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Patterns of teaching style and active teaching: do they differ across subjects in low and high performing primary schools in Kenya?

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This paper focuses on the patterns of teaching styles and active teaching across subjects and between low and high performing schools in an attempt to examine what accounts for differences in performance between schools which are within the same locality. It uses data collected in 72 primary schools spread across six districts in Kenya. Video recordings of 213 lessons in maths (72), science (71) and English (70), and interviews with subject teachers in primary schools, were used to generate evidence on patterns of teaching styles and active teaching. Results show that teaching practice across subjects is inclined towards the command and task styles that do not promote critical thinking among learners. The dominant teaching activity was individual seat work in maths lessons; recitation in English lessons; and whole class chorus in science lessons. Overall, active teaching accounted for 62% of the lesson time. The one way ANOVA results show insignificant variation between subjects and school category on active teaching, and therefore this may not be the source of differential performance between low and high performing schools.

Keywords: teaching styles; active teaching; mathematics; science; English; primary school

Introduction

Public debate on the quality of education in Kenya indicates that there is growing interest and concern about what actually happens in the classroom since the government successfully implemented its free primary education (FPE) policy in 2003. Teachers may be well trained and yet effective learning still fails to take place. Schools are under pressure from parents and communities to show good results at the end of primary cycle examination, as good results will enable the children to transit to better secondary schools. In this paper, an opportunity is provided to inform the debate on the quality of education, and to understand whether teaching styles and active teaching differ across subjects. Teacher and school characteristics that may account for this difference are also explored. Active teaching refers to the use of teaching strategies that maximise opportunities for pupil–teacher interaction during instruction (see for example Hermin and Toth 2006; Winkle and Skubinna 2005). Such strategies aim at making the pupil an active participant in the process of teaching. This could explain why some schools are consistently ranked at the top while others dominate the bottom performance ranks in the Kenya Certificate of Primary Education examinations (KCPE).

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The rest of the paper is organised as follows: firstly, we scan the international literature and identify the gaps and conceptually position the paper; secondly, we present the methods and data within which the teaching styles were observed and analysed; thirdly, we present the findings and their discussion in relation to literature; finally, we offer a conclusion and explore the implications of the findings for education policy.

International literature and gaps

Research evidence has shown that an important aspect of quality education is the teaching process that goes on in the classrooms. For example in Belgium, a study by Opdenakker and Damme (2006) observed that the quality of teaching, time-on-task and content covered are promising explanatory variables of educational effectiveness, among other classroom-based variables. The study concluded that a pupil-centred instructional style has a positive effect on the learning support teacher give to learners during instruction, and to the quality of interaction between the teacher and the learners. According to Aitkin and Zuzovsky (1994) and Wentzel (2002), teaching styles and teaching behaviour mediate teacher influence on learning and explain differences in student learning outcomes. But despite the importance of the teaching practices in explaining differences in learning outcomes, as indicated in these studies, Opdenakker and Damme (2006) lament that little research has been conducted on the degree to which classroom practices are class, teacher and school dependent, on the one hand, and are correlated to pupil composition, teacher attributes and teaching technique on the other.

Not all teacher attributes have an influence on how teachers teach. For instance, in Belgium, teacher's gender did not matter in classroom practices, suggesting that male and female teachers taught the same way (Opdenakker and Damme 2006). The study further found that teachers with higher job satisfaction gave more instructional support to their class, and this can be a source of difference in academic performance between schools.

The amount of time spent on a learning task is highly correlated with learning gains. For example, a randomised control trial in South Africa, involving the use of computer aided instruction to cover the maths curriculum, showed significant improvement in maths performance among the treatment group even with modest time spent using the computer aided instruction (Louw, Muller, and Tredoux 2008). In Spain, a study by Ruiz-Gallardo et al. (2011) found that problem-based learning and cooperative learning used by teachers during instruction significantly and positively influenced student performance. The authors argued that these approaches aided knowledge assimilation and hence higher performance in the exams.

In Nigeria, Hardman, Abd-Kadir, and Smith (2008) found a dominance of teacher explanation, recitation and rote learning in classroom discourse, with little emphasis on pupil understanding. In this study that involved three subjects – maths, English and science – teacher-centred, lecture-driven pedagogy was popular among teachers across the three primary school subjects. The study also found few follow-up moves (that is, a response or comment from the teacher coming immediately after the learner had responded to a question) meant to encourage or motivate the learner after giving a verbal response to a task or during Q and A sessions. This lack of encouraging follow-up moves was found to discourage learners from being active participants in the class.

In Kenya, Hardman et al. (2009) and Ackers and Hardman (2001) have investigated classroom interactions. Hardman et al. (2009) investigated the impact of a school-based pedagogical teacher training program on teaching practice. The study found that compared to the baseline performance (see Ackers and Hardman 2001), there was greater utilisation of group work with improved teacher–pupil interactions during whole class teaching. The study further found that such practices were more common among teachers who had undergone a

school-based in-service training on pedagogical skills. Compared to baseline, teachers were also found to plan better, utilise teaching resources and had improved classroom management practices. In a more recent study, Ngware et al. (2010b) found that group work was hardly utilised during maths instruction, and the few lessons that attempted to use did not succeed in group work because students sat in groups but worked individually.

Conceptual issues

In any teaching and learning interaction, a set of decisions must be made – either deliberately or by default. Such decisions can be grouped into three sets (see Ashworth 1992; Garuccio 2004): pre-impact – decisions that define the intent of the lesson as contained in the lesson preparations and planning; impact – this refers to the decision related to execution of the instructions; and post-impact – include decisions on assessment or evaluation of the lesson objectives. In this paper, teaching style is described as a set of decisions made in line with teaching norms and aimed at causing pre-defined learning outcomes.

Over the last four decades, researchers in education have identified specific teaching styles and related them to philosophies of teaching and student learning. Most notable is the work of Mosston (1966) (cited in Ashworth 1992; Mueller and Mueller 1992) that defined a spectrum of teaching styles and behaviours based on the interactions and decision-making roles between the teacher and students during instruction. The work of Mosston has been developed into a continuum that provides possible options of interactions between teacher and learner based on the extent to which the teacher or learner assumes responsibility of lesson activities (see for example Ashworth 1992; McCullick and Byra 2002; Byra 2002). On one side of the continuum are the teaching styles where the teacher dominates the teaching process with the learner being a recipient or making few or no decisions. These styles include command, practice/task style, reciprocal style, self-check and inclusion styles (see for example Garuccio 2004; Ashworth 1992; Mueller and Mueller 1992; McCullick and Byra 2002; Byra 2002). The basic thinking capacity reflected within this cluster of styles is one of reproducing known knowledge, replicating models, and information recall and practice skills. On the other side of the continuum is the more open-ended and student-centred style where the teacher acts only as a facilitator. Styles on this side include guided discovery, divergent discovery, learner-designed individual programmes, learner-initiated and self-teaching/problem-solving. These styles form the cluster that promotes production (or discovery) of new knowledge. According to Chatoupis (2010), the line between the two clusters is the discovery threshold that identifies the cognitive borders of each cluster.

