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SINGLE SEX VS. CO-EDUCATIONAL HIGH SCHOOLS: PERFORMANCE OF CARIBBEAN STUDENTS ACROSS SCHOOL TYPES IN MATHEMATICS ON THE CARIBBEAN SECONDARY EDUCATION CERTIFICATE

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***Abstract**: Gender-based performance on the Caribbean Secondary Education Certificate (CSEC) mathematics examination across single-sex and co-educational secondary schools in Barbados, Jamaica, St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago was analyzed to determine which group of students is achieving the highest pass rate and the best quality passes in mathematics. Five years (2013-2017) of CSEC data were examined and the findings indicate that girls in single-sex schools in Jamaica, St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago consistently had a higher pass rate than girls in co-ed schools and boys in both single-sex and co-ed schools. Additionally, they had the highest percentage of distinctions over any other group. Girls in Barbados' co-ed traditional grammar schools, formerly single-sex schools, also achieved both a higher pass rate and a greater number of distinctions. Given the consistency of the findings, we conclude that further studies should be conducted to determine the variables which may be contributing to the success or failure of students in the different school types; such as prior performance, teacher qualification, teaching styles, classroom context and motivation. The existing gap in the pass rate and quality of pass between girls and boys in the different school types must be narrowed and eliminated if national targets for mathematics are to be met.*

***Keywords:** school type, mathematics achievement, coeducational schools, single-sex schools, gender-based performance*

INTRODUCTION

Poor mathematics achievement has been a perennial problem among secondary school students in the Caribbean. Data from the Caribbean Secondary Education Certificate (CSEC) mathematics examinations, administered by the Caribbean Examinations Council (CXC) show distinctly, this general portrait of unsatisfactory performance in mathematics. Students typically sit this examination at the end of secondary school.

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Table 1 presents Caribbean students' overall CSEC mathematics performance from 2008-2018.

Table 1

Percentage of Candidates Obtaining a Passing Grade for CSEC Mathematics from 2008-2018

Year	Number of Candidates Writing Exam	Candidates with Passing Grades (%)			Total % Pass	Total % Fail
		I	II	III		
2018	79850	10.89	16.48	21.36	48.73	51.27
2017	84926	10.49	11.55	22.84	44.88	55.12
2016	85017	11.62	11.31	21.38	44.31	55.69
2015	85042	14.81	17.20	24.84	56.85	43.15
2014	91089	10.16	13.95	25.60	49.70	50.30
2013	94187	6.04	9.49	19.59	35.11	64.89
2012	94769	6.87	9.29	17.75	33.91	66.09
2011	89977	6.92	9.71	18.53	35.16	64.84
2010	88373	7.95	11.80	21.29	41.04	58.96
2009	83129	7.80	11.42	20.06	39.28	60.72
2008	80421	7.76	11.71	21.27	40.74	59.26
Average		**8.68**	**11.72**	**21.04**	**41.44**	**58.56**

Source: Caribbean Examinations Council (2008-2018)

Table 1 shows that over the ten-year period, approximately 59% of the candidates who wrote the examination achieved a failing grade. Further, the passing grade that students most frequently obtained was a Grade III, which is the lowest grade in the pass band. It is important to note that the data presented reflect the number of students sitting the examination and not the Grade 11 cohort of students. This is because many students are screened and excluded from sitting the CSEC mathematics examination for various reasons. In Jamaica, for example, data from the Ministry of Education (MOE) shows that in 2012 approximately 43,000 students sat the GSAT and were placed in secondary schools (Ministry of Education, 2012). In 2017, after five years of secondary education, 26,700 sat CSEC mathematics representing only 62% of the cohort of students (Ministry of Education, 2017). Similarly, in 2013, approximately 42,000 sat the GSAT and in 2018 only 22,200 sat CSEC mathematics representing 53% of the cohort (Ministry of Education, 2013, 2018).

The pattern of weak mathematics achievement has been a major concern for stakeholders of education since the outcomes of poorly developed mathematical

competencies are serious for everyday functioning, educational attainment and career advancement (Minskoff& Allsopp, 2003; Sadler & Tai, 2007). It also has far-reaching implications for both the Caribbean region and its peoples, as countries with a workforce lacking proficiency in mathematics are unable to achieve optimal economic growth to fully harness the opportunities that have emerged in this technological age (Carnevale, Smith, & Melton, 2011).

