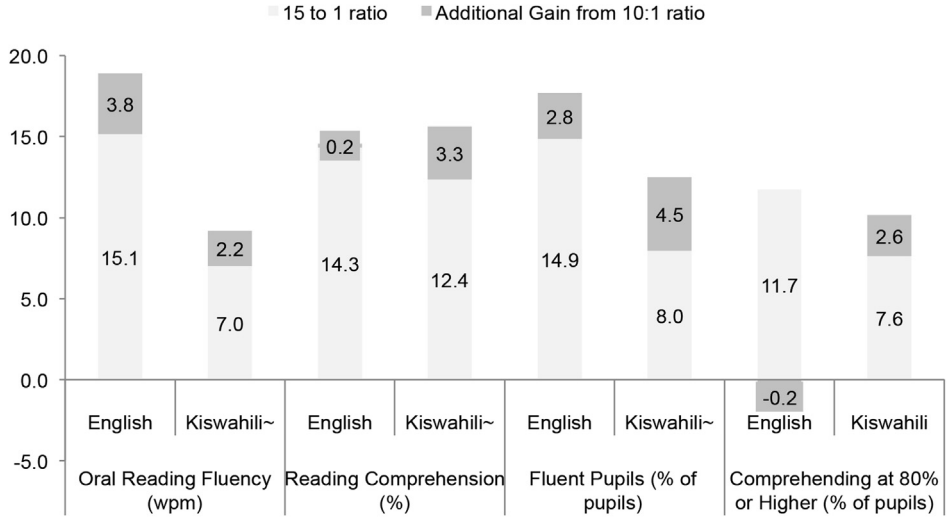

Fig. 2. PRIMR causal impacts over control for 10:1 clusters and 15:1 clusters. Note: "~" denotes statistically significant difference between 10:1 and 15:1 clusters (p-value .10).

although recall that for the DFID-funded portion of PRIMR, the figure was an estimate extrapolation based on results from the amount of the year that the program was active. On the other hand, the nonformal school coaches in the 10:1 zones observed their teachers 12.2 times each in a year, compared with those in 15:1 nonformal clusters, who observed their teachers 11.2 times. Therefore, for both nonformal and public schools, teachers were observed significantly more than in non-PRIMR schools. This suggests that increased contact between classroom teachers and instructional supervisors can be achieved, for relatively low cost, and using existing personnel. Moreover, this suggests that the relatively dormant instructional support mechanism provided by the TAC tutors can be revived with focused investment in their professional development and transport facilitation. For countries like Kenya, Uganda, Ethiopia, and Malawi that have educational personnel with purported emphasis on classroom support but with limited actual classroom contact time, these findings suggest that it is possible to provide instructional support through existing personnel.

The differences in classroom observational support offered by the PRIMR TAC tutors and by the instructional coaches are important to explore more fully. While TAC tutors' job descriptions focus on instructional support, in reality the tutors are responsible for a wide variety of activities in their zones. The PRIMR TAC tutors consistently cited the competing tasks they had to accomplish as the primary reason they visited teachers less frequently than hoped for. We recommend that the TAC tutor role be refocused primarily on instructional support, as our findings suggest that classroom observations can improve teacher pedagogy and student outcomes. Given the recent decision by the MoEST to scale up the PRIMR model in the Tusome (Let Us Read) national literacy program, introducing instructional support at the national level, the TAC tutors will need authority to focus on implementing this support to ensure the success of the national literacy program (Coburn & Woulfin, 2012). As noted above, evidence from the U.S. suggests that teachers who are supported by coaches are better able to align their instruction with best practices (Stephens et al., 2007). Given the extent of the shift that is planned in literacy pedagogy in Kenya, such support is critically needed, particularly in the early stages of an intervention like PRIMR before improvements in student outcomes are visible to teachers (Guskey, 1985).

Technology initiatives can assist TAC tutors in this process. An example is the utilization of tablets to support the coaching process, as trialed in the ICT portion of the PRIMR program, and scaled up nationally through the National Tablet Programme funded by DFID (Piper & Kwayumba, 2014). If the TAC tutors have more time for instructional support, and/or can provide this support more efficiently using technology, then the number of contacts per teacher can be increased without a dramatic cost in terms of TAC tutor salaries. Of course, a greater emphasis on supporting teachers to implement reflective practice techniques would mean that the frequency of the coach visits would be less important, as the teachers would be able to generate their own higher-quality instructional feedback.