Every teacher has his or her dominant and preferred teaching style, though most often a blend of aspects of different styles is adopted to make teaching more effective. The choice of style can be influenced by beliefs about what constitutes good teaching, student backgrounds, preferences, abilities, the norms of particular disciplines, individual attributes and working environments (Byra 2002). Previous analysis of data from the study reported here identified three dominant teaching styles: (1) recitation, characterised by the teacher asking questions or guiding the process, with individual or whole class chorus being the order of response. This is similar to command style in Mosston's spectrum; (2) individual seat work – similar to practice or task style, where students carry out teacher-prescribed tasks as the teacher goes round the classroom correcting or assisting individual learners; and (3) whole class instructions that was characterised by lectures, demonstrations and reviews, with the teacher making almost all decisions – the learners were in most cases passive (Ngware et al. 2010b). Under the Mosston spectrum, this style resembles the command style, as in the previous style, only that in this case learners were only listening, observing and/or taking notes.

Table 1. Activities identified to involve active teaching.

	Teaching style	Specific teaching activity
Q10d	Individual seat work	Teacher checking work individual (working)
Q10e	Individual seat work	Teacher checking work Individual (stopped)
Q11a	Recitation	QA: Individual learner (teacher asks)
Q11d	Recitation	QA: Individual learner (learner asks)
Q12g	Whole class	Teacher checking – work group (working)
Q12h	Whole class	Teacher checking – work group (stopped)
Q13a	Whole class	Whole class task instructions (teacher only)
Q13b	Whole class	Whole class demonstrations (teacher only)
Q13c	Whole class	Whole class lecture (teacher only)
Q13d	Whole class	Whole class review/recap (teacher only)
Q13e	Whole class	Whole class evaluate lesson (teacher only)

In all the teaching styles mentioned, pupil–teacher interactions are important to maximise learning. In the education literature, this is referred to as active teaching – that is, the use of strategies that maximise opportunities for interaction. Within each of the teaching styles observed, active teaching is identified by the aspects or activities within the style where opportunities for teacher–pupil direct interactions are enhanced. Table 1 presents all the activities within a lesson that had aspects of active teaching, and were measured in minutes indicating how long the activity took within a lesson. Activities and tasks under the whole class teaching approach can be described as active teaching when they promote quality discussion between teachers and pupils or group of pupils; however, opportunities for active interaction are minimal (see for example Hardman et al. 2003; Tanner et al. 2005). For instance, during a lecture, a teacher can ask a question based on the content or demonstration that has just been presented. The learner or class (whole group chorus) will respond in the context of the lecture or demonstration.

Methodology

The data

Data for this study come from the classroom observation study carried out by the Education Research Program at the African Population and Health Research Center. The classroom observation study involved collection of data from a randomly selected school sample in pre-selected districts. The sampling was done at two levels. One was the selection of districts by performance in their Kenya Certificate of Primary Education (KCPE). KCPE is a summative examination at primary level and it is used for screening in order to determine who transits to secondary school. Districts were first stratified into 10 deciles according to their performance in KCPE for four consecutive years. Using this criterion, six districts were randomly selected as follows: (1) two districts from those that had consistently been ranked in the bottom 10%; (2) two districts from those that had been consistently ranked within the middle 20%; and (3) two districts from those that had been consistently ranked in the top 10%. The other level of sampling involved random selection of schools from the sampled districts. The selection of schools was also informed by how they performed in the KCPE during the same period. Schools within each district were ranked into five quintiles according to their performance in KCPE. Thereafter a random selection of six schools that were ranked consistently at the top 20% and six ranked consistently at the bottom 20% was undertaken in each of the sampled districts. In total, 72 schools were randomly selected, 12 from each of the six districts. The selection of schools was also carried out in a way to

ensure a mix of rural, peri-urban and urban schools in the sample. The districts selected included Nairobi, Murang'a, Baringo, Gucha, Embu and Garissa.

The study involved a mixed method approach, and data were collected using observation checklists, questionnaire and filming of actual lesson for three subjects (maths, English and science) from Grade 6 pupils, their subject teachers and the school head. The study also involved testing Grade 6 pupils in maths, as well as their maths teachers. Data collection was undertaken in two rounds: The first round involved filming of the actual lessons and coding of a classroom observation checklist, collection of teacher, pupil and school characteristics and testing of the Grade 6 pupils in maths, as well as their teachers. The test given to the pupils was not the same as that given to their teachers. During the second round, the same Grade 6 pupils were tested using the same maths test; however this time the questions were re-shuffled. The second round also involved collection of opportunity to learn (OTL) data, particularly curriculum coverage.

In total, 213 video recordings were collected (72 maths, 70 English, and 71 science) from the 72 sampled schools. The teacher characteristic questionnaire was administered to 201 teachers (190, 10 and 1 teaching one, two and all three subjects respectively) and it collected information on teacher attributes such as age, gender, experience, level of education and professional qualifications. It also gathered data on teacher socio-economic status, the internal and external support teachers had received, their attitudes towards using various teaching activities such as listening and speaking, working alone to solve problems, home assignments and examinations, as well as on teachers' expectations of pupils and the goals they set for themselves with regard to their teaching (Ngware et al. 2010a).

Analysis

In this paper, the outcomes of interest are teaching style and active teaching. Teaching style is measured by the dominant teaching practice in a lesson and type and kind of questions asked during the lesson; while active teaching is the proportion of time spent on a task that involved pupil–teacher interaction during the lesson and maximised learning opportunity. Time was measured by the number of minutes spent on specific activities that were classified to involve active teaching during video analysis. The next section describes the approach used during video time-segment analysis.

