A Multilevel Approach to Investigating the Achievement Gap of Students in Single-Sex Schools with Students in Coeducational Schools

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A Research Road-Map For the Study

1: Introduction, Current Conversation & History

2: Purpose of the Study & Research Questions

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3: Prior Research in Single-Sex and Coeducational Schools

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4: Methodology

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5: Results

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6: Discussion, Conclusions & Recommendations

Introduction

Current Conversation on Education in Kenya Focuses on:

- Access and Quality
- Relevance
- Equity
- Transition
- School Change and Leadership
- Assessment and Frequent Program Evaluation
- Financial Management
- Reforming Education to Align to Constitution
- Emerging Global Issues and Technology

Kenya - Provinces

Introduction Cont'd

History of System of Education in Kenya

- The number of public and private primary schools has increased from 6,000 to over 27,000 since independence
- During the same period, the number of secondary schools has increased from 150 to over 7,000
- Before independence, education system was designed along racial lines
- Then came the Ominde Commission in 1964 that sought to de-segregate schools formerly created along racial lines

Introduction Cont'd

History of System of Education, Cont'd

- After the Ominde Commission of 1964, came several other Commissions and Committees on Education such as:
  - -- Gachathi Report, 1976
  - -- McKay Report, 1981
  - -- Kamunge Report, 1988, &
  - -- Koech Report, 1999
- Each of these Reports gave recommendations on education system
- The most significant of these reports was that of McKay which ushered in the 8-4-4 system of education

Introduction Cont'd

History of System of Education, 8-4-4

- 8-4-4: 8 years in primary/elementary school, 4 years in secondary school and 4 years in the university
- 8-4-4: was built on the premise that the previous system (7-4-2-3) that was in operation from independence (1964) to 1985 churned out an elitist population that lacked vocational skills for self-employment
- Designers of the 8-4-4 system wanted to include practical/vocational skills and knowledge component that the previous system (7-4-2-3) system did not

Introduction Cont'd

History of System of Education, 8-4-4

- However, due to the intense nature and the overwhelming need for resources to effect a practical-oriented curricular, 8-4-4 has struggled through since its inception
- The last government (coalition government[2007-2012]) grappled with a new idea that sought to introduce another system of 2-6-6-3 without first addressing problems experienced in the previous systems of education

Purpose of the Study

The Primary Purpose of this Research is Guided by three Major Objectives:

- To use data and prior research to inform the ongoing discussion about the system of education Kenya plans to develop/adopt
- To use data to lead change in school reforms particularly when the country is transitioning into a devolved/Federal system of government
- To discuss the implications school type (boys, girls, coeducation/mixed) and segregated system of education have on student academic achievement

Achievement/Opportunity Gap

What is Achievement Gap?

- The term achievement gap is used to denote differences in the academic achievement of particular groups of learners
- There are achievement gaps rather than merely one achievement gap.
- There are many gaps, and the gaps themselves have changed overtime.

(Kober, 2001)

Achievement/Opportunity Gap

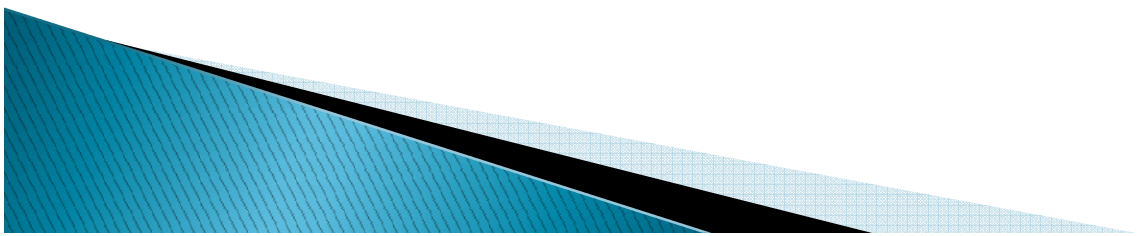
The difference in school performance among students of different backgrounds continues to be a persistent problem and a serious one!