Further to the issue of prevailing weak performance in mathematics that exists at the secondary educational level, gender-related differences in academic achievement have also been observed. Bailey and Charles (2010) report that for the last two decades, girls' achievements inclusive of mathematics and school enrolment have generally surpassed that of boys. They further highlight that despite the aforementioned trend, "men still dominate in areas such as agriculture, natural sciences and engineering, with parity in some disciplines of the humanities" (p. 71). The findings of Bailey and Charles (2010) are consistent with other Caribbean-based research involving islands such as Trinidad, Barbados and Jamaica (e.g., Cobbett & Younger, 2012; Drayton, 1995; Evans & Johnson, 2001; Kutnick, Jules, & Layne, 1997).

Irrespective of which group the achievement gap favours, males or females, it is undesirable for several reasons. Evans (1997) states that a gender gap in students' performance is disadvantageous from a societal perspective. She asserts further that the underachievement of any social group raises human capital issues, since developing countries need a wide range of educated and skilled personnel. Finally, she states that the disparity in achievement also raises issues of equity, and social justice or equal distribution of social benefits.

Another dimension to the discussion of mathematics achievement focuses on the varied factors that may contribute to the observed differences in achievement by males and females. Bailey and Charles (2010) inform, based on their analysis of school-based assessments involving thirty-nine schools in 4 Caribbean islands, that structural factors, not personal attributes or demographical characteristics, such as sex, most significantly affected the performance of male and female students. One key structural factor that was identified by this research and has been discussed and experimented with by Ministries of Education (e.g. Trinidad) and others is school type – single-sex versus co-educational (co-ed) schools.

Achievement and School Type

As the Caribbean region readies itself to transform its education system to improve student performance, differences in gender-based performance in secondary education have been examined to determine if there are advantages to attending co-ed versus

single-sex educational institutions. Studies (e.g., George, 2012; Ivinson & Jackson, 2013; Pahlke, Hyde, & Allison, 2014) conducted to identify the link between gender-based performance and school type have produced contrasting findings. The equivocal nature of these studies brings to light the fact that differences in gender-based performance in single-sex and co-ed institutions should not be treated as absolute (Harker, 2000; Ivinson & Jackson, 2013; Pahlke et al., 2014). The hypothesis that students perform better in single-sex schools as opposed to co-ed secondary schools is dominant in most of these studies (Harker, 2000; Ivinson & Jackson, 2013; Smyth, 2010). For example, in England a 2006 survey of performance at the secondary level found that, "nine out of ten of the best performing secondary schools in England were single-sex, and seven of these were girls' schools" (Ivinson & Jackson, 2013, p. 1). Similarly in the United States, students in single-sex schools were performing at a higher level than students in co-ed schools, and in the case of Thailand it was found that single-sex schools proved to be more beneficial for girls than for boys (Lee & Lockhead, 1990).

Within the Caribbean, Jackson (2012) in a study of single-sex schools in Trinidad and Tobago presented evidence suggesting that there were no benefits to attending single-sex schools for the vast majority of males, but by contrast, he reported highly significant positive single-sex school effects for females. Figueroa (2010) reports the decision by the Trinidadian Ministry of Education to convert 20% of its 90 secondary schools from co-ed to single-sex institutions. Jackson (2016) reporting on this decision, found that students performed better in the single-sex schools. Evans and Johnson (2001) found similar results in Jamaica.

Gender Differences in Mathematics Achievement as per School Type

Pahlke et al. (2014) conducted a meta-analysis with data from 184 studies involving 1.6 million students in Grades K-12 from 21 countries. For the studies which incorporated controls for selection effects and no random group assignment, students in single-sex schools performed modestly better than their co-ed counterparts. When studies used random group assignments and controls for selection effects, the researchers found no significant differences between students' mathematics achievement in single-sex and coeducational schools. In keeping with Pahlke et al.'s (2014) findings for uncontrolled studies, Lee and Lockhead (1990) in early research, found that Nigerian students in single-sex schools performed better in mathematics than those in co-ed schools. This result in Lee et al.'s study was, however, significant. A second key finding from Lee et al.'s empirical research was that boys in single-sex schools performed better than those who attended coeducational schools, but this result was not significant. Lee and her associate noted that these results should be interpreted with caution since "students in girls' schools are also advantaged in many aspects of background, attitudes, school, and teaching characteristics" (p. 223).