Video analysis

This study uses the classroom verbal interaction and time-segment video analysis of the lesson in order to characterise the classroom discourse and understand the teaching and learning styles employed by teachers as well as the activities taking place in the classroom. The time-segment video analysis involved used a systematically developed video analysis rubric in order to ensure a systematic and objective way of coding (Sorto et al. 2009). The rubric included four broad teaching and learning activities (individual seat work, recitation, group work and whole class) with specific activities under each one of them. The video data were analysed by two internal video analysts with expertise and long experience in teacher training programs. In the analysis, the video analysts coded under the most dominant specific activity for every lesson minute. The coding was done independently by each of the video analysts and then jointly (consensus coding). An external video analyst validated the analysis. The analyses by the external expert did not significantly differ from that of the internal expert: the overall agreement on video observations between the internal and external experts was 89%. In order to determine the dominant teaching practice used in each lesson, the time

spent on each of the specific teaching and learning activity under each domain were summed together. The proportion of time spent in each of the four domains, in each of the lessons observed, was calculated and the teaching style that took up the largest proportion of lesson time was then coded as the dominant teaching and learning activity. There were only two lessons that attempted to utilise group work. During the analysis, it was observed that in those two lessons, learners sat in a group but to a larger extent worked as a 'whole class'. These two observations of group work were therefore recoded to reflect whole class.

The second component of video analysis involved the analysis of the verbal interaction taking place in the classroom between the pupils and teachers. This component entailed identification of questions directed to the pupils, their responses and the teacher follow-up moves. The questions were then mapped into the four levels of cognitive demand in order to assess their levels of difficult (Stein et al. 2000). Easy questions were placed in Levels 1 and 2: Level 1 was knowing or memorisation, and Level 2 required the pupil to perform a routine procedure or conceptualise without connection; difficult questions were placed in Levels 3 and 4: Level 3 was questions that required the pupil to perform a complex procedure in order to get a solution, while Level 4 was problem-solving. The teacher follow-up moves involved how the teacher responded to pupil responses, and were categorised into five levels: (1) very encouraging feedback (e.g., very good, keep it up, well done); (2) encouraging feedback (good/OK/fine/correct/right/yes, try again, a good trial or teacher affirms the response); (3) neutral feedback (teacher probes, teacher gives the answer, teacher proceeds to confirm the correctness of the response from a pupil or class); (4) discouraging feedback (teacher proceeds to ask another pupil to respond to the same question, teacher says nothing and proceeds to another issue or task); and (5) very discouraging feedback (incorrect/not right/no, poor/very poor/wrong, teacher uses unpalatable language).

In order to understand the relationship between patterns of teaching, teaching style and the type of school, this study uses descriptive statistics including percentages, means and frequencies. To find out differences in teaching styles across subjects and schools, ANOVA analysis technique is used. To understand teacher and school characteristics that have significant relationship with patterns of teaching styles and active teaching, an ordinary least squares regression (OLS) with time spent on active teaching as the outcome is fitted.

Measurement of outcomes

(1) Active teaching in this study is operationalised as the proportion of lesson time spent on activities that directly promote teacher–pupil interactions and maximise learning opportunity. In total, the video rubric had 33 specific teaching activities of which 11 (33.3%) were identified to involve active teaching (Table 1). The amount of time spent in the 11 active teaching activities was calculated and the proportion relative to lesson duration calculated in cases where the lesson was more than 35 minutes, otherwise 35 minutes was used (the usual time for a single lesson).

(2) Dominant teaching style: The dominant teaching style was determined by tallying the amounts of time spent on each of the specific activities under that domain. The proportion of time in relation to the lesson duration was calculated. The teaching and learning style that took much of the time was coded as the dominant one. The three dominant teaching styles were individual seat work, whole class and recitation. Using Mosston's spectrum of teaching styles, the first observed style is similar to the task/practice style while the last two are similar to the command style. These observed styles are teacher-centred and are to promote reproduction of knowledge. However,

this does not imply that there are no active teaching related activities under these styles.

(3) Classroom verbal interaction: This refers to the pupil–teacher interactions observed in questions and answer sessions. It involved teacher asking questions, student responses and teacher follow-up moves. In the analysis, verbal interaction is used to characterise the classroom discourse within each subject.

Results and discussion

Background characteristics

Table 2 shows the background characteristics at both the teacher and school level. The teacher characteristics do not vary by school category, with an exception of the wealth index, where 42.9% of teachers from the bottom schools were ranked in the poorest category compared to 24.3% of teachers from the top school category.

On school characteristics, average class size and pupil teacher ratio (PTR) were not significantly different between the bottom and top performing schools. Nevertheless, top

Table 2. School and teacher background characteristics.

		Top schools	Bottom schools		
Teacher characteristics (n = 201)	Number (%)	Number (%)			P-value
Mean age†	Years	*38.30*	*37.69*		0.949
Teacher sex	Female	47 (45.63)	39 (39.80)		0.403
	Male	56 (54.37)	59 (60.20)		
Teacher experience	10 yrs or less	31 (30.10)	43 (43.88)		0.083
	Between 11 to 20 yrs	44 (42.72)	29 (29.59)		
	Above 20 yrs	28 (27.18)	26 (26.53)		
Teacher training	No teacher education	15 (14.56)	18 (18.37)		0.110
	Certificate	74 (71.84)	75 (76.53)		
	Diploma/degree	14 (13.59)	05 (05.10)		
Teacher wealth index	Least poor	40 (38.83)	30 (30.61)		0.020
	Middle	38 (36.89)	26 (26.53)		
	Poorest	25 (24.27)	42 (42.86)		
School characteristics (n = 72)					
Average class size†		*38.97*	*29.06*		0.107
Poverty (20%) †	Poorest 20%	*13.74*	*24.59*		0.079
Poverty (40%) †	Poorest 40%	*28.42*	*50.17*		0.001
PTR	PTR: < 26	09 (25.00)	12 (33.33)		0.675
	Between 26 and 45	20 (55.56)	19 (52.78)		
	PTR: > 45	07 (19.44)	05 (13.89)		
Teachers math score		62.83		57.72	0.19
Pupil mean scores in math test 1	*53.21*	*39.93*		0.001	
Pupil gains scores in Math	*10.37*	*8.49*		0.001	

Notes: † Mean/averages reported.

schools had larger class sizes (mean of 39) compared with bottom schools (mean of 29). Significant differences were however observed in school poverty levels. The school poverty level was calculated as a function of the proportion of pupils from a particular school ranked either in the 20% or 40% poorest category in each of the sampled district; this reduces the indicator to school level. The results show that 50% of the bottom schools were ranked in the 40% poorest category compared to 28% of the top schools. Significant differences are also noted in the maths mean scores, where the top schools scored significantly higher than the bottom schools. This is also evident on pupil gain scores; despite the bottom schools scoring significantly lower in Round 1 testing, they also gained significantly fewer marks compared to pupils from the top schools.