a. Theoretical models to explain linkages existing among learning variables and student's educational outcomes have been proposed (Bennett, 1978; Carroll, 1963; Glaser, 1976; Walberg, 1981)
b. These models include characteristics of the learner, the learning environment, and the quality of instruction the learner receives (Haertel, Walberg, & Weinstein, 1983)
c. The value-added assessment system (Sanders & Horns, 1998) adds another angle to this

Study Research Questions

Primary Research Questions

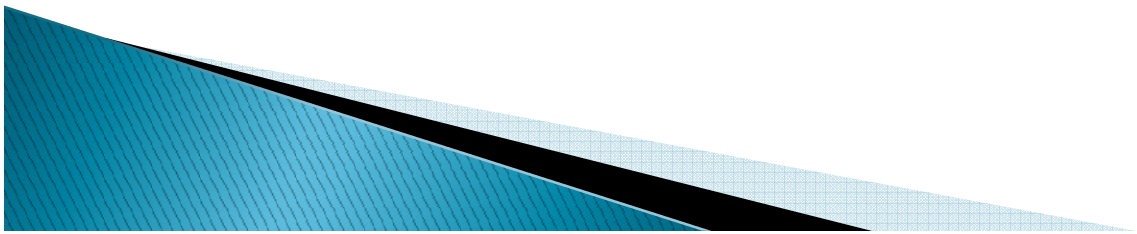
- 1) Are there differences in student achievement scores among secondary schools in Kenya?
- 2) Does single-sex school status explain the differences in mean school achievement scores?



Study Research Questions

Secondary Research Questions

a) Do students in specific gender schools perform better than students in coeducational (mixed) schools on achievement scores?
b) Do boys in the boy only schools perform better than students in the girl only schools?
c) Do students in the boy only schools perform better than male students in the coeducational (mixed) schools?



Study Research Questions (Cont'd)

Secondary Research Questions (cont'd)

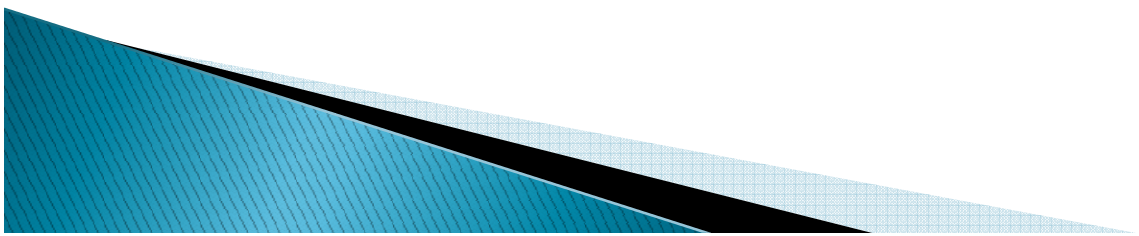
- d) Do students in girl only schools perform better than female students in the coeducational schools?
- e) Do students in single-sex schooling in a district, county/provincial, or a national school differ in academic achievement when compared to students in coeducational schooling in a district, provincial or a national school?
- f) Do students in gender specific schools perform better than students in coeducational schools in academic achievement across the 14 counties in Rift Valley, Kenya?

Study Research Questions (Cont'd)

g) Do students in gender specific schools perform better than students in coeducational schools on:

-- English
-- Mathematics
-- Kiswahili
-- Chemistry
-- Biology
-- Physics
-- Business Studies
-- Religious Studies (Christian, Hindu, Islamic) and
-- History and Government

achievement scores?



Prior Research/Literature Review

- Sullivan (2009) state that academic self-concept affect students' perceptions of their own academic abilities (academic self-concept) more so in single-sex schools
- Sullivan indicated that boys had higher self-concepts in mathematics and science, and girls in English thus narrowing gender gap in self-concept
- Riordan (1990) indicate that policies in single-sex schools that emphasize the academic side of educational activities explain the higher score

Prior Research/Literature Review

- Boys are likely to rate their abilities more highly than girls in subjects that have traditional been perceived as “masculine” such as mathematics and the sciences (Joffe & Foxman, 1988; Marsh, 1989; Marsh & Yeung, 1998; Wilgenbusch & Merrell, 1999)
- Stables (1990) found that the polarization of interest in physics and modern languages between the sexes in English comprehensive schools was greater in mixed schools than in single-sex schools