The randomized controlled trial research design of PRIMR made it feasible to estimate the relative effectiveness of organizing schools into clusters of 10 versus clusters of 15. Those cluster options were chosen by PRIMR because they were within the range of the majority of the supervisor, tutor, or coach instructional support programs operating in East Africa. However, there is a dearth of literature driving the decision regarding what ratio of schools to coach is the most appropriate and cost-effective. In answering research question 2, we fit eight OLS regression models that estimated the causal impacts of PRIMR for both 10:1 and 15:1 school-to-coach ratios, and then post-hoc tests that allowed us to determine whether any apparent differences in the impact were significant. Of the eight models, three showed statistically significant differences at the .10 significance level. We used this level of statistical significance because our design was slightly underpowered for this subset of analyses. The effect sizes for these three impacts were in the range of .1 SD.

Using cross-sectional data in a noncausal design, to answer question 3, we fit OLS regression models to determine whether the size of the zone in the public sector had a relationship with literacy outcomes. Several of the variables showed statistically significant differences, as indicated in Table 3 above. Below we present Fig. 3 to portray the size of the relationships for these variables in public schools. This figure shows which variables were statistically significantly related to the size of the zone, and the magnitude of that relationship if the hypothetical zone had five more schools in it. Additional analysis showed that the magnitude of these effects was relatively large, with some of the effect sizes as large as .35 SD.

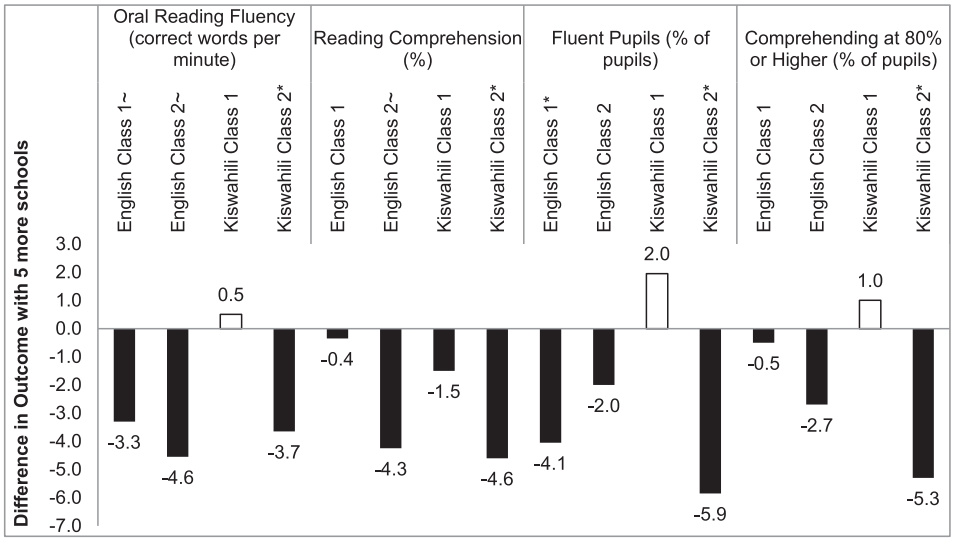

Fig. 3. Difference in learning outcomes for students in zones with five more schools. Note: "*" indicates statistical significance at the .05 level; "~" indicates statistical significance at the .10 level.

The directionality of the statistically significant relationships lends credence to the view that TAC tutors in Kenya with zones with higher numbers of schools are less likely to make a significant impact on student outcomes than those with fewer numbers of schools.

These results align with the findings from the U.S.-based literature discussed above, which generally concludes that more time with teachers is associated with greater increases in outcomes (Elish-Piper & L'Allier, 2011; L'Allier et al., 2010; Ross, 1992; Shidler, 2009). There are likely several mechanisms that explain these outcomes. Teachers who spend more time with coaches are likely better able to build a positive relationship with them, including greater trust (Bean et al., 2010; Hershfeldt et al., 2012). The more schools and teachers a TAC tutor is assigned to support, the less time he or she will be able to spend with each teacher individually. As feedback on teaching performance has been linked to changes in teacher behavior in the classroom (Reinke et al., 2014), this individual support is central to supporting Kenyan teachers in changing their approaches to teaching reading.