Dominant teaching and learning activity

Table 3 shows the proportion of lessons using the various dominant teaching styles by school category and subject. It is apparent in all lessons and subjects there was a mix of styles; however the dominant teaching style varied by subject and sometimes by school category. In maths lessons, the dominant style was individual seat work; when split by school type, this activity was dominant among the bottom schools (50.0%), while in the top schools both individual seat work (36.1%) and whole class work (36.1%) were commonly used.

In the English lessons, recitation was the dominant teaching activity; over two-thirds (68.6%) of the teachers from top schools and 42.9% from the bottom schools dominantly used recitation in their English lessons. Science teachers employed whole class approach with 65.7% and 58.3% of the teachers in top and bottom performing schools using this method. These observed dominant teaching styles seem to characterise teaching elsewhere in Africa. For example, in Northern Nigeria, Hardman, Abd-Kadir and Smith (2008) found the prevalence of teacher directed descriptions, recitation and rote learning being a norm. Table 4 shows the cumulative proportion of time in each of the subjects and by school category spent on the different styles. While in the top schools there was a mix of individual seat work, recitation and whole class approaches, the bottom schools mainly used individual seat work and whole class.

Verbal interactions during instruction

The type and nature of questions asked within a lesson depict the nature of teaching and learning style employed by the teacher (Table 5). Simple and repetitive questions were common in all lessons, irrespective of the school category. The bottom schools were however characterised by a significantly higher proportion of their lessons having

Table 3. Dominant teaching style by school category and subject.

Teaching style	School category	Math	English	Science
Individual seat work	Top schools	13 (36.11)	6 (17.14)	5 (14.29)
	Bottom schools	18 (50.00)	8 (22.86)	7 (19.44)
Recitation	Top schools	10 (27.78)	24 (68.57)	7 (20.00)
	Bottom schools	5 (13.89)	15 (42.86)	8 (22.22)
Whole class	Top schools	13 (36.11)	5 (14.29)	23 (65.71)
	Bottom schools	13 (36.11)	12 (34.29)	21 (58.33)

Table 4. Proportion of time spent on the dominant teaching style by school type and subject.

Subject	Style	Top schools (%)	Bottom Schools (%)
Math	Individual seat work	31.80	32.84
	Recitation	30.62	26.50
	Whole class	33.9	36.58
	Other†	3.69	4.08
English	Individual seat work	18.59	17.46
	Recitation	50.93	43.73
	Whole class	27.33	34.06
	Other†	3.14	4.75
Science	Individual seat work	16.98	19.83
	Recitation	32.59	31.90
	Whole class	46.65	42.22
	Other†	3.77	4.05

Notes: † Refers to transitional activities such as disruptions and switching from one activity to another.

very few or no questions at all (18.7%) as compared with top schools (5.7%). Questions of higher level of cognitive demand were virtually absent among the top (2.8%) and bottom (0.9%) performing schools and across the three subjects. Other studies, for instance, Carnoy et al. (2008) and Hardman et al. (2009) found similar patterns – simple and repetitive questions in South African- and Kenyan-based studies, respectively. It would appear that this is a common characteristic of instructional discourse in primary schools in Africa.

Across the three subjects, three quarters of the teacher questions were categorised as Level 1 and only required memorisation or knowing and the question level of difficulty did not vary by school category. Low level questions were common in English and science lessons. Higher level questions (Level 4, that included questions that involved complex procedures to find a solution) were absent in English and maths lesson, and were present in less than 1% of the science lessons. In the South African study by Carnoy et al. (2008), a majority (77%) of lessons required students to simply recall rules and definitions, with no connection to underlying concepts. The earlier study in Kenya (see Hardman et al. 2009) found that questioning was characterised by 'cued elicitation', that is, mid-sentence rise in teacher's voice to prompt a response from the learner or repeat of what the teacher has just said.

The way the teacher responds to a pupil or class after response has a direct influence on classroom interaction. The teacher follow-up moves in this study were categorised into five categories: very encouraging, encouraging, neutral, discouraging and very discouraging. The results show that though teachers have encouraging follow-up moves, this is still below average (50%); and this cuts across the three subjects and school categories. Across the three subjects, one third of the pupil responses were coupled by discouraging teacher follow-up comments and this happened in most instances where the pupil response was incorrect. Table 6 shows some selected examples of classroom verbal interaction. In the Hardman et al. (2009) study, up to 30% of student responses had no follow-up by the teacher, while in another 10%–15%, the teacher simply affirmed the response. Incidences of the learner being praised after responding were low, that is, slightly over 10% in maths and science, and below 10% in English. Compared to the Hardman et al. (2009) study, the study reported in this paper seem to record an improvement among teachers in encouraging or praising learners and this may act as a motivation to learn.

Table 5. Classroom verbal interaction: type and level of questions and teacher follow-up moves across the three subjects by school category.

	Top schools			Bottom schools		
	Mathn (%)	Englishn (%)	Sciencen (%)	Mathn (%)	Englishn (%)	Sciencen (%)
Type of question asked						
Few/no questions	2 (5.56)	2 (5.71)	2 (5.71)	5 (13.89)	9 (25.71)	6 (16.67)
Simple and repetitive	34 (94.44)	32 (91.43)	31 (88.57)	31 (86.11)	25 (71.43)	30 (83.33)
Give example/short answer	0 (0.00)	1 (2.86)	2 (5.71)	0 (0.00)	1 (2.86)	0 (0.00)
Level of cognitive demand of question						
Level 1	774 (66.38)	1215 (91.08)	1481 (94.81)	1027 (71.12)	1176 (89.7)	1271 (95.64)
Level 2	376 (32.25)	9 (0.67)	20 (1.28)	407 (28.19)	3 (0.23)	16 (1.2)
Level 3	16 (1.37)	110 (8.25)	57 (3.65)	10 (0.69)	132 (10.07)	39 (2.93)
Level 4	0 (0.00)	0 (0.00)	4 (0.26)	0 (0.00)	0 (0.00)	3 (0.23)
Teacher follow-up moves						
Very encouraging	33 (2.83)	72 (5.4)	131 (8.39)	22 (1.52)	88 (6.72)	111 (8.35)
Encouraging	577 (49.49)	657 (49.25)	882 (56.47)	668 (46.26)	695 (53.05)	682 (51.32)
Neutral	174 (14.92)	91 (6.82)	122 (7.81)	165 (11.43)	139 (10.61)	111 (8.35)
Discouraging	365 (31.3)	433 (32.46)	401 (25.67)	560 (38.78)	374 (28.55)	377 (28.37)
Very discouraging	17 (1.46)	81 (6.07)	26 (1.66)	29 (2.01)	14 (1.07)	48 (3.61)

Table 6. Classroom verbal interactions.