Prior Research/Literature Review

- The British liberal consensus posits that coeducational schooling was healthier for both male and female students-affords both male and female students same opportunities to study a sex-atypical curriculum
- However, this has been challenged by both proponents and opponents of coeducation schooling (Dale 1969, 1971, 1974).
- Historically, single-sex schools have been prestigious, mostly private and are held in greater esteem because they generally have selective admission policies

Prior Research/Literature Review

- Research on single-sex classes within co-educational schools concludes that girls-only classes may have positive effects for girls, but no evidence on boys' achievement (Jackson, 2002)
- of single-sex classes of mathematics and sciences in a middle school also corroborates Jackson's findings emphasizing that the single-sex environment contributed to girls', but not boys' feelings of empowerment, peer support and positive self-concept (Baker, 2002)

Prior Research/Literature Review

- Harker (2000) explored the relative achievements of girls in single-sex and coeducational schools while controlling for the student population differences at two types of school and concluded that when controls are introduced, the apparent significant differences between the two types of school disappear
- Differences existed in student achievement (English, mathematics and science) at a variety of levels in secondary schools in New Zealand (Harker, 2000)

Prior Research/Literature Review

- Research has also shown that the brain anatomy of males is different than that of females (Gur et al., 1999)
- Conlin (2003) state that males are developmentally two years behind females in reading and writing within the first days of school
- However, males score higher on average on achievement measures in mathematics and science (Streitmatter, 1997). These differences may be due to differences in brain anatomy as document by Gur and colleagues

Prior Research/Literature Review

- Gur and colleagues show women were more successful on verbal and memory tasks and men tend to be more successful in spatial tasks (Gur et al., 1999)
- It is thought that the differences seen between men and women are due to the specialization of hemispheres within the brain
- Women are thought to have less specialization of hemispheres because there is greater communication between hemispheres in women's brains

Methodology

Data Source and Data Preparation

- Data came from the Kenya National Examination Council-KNEC (Ministry of Education)
- The construction of data files involved writing SAS programs to read each school's ASCII file due to individual school's different subject combinations
- The resulting 956 school files were then matched to create a single data file, which included:
- A unique student identifier,
- A unique school code,
- KCSE composite mean score,
- Mean score for each of the three compulsory subjects (English, Kiswahili and Mathematics),
- Gender, and
- Individual KNEC subjects that individual school choose to offer to its students (based on facilities, teaching resources and availability of trained teachers)

Methodology

Data Source and Data Preparation

- Four extra variables were created:
- County, the geographical administrative unit that the school is located;
- School type which indicated whether the school is boy only, girl only, or coeducational (mixed);
- Status that indicated whether school is district, provincial or national; and
- Whether the school provides or does not provide room and board facilities (boarding or day school).
- The data are based on the entire population of students and schools in Kenya's Rift Valley province and National schools in Nairobi, Central and Nyanza provinces

Methodology

Table 1: Number and percentage of students (in boys, girls, and coeducational schools) split by county (Rift Valley province)

County	Boys	Girls	Mixed	Total-students
Baringo	744 (18.8%)	1,060 (26.8%)	2,145 (54.3%)	3,949
Bomet	614 (18.4%)	565 (16.9%)	2,164 (64.7%)	3,343
Kericho	1,627 (19.9%)	1,708 (20.9%)	4,849 (59.2%)	8,184
Kajiado	279 (16.4%)	522 (30.7%)	899 (52.9%)	1,700
Keiyo-Marakwet	1,097 (30.8%)	1,256 (35.2%)	1,212 (34.0%)	3,565
West Pokot	543 (42.9%)	462 (36.5%)	261 (20.6%)	1,266
Laikipia	487 (13.7%)	317 (8.90%)	2,740 (77.3%)	3,544
Nakuru	959 (7.2%)	2,219 (16.6%)	10,183 (76.2%)	13,361
Nandi	1,306 (24.4%)	1,261 (23.6%)	2,776 (52.0%)	5,343
Narok	283 (11.9%)	362 (15.2%)	1,739 (72.9%)	2,384
Samburu	272 (49.7%)	166 (30.3%)	109 (19.9%)	547
Trans Nzoia	467 (13.4%)	531 (15.2%)	2,485 (71.3%)	3,483
Turkana	298 (32.6%)	210 (23.0%)	405 (44.4%)	913
Uasin Gishu	812 (14.7%)	1,134 (20.5%)	3,592 (64.9%)	5,538