Given the flexibility and importance of the TAC tutor program in Kenya, and the relatively large effect size of the differences in the public school sector compared to those of the nonformal sector, it appears that increasing the TAC tutor workforce to reduce the ratio of schools to tutors by five—i.e., from the approximate current ratio of 20:1 to 15:1—would be an effective investment in Kenya. The Kenya TSC is currently considering this ratio for deployment of TAC tutors, and our findings suggest that such a shift is likely to increase the number of classroom visits per teacher and improve learning outcomes. The cost of a change in ratio also would be quite substantial, however, as the wage bill of the TAC tutor cadre would increase substantially. For example, decreasing the school-to-TAC tutor ratio from 20 to 15 schools would increase the number of TAC tutors by one-third—a substantial cost. Our rationale justifying the increased cost would be that decreasing the ratio of TAC tutors to schools might have a larger effect on student outcomes than decreasing teacher-to-student ratios, as a relationship between class size and student outcomes in Kenya has not been established (Piper & Mugenda, 2014). In short, given the difficulty that Kenya has in improving instructional quality, we suggest that the TAC tutor cadre be reoriented toward its initial purpose of working directly with teachers to improve outcomes. This approach will likely be more effective and less costly than complicated interventions that utilize new and expensive personnel.

7. Limitations

The study has several limitations. First, the public school subsector assigned TAC tutors to zones that had specific numbers of schools. This meant that any analysis investigating the relationship between zone size and student outcomes would be associational and noncausal. On the other hand, the nonformal school sample utilized random selection and assignment to treatment groups, making those results causal. The limitation of the study, therefore, is its inability to determine whether the similarities between the public school results and nonformal school results were coincidental or not. Second, the PRIMR data set did not track the visits and interactions of TAC tutors and teachers in the control sites. We are therefore unable to say with certainty that PRIMR increased classroom visits, although the anecdotal evidence suggests it did. Finally, while PRIMR had a relatively large sample size for a randomized controlled trial in sub-Saharan Africa, understanding the causal mechanisms at work between TAC tutor behavior and educational outcomes at the student level could best be done with a focused qualitative study, designed specifically to investigate whether and how interactions between TAC tutors and teachers affected teacher behavior, and therefore student achievement. This sort of qualitative study can answer the evaluation questions that the most rigorous quantitative studies cannot.

8. Conclusion

The results of this analysis can inform policy in Kenya as well as in other countries on the appropriate ratio of TAC tutors (or coaches, or coordinating center tutors, or primary education advisors, or cluster supervisors, depending on the country context) to schools based on the cost-effectiveness of the 10:1 and 15:1 comparisons in nonformal schools, as well as on the noncausal relationships between zonal size and outcomes in the public school sector. We note that the analyses estimating the impact of public school zonal size on student achievement suffered from endogeneity and should be evaluated cautiously. However, given the similarity of findings between the 10:1 vs. 15:1 comparison in the nonformal schools and the zonal size comparison in public schools, we argue that there is strong enough evidence that policy debates should be informed by data illustrating that the 10:1 ratio is somewhat more effective. These findings provide encouraging evidence for the broader application of the coaching model to the sub-Saharan African context, even in countries and education systems with limited resources. They also suggest that in countries like Kenya, Uganda, and Malawi, where these instructional supervisors are employed but where there are systemic impediments to their visiting classrooms and providing instructional feedback to teachers, student learning can be increased by reallocating coaches' time away from administrative tasks and toward classroom instructional support.

Additional research is required to analyze whether the ratios between instructional supervisors and schools should be decreased further, since our causal analysis was able to compare only the effectiveness of the 10:1 and 15:1 ratios. It might be that even smaller ratios could have larger impacts. The USAID Early Grade Reading Assessment (EGRA) Plus: Liberia program tested coach-to-school ratios of 4:1 and saw large impacts on student achievement (Piper & Korda, 2011). Future research should also investigate the cost-effectiveness of various ratios. Our analyses were not well suited for a cost-effectiveness comparison, given the short timeframe for implementation and the relatively novel concept of instructional support in the Kenyan context. Without additional research, we cannot rule out the alternative that while smaller ratios of schools to instructional supervisors increase achievement, the additional cost of human resources and transportation is not worth the additional increase in learning outcomes, and other investments might have a larger impact on student achievement (Piper & Mugenda, 2014). We recommend that further studies examine this issue, with a particular focus on whether decreasing the ratios of instructional supervisors to schools changes classroom observational behavior. Our expectation is that decreasing the ratios without requiring an increase in classroom visits will have little effect on learning outcomes, and that a policy change focused on these ratios must be accompanied by clear guidelines regarding the performance of instructional supervisors in providing classroom-based support to teachers with a focus on improved learning.

Acknowledgments

We are grateful to the Kenyan Ministry of Education, Science and Technology, and the committed teachers and educators in Kenya. We are thankful for the excellent editorial work of Erin Newton and Lynda Grahill. This work was supported by the United States Agency for International Development through the Kenya PRIMR Initiative under the USAID Education Data for Decision Making

(EdData II) project [Task Order Contract No. AID-623-M-11-00001] and by a Professional Development Award from RTI International [award number 0190453.300.001].

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