	Teacher question	Pupil Response	Response Right?	Teacher Follow up move
Math	What time would it be by the 24 hour clock when it is 8.00am by the 12 hour clock?	008Hrs	Incorrect responses	Well done
	Which number will you multiply by 25 to give you equivalent or near to 100?	7	Incorrect responses	No
English	If we are still learning English and another teacher comes in and asks what you have been doing or one of our quests comes back and asks, what will you tell them in the past passive tense?	We were learning English	Incorrect responses	Not right
	Can someone make a sentence with a qualifier and tell us where we have that qualifier?	The bicycle you rode to school has a puncture	Correct responses	Very good
Science	Can someone give me one of the uses of carbon dioxide?	Transpiration	Incorrect responses	No
	What is a paddock so that we can understand the word paddocking?	A paddock is a small fenced piece of land where animals are fed and kept	Correct responses	Very good

Teacher preparedness

Table 7 shows the distribution of self-reported teacher preparedness. The interviewed teachers were asked to rate themselves on how adequately they are prepared to implement the curriculum of the subject they teach. The responses were measured in a Likert-type scale ranging from very inadequate (score 1) to very adequate (score 5). There were few responses in each of the categories 'very inadequate', 'inadequate' and 'somehow adequate',

Table 7. Self reported teacher preparedness to teach.

	Variable	Inadequate n (%)	Adequate n (%)	Very adequate n (%)	P-value
Subject	Math	8 (11.11)	29 (40.28)	35 (48.61)	0.211
	English	10 (14.29)	39 (55.71)	21 (30)	
	Science	11 (15.49)	30 (42.25)	30 (42.25)	
Teacher sex	Female	12 (13.19)	37 (40.66)	42 (46.15)	0.313
	Male	17 (13.93)	61 (50)	44 (36.07)	
School category	Top	9 (8.49)	53 (50)	44 (41.51)	0.083
	Bottom	20 (18.69)	45 (42.06)	42 (39.25)	
Teacher experience	10 yrs or less (r)	20 (11.56)	71 (41.04)	82 (47.4)	0.001
	Between 11 to 20 yrs	1 (33.33)	2 (66.67)	0 (0)	
	Above 20 yrs	8 (21.62)	25 (67.57)	4 (10.81)	

prompting them to be collapsed into a single category of 'inadequate' for purposes of analysis. The results show insignificant association between preparedness and subject, teacher gender and school category. However there is significant association between teacher preparedness to teach and teacher experience. That is, most teachers who have taught for 11 years and above felt just adequate or inadequate enough to teach the subject in question. For those who had taught for less that 10 years, 47% reported that they are very adequately prepared to teach the subject curriculum as compared to 11% of those who had taught for more than 10 years. The results indicate that newer teachers are enthusiastic to teach as compared to those who have taught for longer. This can be partly explained by the fact that 78.9% of the teachers had never attended an in-service training in the last 18 months preceding the study, in spite of majority of them having taught for at least five years. Another plausible explanation could be that more experienced teachers have other official and non-official non-teaching related responsibilities that compete for teachers' limited time for teaching preparation. Available literature on teacher preparedness to teach observes that teachers' feelings of preparedness may influence their ability to perform teaching tasks (Housego 1990).

Patterns and time spent on active teaching

Another aspect of teaching style is the time spent on active teaching activities. The proportion of time taken by each specific activity is calculated as a function of total time on active teaching rather than lesson duration. Table 8 shows the proportions of lesson time spent on each of the active teaching activities, while Figure 3 illustrates the same graphically. Overall, 62% of the lesson time was used in active teaching; this did not vary by subject, that is, maths, 61.5%, English, 62.6% and science 62.3%. After splitting by school category, 63.2% and 61.2% of the lesson time was used in active teaching among the top and bottom performing schools respectively, not a statistically significant difference. The literature suggests that the higher the active teaching time, the higher the learning achievement (see for example Louw, Muller, and Tredoux 2008). The findings reported in this paper also show that the main styles of teaching across the three subjects are those associated with reproducing knowledge and are heavily teacher-centred, thus being unlikely to develop adaptive and critical learners. It is therefore likely that the learning gains made from the high proportion of active teaching

Table 8. Proportion of time spent on active teaching by active learning activity.

Specific activity	Q's number	Math	English	Science
Teacher checking work Individual (working)	Q10d	0.280	0.159	0.023
Teacher checking work Individual (stopped)	Q10e	0.012	0.004	0.009
Q_A: Individual learner (teacher asks)	Q11a	0.219	0.413	0.322
Q_A: Individual learner (learner asks)	Q11d	0.002	0.006	0.007
Teacher checking – work group (working)	Q12g	0.019	0.000	0.008
Teacher checking – work group (stopped)	Q12h	0.000	0.000	0.000
Whole class task instructions (teacher only)	Q13a	0.040	0.038	0.020
Whole class demonstrations (teacher only)	Q13b	0.338	0.266	0.415
Whole class lecture (teacher only)	Q13c	0.085	0.107	0.177
Whole class review/recap (teacher only)	Q13d	0.003	0.004	0.014
Whole class evaluate lesson (teacher only)	Q13e	0.001	0.002	0.005
Overall: top school		0.633	0.621	0.620
Overall: bottom school		0.612	0.609	0.631
Overall		0.615	0.625	0.626

time spent during instruction is eroded by the teacher-centred teaching styles that may not provide opportunities for developing high cognitive abilities among learners.

Teachers in top schools spend approximately two percentage points more of their time in active teaching compared to those in bottom schools in maths and English. On the proportion of time spent on each of the active teaching activities, the results show that in each of the three subjects, there were common activities that cumulatively took more than 75% of the active teaching time. They included teacher checking learners' work while the learner was working (Q10(d)); a teacher asking an individual learner a question (Q11(a)); and a teacher demonstrating to the whole class how to carry out a task (Q13(b)). The study by Hardman et al. (2009) found that cued elicitation and checking student work were ritualised in a lesson and took almost the entire lesson time.