Methodology

Table 2: Number and percentage of schools (boys, girls and coeducational) split by county (Rift Valley province)

County	Boys' Schools	Girls' Schools	Mixed Schools	Total-schools
Baringo	10 (14.3%)	15(21.4%)	45(64.3%)	70
Bomet	7(10.0%)	9(12.7%)	55(77.6%)	71
Kericho	16(11.3%)	28(19.7%)	98(69.0)	142
Kajiado	6(18.2%)	10(30.3%)	17(51.5%)	33
Keiyo-Marakwet	14(25.0%)	18(32.1%)	24(42.9%)	56
West Pokot	8(36.4%)	6(27.3%)	8(36.4%)	22
Laikipia	7(11.3%)	5(8.06%)	50(80.6%)	62
Nakuru	12(5.36%)	36(16.1%)	176(78.6%)	224
Nandi	16(13.6%)	23(19.5%)	79(66.9%)	118
Narok	2(4.9%)	3(7.3%)	35(85.4%)	41
Samburu	6(54.5%)	3(27.3%)	2(18.2%)	11
Trans Nzoia	6(8.7%)	8(11.6%)	55(79.7%)	69
Turkana	3(30.0%)	3(30.0%)	4(40.0%)	10
Uasin Gishu	10(9.9%)	14(13.9%)	77(76.2%)	101

Results (Descriptive)

Table 3: County achievement mean score for boy only, girl only and coeducational (mixed) schools split by county (Rift Valley province)

COUNTY	BOYS	GIRLS	MIXED
Baringo	6.45	5.78	5.31
Bomet	6.56	6.12	4.93
Kericho	6.93	6.17	4.62
Kajiado	6.10	5.65	4.82
Keiyo-Marakwet	6.68	6.42	5.23
Laikipia	6.72	6.20	4.64
Nakuru	6.90	5.45	4.86
Nandi	7.01	6.45	4.71
Narok	5.56	4.72	4.38
Samburu	5.08	5.08	5.46
Trans Nzoia	8.25	6.38	4.66
Turkana	6.09	5.45	4.84
Uasin Gishu	7.25	6.58	5.04
Pokot	6.38	5.93	4.73
Rift Valley	9.43	8.94	9.24
Central	10.94	10.20	
Nairobi	10.43	9.85	
Nyanza	10.43		

Figure 1:KCSE Achievement Mean Scores of School Type by County

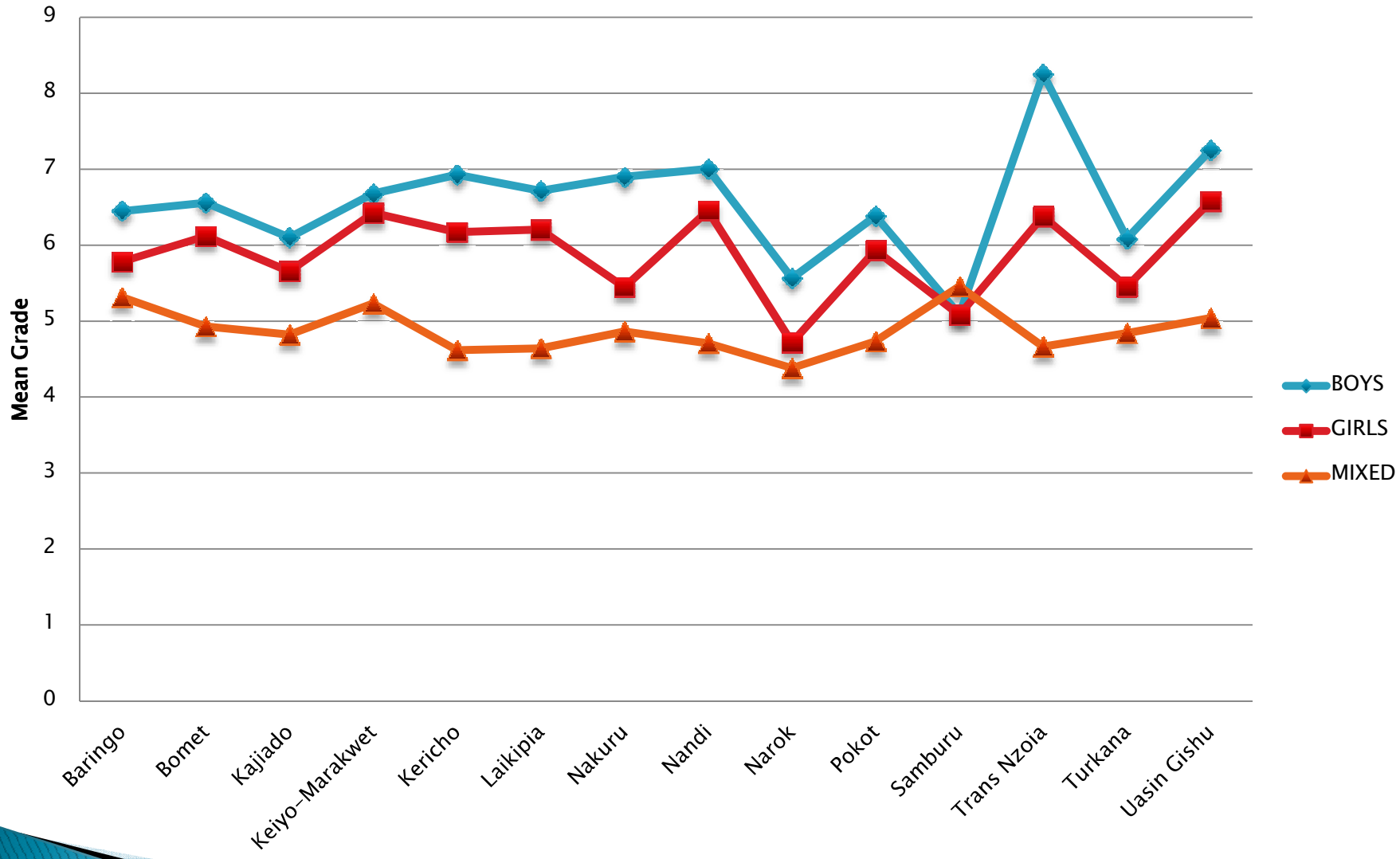
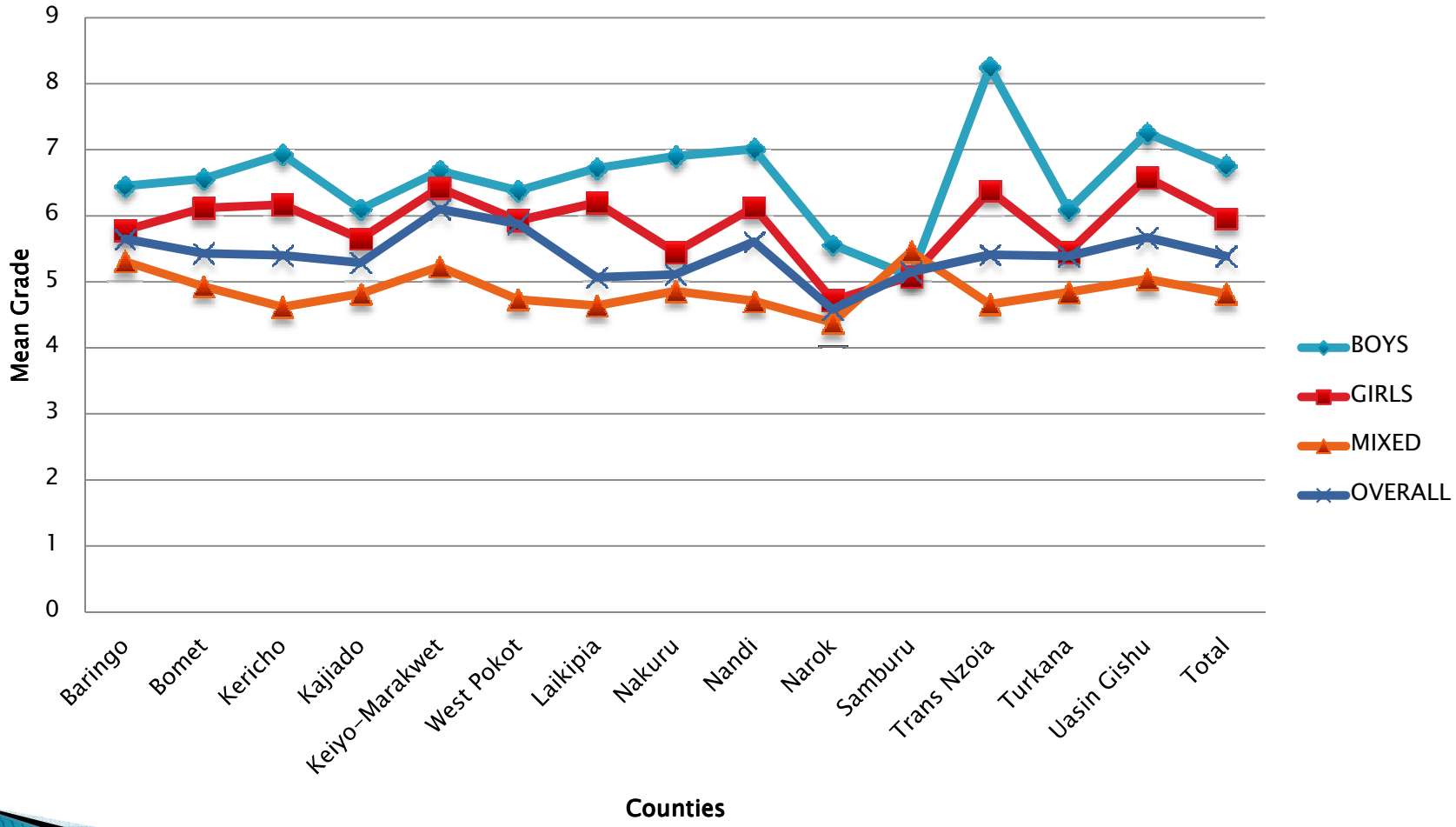