Based on the time spent on active teaching and the main teaching styles observed in this study, the emerging scenario is that of classroom discourse that is teacher driven with little opportunities for learner participation. The active teaching time observed here can therefore be described as less meaningful as it does not translate to higher scores, particularly in low performing schools. To put this into perspective, Figure 1 presents the teaching styles observed and casts this on Mosston's spectrum of teaching style (McCullick and Byra 2002; Mueller and Mueller 1992).

From Figure 1, the observed teaching styles in the sampled primary schools can only be compared to the command and/or task style in the Mosston's spectrum of teaching styles. This implies a heavily teacher-centred and reproductive style that may not develop critical thinking among learners. Figure 2 shows a cross-sectional representation of teaching time in a typical lesson based on the data. From the Figure 2, 38% of lesson time is spent on activities that do not directly enhance learning while 46.5% of lesson time is spent on three activities. The analysis shows that across all subjects, 48% of the lessons spent up to a quarter of the lesson time in Zone A; 86.4% of the lessons spent up to 25% of lesson time in Zone B; and, 49.3% of lessons spent up to half of teaching time in Zone C. This is a clear demonstration that in a considerable proportion of lessons, teaching time is not being optimised in a

Observed teaching styles		Spectrum of teaching styles
Not present		Self-teaching
Not present	Learner centered and productive styles	Learner initiated
Not present		Learner-designed individual program
Not present		Convergent and divergent discovery
Not present		Guided discovery
Not present		Inclusion
Not present		Self-check
Not present	Teacher centered and reproductive styles	Reciprocal
Individual seat work		Task/practice
Recitation & whole class style		Command

Figure 1. Comparing the observed teaching styles to the spectrum of teaching styles.

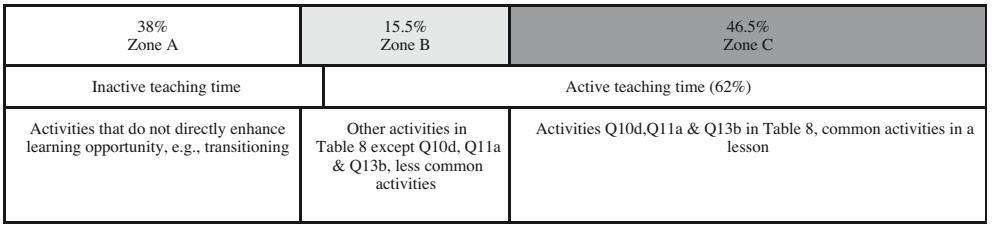

Figure 2. Distribution of teaching time during a lesson.

way to enhance learning opportunities. But even if it were to be optimised, the reproductive inclined teaching styles will compromise any gains made on active teaching time.

Figure 3 shows that the activities taking most of the lesson's active teaching time did not differ by subject though the actual proportion of time spent in each activity was slightly different. In English lessons, question and answer verbal interaction, where the teacher asks questions, was the dominant active teaching activity (41.3%); whole class demonstration (41.5%) took most of the active teaching time in science; while in maths, whole class demonstration took 33.8% of the teaching time. From these statistics, one can say that teachers used similar teaching styles regardless of the subject. From Appendix 1, time spent on active teaching activities is a function of lesson duration. This implies that if teachers, for instance, do not teach for the entire duration of the lesson, then learning opportunities are missed. This relationship (between lesson duration and active teaching time) demystifies the popular thinking that all what matters is 'what you know' and 'what you teach in the first few minutes' that leads to learning, regardless of how long it takes to do it.

In order to understand if patterns of teaching differ within and between schools and by school categories, a one way ANOVA is fitted with (1) schools as the grouping factor, irrespective of the subject; and (2) school category as grouping factor and for each subject. In Table 9, ANOVA is used to show the variation that is attributable to the grouping (between group variation) and the variation that is unexplained (within group variations). Considering subjects as independent observations made in each school, results show that 43.9% of the variation is between schools (attributable to grouping effect), which is statistically significant; therefore the variability of proportion of active teaching time between subjects in the same school is less than the variability between the underlying proportions of active teaching time between different schools.

In maths and English lessons, school category accounts for less than 1% of the total variation of time spent on active teaching. In science lessons, the variation accounted for by school category is 3.27%; however, much of the variation remains unobserved for (within schools category). Therefore, across the three subjects, much of the variation on time spent on active teaching is observed within the groups, with insignificant variations between groups.

Table 9. ANOVA results for effect of school on teaching style.

Source of variation	SS	df	F-ratio & P-value
			F = 1.56
School (between)	2.723892	71	P = 0.0136
Residual (within)	3.477378	141	
Total	6.201270	212	
R-Squared		0.4392	

Note: SS = Sum of squares; df = degrees of freedom.

Table 10. ANOVA results for effect of school category on teaching style.

	Math		English		Science	
Source of variation	SS	df	SS	df	SS	df
Model	*0.002600*	*1*	*0.002041*	*1*	*0.066371*	*1*
School Category	0.002600	1	0.002041	1	0.066371	1
Residual	2.165561	70	1.993828	68	1.965946	69
Total	2.168161	71	1.995869	69	2.032317	70
R-Squared		0.0012		0.001		0.0327

Note: SS = Sum of squares; df = degrees of freedom.

This study also sought to understand whether there are significant effects of teacher and school characteristics on patterns of teaching styles and active teaching. Teacher characteristics included: teacher years of teaching experience, gender, age, academic qualifications, confidence and teacher socio-economic characteristics; school characteristics included PTR, average class size, school size and school SES (Table 11 and 12). The results show insignificant effects of most of the school and teacher characteristics on time spent on active teaching, with an exception for the type of questions asked during the lesson. That is, lessons with tasks/questions of high-level cognitive demand utilised a higher proportion of lesson time (14.7%) on active teaching as compared to those that had lower level questions. An evaluation conducted in seven schools in the Pemberton School District, in the US, reported a positive relationship between the time taken to complete lesson activities and test scores (Clariana 2008). Though the US is not a perfect comparison for developing countries, the relationship between time and learning is an important limiting factor in instructional delivery (Clariana 1998; Horn 2007; McMurrer 2007). Therefore, meaningful time on task, for instance, instructing pupils on new concepts and not using time to teach what they already know, is an efficient use of time. Effective lesson planning on content coverage and careful execution of the same is therefore critical for meaningful use of active teaching time. Though we observe that more than 62% of the lesson is spent on active teaching time, it may be the case that this time is not spent in a meaningful way as teachers and learners engage in simple and repetitive interactions.