Figure 2: KCSE Achievement Mean Scores of School Type by County



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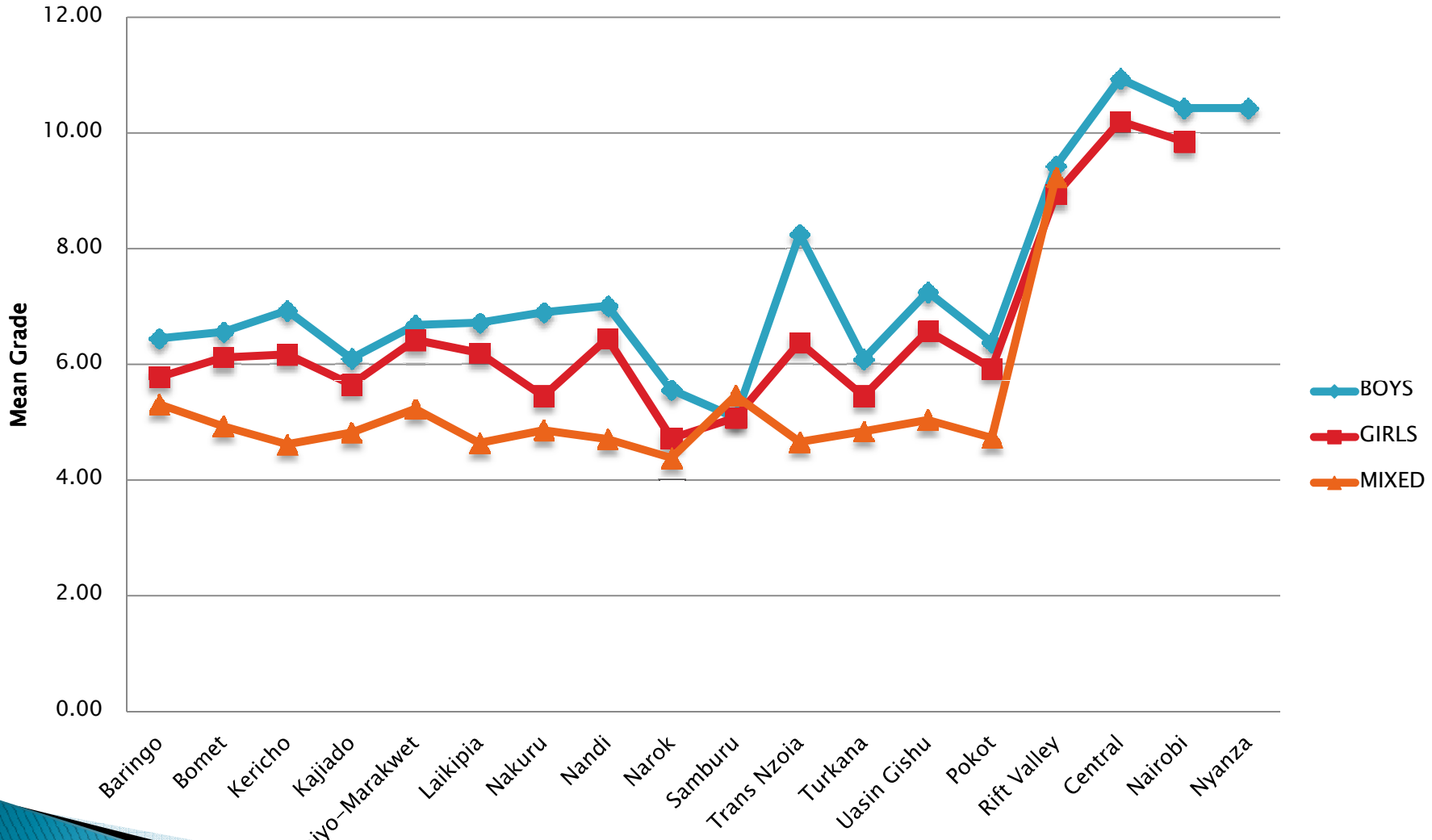