Table 11 also shows the amount of variation that is attributable to each of the teacher and school characteristics. It is apparent that with the exception of pupil teacher ratio and types of questions asked in the classroom, each of the other variables explains less than 1% of the lesson time spent on active teaching. Table 12 shows the separate effects of school and teacher characteristics. This helps understand which characteristics have a higher impact on time spent on active teaching. The separate R-squared for the teacher and school multiple regression results are 2.2% and 4.5% respectively. This gives an indication that the school characteristics have a much larger effect on teaching style compared with the teacher characteristics, perhaps an indication of the different school contexts and/or ethos.

Further analysis of the data shows that there is no significant association between number of teaching years and dominant teaching style by subject. Teaching for a long time does not make one necessarily teach any different from a newly recruited teacher. Both long-serving and inexperienced teachers taught in a similar way – teacher centred – indicating the existence of either (1) poor pre-service teacher preparation in pedagogical skills; (2) inadequate on-the-job skill upgrading through in-service program; and/or (3) weak teacher support programs, for example, professional guidance through supervision and peer evaluations. A further investigation of teaching style reveals a significant association in the style of teaching English and the teacher's gender. In every 10 female teachers, seven to eight used

Table 11. Univariate regression coefficients showing effect of school and teacher characteristics on teaching style.

Variable	Coefficient	T-statistic	Constant	R-squared	
Teacher characteristics					
Mean age	Years	0.000	0.39	0.603	0.001
Teacher sex	Female (r)	0		0.628	0.001
	Male	− 0.010	−0.37		
Teacher experience	10 yrs or less (r)	0		0.629	0.009
	Between 11 to 20 yrs	0.004	0.14		
	Above 20 yrs	− 0.034	−0.88		
Teacher training	No Teacher Education(r)	0		0.620	0.001
	Certificate	0.000	0.02		
	Diploma/Degree	0.020	0.41		
Teacher wealth Index	Least poor (r)	0		0.618	0.002
	Middle	− 0.002	−0.08		
	Poorest	0.015	0.54		
Subject	Math (r)	0		0.615	0.001
	English	0.010	0.40		
	Science	0.010	0.40		
School characteristics					
School category	Bottom (r)	0		.633	0.004
	Top	− 0.021	−0.78		
Average class size		0.001	1.23	0.592	0.008
Poverty (20%)		0.001	0.92	0.610	0.004
Poverty (40%)		0.000	0.13	0.619	0.000
PTR	PTR: < 26 (r)	0		0.586	0.019
	Between 26 and 45	0.054	1.68		
	PTR: > 45	0.038	0.93		
Public schoolNo (r)					
	Yes	0.010	0.31	0.614	0.001
Questions asked	Few/No questions (r)	0		0.637	0.019
	Simple and Repetitive	− 0.020	−0.51		
	Give example/short answer	0.147**	2.51		

Note: ** Significant at 5% level of significance; ∗ Significant at 10% level of significance; r – reference category.

recitation compared to four to five in every 10 male teachers; this association is not seen in the maths and science lessons.

Conclusions and implications

The purpose of this paper was to find out whether there are differences in teaching styles and active teaching time across three subjects taught in primary schools in Kenya. The association between the patterns of teaching and teacher/school characteristics was also investigated. The analysis arrives at the following key findings.

(1) Teachers taught in similar ways, regardless of their teaching experience, school category (high or low performing) and subject (maths, English and science). Except in the utilisation of recitation (a command style of teaching) in the teaching of English, other teaching styles did not differ by teacher gender.
(2) In all categories of schools and across all subjects studied, the teaching styles are predominantly teacher-centred – particularly command and practice styles.

Table 12. Multivariate regression coefficients showing effect of school and teacher characteristics on teaching style.

Variable	Teacher characteristics Coef [t-statistic]	Schoolcharacteristics Coef [t-statistic]	
Teacher characteristics			
Mean age	Years	0.002 [1.46]	
Teacher sex	Female	0	
	Male	−0.009 [−0.32]	
Teacher experience	10 yrs or less (r)	0	
	Between 11 to 20 yrs	−0.02 [−0.56]	
	Above 20 yrs	−0.067 [−1.53]	
Teacher training	No teacher education (r)	0	
	Certificate	−0.007 [−0.24]	
	Diploma/degree	0.022 [0.46]	
Teacher wealth index	Least poor (r)	0	
	Middle	−0.004 [−0.12]	
	Poorest	0.016 [0.56]	
Subject	Math (r)	0	
	English	0.015 [0.55]	
	Science	0.016 [0.60]	
School characteristics			
School category	Bottom(r)		
	Top		−0.026 [−0.83]
Average class size			0.000 [0.15]
Poverty (20%)			-
Poverty (40%)			0.000 [0.58]
PTR	PTR: < 26 (r)		0
	Between 26 and 45		0.063 [1.50]
	PTR: > 45		0.044 [0.87]
Public school	No (r)		0
	Yes		−0.035 [−0.71]
Questions asked	Few/no questions (r)		0
	Simple and repetitive		−0.027 [−0.61]
	Give example/short answer		0.137* [2.05]
Constant		0.556 [7.9]	0.648 [8.79]
R-squared		0.0222	0.0453

Note: ** Significant at 5% level of significance; * Significant at 10% level of significance; r – reference category.

(3) On average, active teaching time takes up almost two-thirds of the lesson teaching time – with active teaching being concentrated on three activities, namely the teacher checking on how individual learners carry out teacher-assigned tasks, the teacher asking individual learners questions, and the teacher demonstrating to a whole class.
(4) Although teacher-centred, each of the subjects had a dominant teaching style – recitation for English, individual seat work in maths and whole class chorus in science.
(5) Using the Mosston continuum of teaching styles, in the 213 lessons observed, only the command and practice/task styles were therefore evidenced.
(6) There exists higher variability of teaching patterns across the three subjects between schools than within schools.

The conclusion is that the current teaching styles in use in Kenyan primary school classrooms do not enhance opportunities to learn and will lead to learners who reproduce knowledge rather than learners who produce knowledge for a growing economy.

The key policy implication emerging from this paper is on pre-service and in-service teacher preparation programs that may not be adequately preparing teachers for a broad spectrum use of teaching styles – particularly the learner-centred styles. This is an area where the Ministry of Education and other stakeholders involved in teacher preparation program may have to initiate reforms aimed at revitalising teacher training programs and pedagogical skills of teachers in station. In addition, active teaching time need to be used in a more meaningful way for it to have better impacts on learning outcomes.

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References

Ashworth, S. 1992. The Spectrum and teacher education. *Journal of Physical Education, Recreation, and Dance* 13, no. 2: 6–7. www.spectrumofteachingstyles.org/pdfs/literature/McCullick_Byra_2002_Spectrum_Teaching_Styles_and_National_Standards.pdf.

Ackers, J., and F. Hardman. 2001. Classroom interaction in Kenyan primary schools. *Compare* 31, no. 2: 245–65.

Aitkin, M., and R. Zuzovsky. 1994. Multilevel interaction models and their use in the analysis of large-scale school effectiveness studies. *School Effectiveness and School Improvement* 5: 45–73.

Byra, M. 2002. A review of spectrum research. In *Teaching physical education*, ed. M. Mosston and S. Ashworth, 319–35. San Francisco, CA: Benjamin Cummings. http://www.spectrumofteachingstyles.org/pdfs/literature/Byra_2002_A_Review_of_Spectrum_Research.pdf.

Carnoy, M., L. Chisholm, et al. 2008. Towards understanding student academic performance in South Africa: A pilot study of grade 6 mathematics lessons in South Africa. Report prepared for the Spencer Foundation. Pretoria: HSRC.

Chatoupis, C. 2010. Spectrum research reconsidered. *International Journal of Applied Sports Sciences* 22, no. 1: 80-96. www.spectrumofteachingstyles.org/pdfs/literature/Chatoupis2010_IJASS.pdf.

Clariana, R.B. 1998. Smarter tools, better teachers: Applying neural network technology to curriculum alignment. Paper presented at the Annual Meeting of the Society for Information Technology and Teacher Education, March 11, in Washington, DC. www.eric.ed.gov/PDFS/ED418949.pdf.

Clariana, R.B. 2008. Meaningful time on task: Practical guidelines for implementing compass learning software. A web based article on time-on-task. http://meaningful-time-on-task.wikispaces.com.

Garuccio, J. 2004. Teaching styles. www.snowbird.com/imagelib/mtnschool/mspdf/ms_tstyles.pdf.

Hardman, F., J. Adb-Kadir, C. Agg, J. Migwi, J. Ndambuki, and F. Smith. 2009. Changing pedagogical practice in Kenya primary schools: The impact of school-based training. *Comparative Education* 45, no. 1: 65–86.

Hardman, F., F. Smith, M. Mroz, and K. Wall. 2003. Interactive whole class teaching in the national literacy and numeracy strategies. Paper presented at the British Educational Research Association Annual Conference, Heriot-Watt University, 11-13 September, Edinburgh. www.leeds.ac.uk/educol/documents/00003267.htm.

Hardman, F., J. Abd-Kadir, and F. Smith. 2008. Pedagogical renewal: Improving the quality of classroom interaction in Nigerian primary schools. *International Journal of Education Development* 28: 55–69.

Hermin, M., and M. Toth. 2006. *Inspiring active learning: A complete handbook for teachers*. Alexandria, VA: Association for Supervision and Curriculum Development (ASCD).

Horn, A. 2007. Teachers' time on task: Middle-school teachers are teaching more than ever. www.suite101.com/content/teachers–time-on-task-a11471.

Housego, B.E.J. 1990. Student teacher feelings of preparedness to teach. *Canadian Journal of Education* 15, no. 1: 37–56.

Louw, J., J. Muler, and C. Tredoux. 2008. Time-on-task, technology and mathematics achievement. *Evaluation and Program Planning* 31: 41–50. www.elsevier.com/locate/evalprogplan.

McCullick, B., and M. Byra. 2002. Spectrum teaching styles and the national standards for physical education: Introduction. *Teaching Elementary Physical Education* 13, no. 2: 6–7. www.spectrumofteachingstyles.org/pdfs/literature/McCullick_Byra_2002_Spectrum_Teaching_Styles_and_National_Standards.pdf.

McMurrer, J. 2007. Choices, changes, and challenges: Curriculum and instruction in the NCLB Era. A report published by the Center on Education Policy, Washington, DC. www.cep-dc.org/displayDocument.cfm?DocumentID=312.

Mueller, R., and S. Mueller. 1992. The spectrum of teaching styles and its role in conscious and deliberate teaching. *Journal of Physical Education, Recreation, and Dance* 63, no. 1: 48–53.

Ngware, M., M. Oketch, M. Mutisya, and B. Abuya. 2010a. Classroom observation study: A report on the quality and learning in primary schools in Kenya. A research report on the quality of primary education in Kenya carried out by the African Population and Health Research Center, Nairobi, Kenya.

Ngware, M., M. Oketch, M. Mutisya, and I. Kodzi. 2010b. Does teaching style explain differences in learner achievement in low and high performing schools in Kenya? APHRC Working Paper 44.

Opdenakker, M., and J.V. Damme. 2006. Teacher characteristics and teaching styles as effectiveness enhancing factors of classroom practice. *Teacher and Teacher Education* 22: 1–21. www.elsevier.com/locate/tate.

Sorto, M.A., J.H. Marshall, T.F. Luschei, and M. Carnoy. 2009. Teacher knowledge and teaching in Panama and Costa Rica: A comparative study in primary and secondary education. *Revista Latinoamericana de Investigación en Matemática Educativa* 12, no. 2: 251–90.

Stein, M.K., M.S. Smith, M.A. Henningsen, and E.A. Silver. 2000. *Implementing standards-based mathematics instruction: A casebook for professional development*. New York: Teachers College Press.

Tanner, H., S. Jones, S. Kennewell, and G. Beauchamp. 2005. Interactive whole class teaching and interactive white boards. www.merga.net.au/documents/RP832005.pdf.

Wentzel, K.R. 2002. Are effective teachers like good parents? Teaching styles and student adjustment in early adolescence. *Child development* 73: 287–301.

Winkle, R., and T. Skubinna. 2005. Active teaching–active learning: Teaching techniques and tools. http://extension.oregonstate.edu/catalog/4h/4-h0259l.pdf.