Results

Multilevel Analysis (HLM)

- To answer the study's research questions, a two-level hierarchical linear model (HLM) with individual - level variables at the first level, and school-level variables at the second level was used

Results

Multilevel Analysis (HLM)

- *Research Question 1*: Are there differences in student achievement scores among secondary school students?
- HLM model without L1, L2 predictors:

$$\text{Achievement}(Y_{ij}) = \beta_{oj} + r_{ij}$$

Results

Multilevel Analysis (HLM)

- The HLM results indicate significant differences among schools, ($X^2[995] = 53{,}252.11$, $p<0.001$)

- The HLM results indicate an intra-class correlation of 0.4558 indicating that 45.58% of variance in student achievement scores was among schools

Results

Multilevel Analysis (HLM)

- This shows variation among schools in their student achievement and suggests that the school-level (L2) variables might have accounted for the differences in student academic achievement.

Results

Multilevel Analysis (HLM)

- Research Question 2: Does single-sex school status explain the differences in mean school academic achievement?

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Single-sex})_j + \mu_{0j}$$

Results

Multilevel Analysis (HLM)

- When single-sex school status was used as a level 2 predictor with no level 1 predictors, the school variability dropped from 1.84349 to 1.51200 indicating that 18% of variance in school achievement was due to single-sex school status (x^2 [994]) = 40,739.94, p<0.001)

Results

Multilevel Analysis (HLM)

- The HLM results showed that students in single-sex schools achieved at a significantly higher level than those in co-educational schools

Discussion and Implications

- Analyses of complex data that are nested have often been analyzed using statistical techniques that focus only level 1 variables. However, multilevel analyses show that understanding the role of individual level variables, while necessary, is not sufficient to fully understand all factors affecting academic achievement gaps

- Variation at the school level is clearly important in explaining, and predicting academic achievement

- The single-sex school status had a statistically significant and positive main effect on academic achievement (note: single-sex school was coded as 1 while co-educational school was coded as 0)

Discussion and Implications (cont'd)

- Closing the achievement gap will take time, resources, and the commitment of families, schools and communities, policy developers and decision makers

- When all components of this study are considered collectively, these results document a complex set of school effects on, and organizational and individual level variable interactions on student/school academic achievement

- The final manuscript includes complete results, discussion of the major findings and implications for research, research design and practice

Questions?

Thank You !