Using the 2003 and 2007 Trends in International Mathematics and Science Study (TIMSS) data for Korea,Pahlke, Hyde, and Mertz (2013) found that Grade 8 students did not perform significantly different in mathematics based on the type of school that they attended. By contrast, Mucherah, Dixon, Hartley, and Hardin (2010) found in a study involving 1990 high school students in Kenya from single-sex girls' and boys' schools, that girls did significantly better in mathematics than boys. The mathematics assessments in Mucherah et al.'s study were teacher-constructed tests, whereas for Pahlke et al. (2013), the assessments were standardized.

Within the Caribbean region, students in single-sex schools appear to consistently outperform those in co-ed schools. Hamilton (1985) explored the performance levels of 1,146 Jamaican secondary school students in several subjects, including mathematics in single-sex and co-ed schools. The performance of females in single-sex schools was marginally superior to the males in the same school type, while for the co-ed institutions the finding was reversed. In Antigua and Barbuda, George (2012) conducted a case study of secondary schools and found that "the mathematics achievement of students in single-sex schools … was markedly different from that of students in mixed-sex schools" (p. 103).

Benefits

In some studies, co-educational institutions were found to contribute to gender stereotyping, in that boys tended to dominate the sciences, while girls gravitated more towards the arts and social sciences (Favara, 2012; Lee & Lockhead, 1990; Smyth, 2010). In developing countries such as Kenya and Nigeria, single-sex girls' schools received lower funding from government, and this has been identified as one of the factors contributing to a lower quality of science and mathematics passes (Lee & Lockhead, 1990). In addition, by contrast, single-sex boys' and co-ed schools that were government funded and had science laboratories, were found to be well equipped. In these contexts, females appeared to be guided by the hidden curriculum, i.e. to be wives and mothers. Not surprisingly, Lee and Lockhead contend, males dominated both in numbers and passes in areas such as science and mathematics As a result of these cases of gender stereotyping, feminists have been forced to lobby for equal access to all subjects irrespective of gender (Lee & Lockhead, 1990; Salomone 2004).

Overwhelming support for single-sex education stems from the many apparent advantages it affords its beneficiaries. Single-sex schools, it is argued by proponents such as Gurian, Stevens, and Daniels (2009), allow for greater focus across each gender; boys are less distracted by girls and girls are less dominated by boys. It is also believed that girls are given more attention in a single-sex classroom environment by teachers

than they would receive in a co-ed school (Smyth, 2010; Spender & Sarah, 1980; Sullivan, Joshi, & Leonard, 2009). Another advantage provided by single-sex schools is that they facilitate exposure to tailored learning approaches for each gender, as this setting takes into account the gender differences in learning styles (Finn, 1980; Gurian, 2010; Hayes, Pahlke, & Bigler, 2011; Jackson, 2010; Lee & Lockhead, 1990; Theirs, 2006). In the case of females, they are shielded from the social stereotypes that exist in society, as well as from chauvinistic male students that tend to reinforce societal stereotypes in a co-ed classroom, especially in subject areas such as mathematics and science which are traditionally considered masculine (Cookson, 2009; Finn, 1980; Hayes et al., 2011; Sax, 2005; Smyth, 2010).

In more recent studies (e.g., Booth, Cardona, & Nolen, 2013; Eisenkopf, Hessami, Fischbacher, & Ursprung, 2015), it was found that girls benefitted from attending single-sex schools as the analysis showed that they were more likely to perform better academically, in subjects labelled as "masculine" such as science and mathematics, than girls in co-educational schools. In the case of boys, minute differences were found in their performance irrespective of single-sex or co-educational school type (Spielhofer, Benton, & Schagen, 2004; Sullivan et al., 2009; Woodward, fergusson, & Horwood, 1999).

While the authors concede that the findings reported in this section are from various localities globally, with different cultural and educational settings, when taken collectively, these studies appear to offer some substantiation that single-sex classes and/or schools are particularly advantageous both academically and affectively, to female students.

Prestige and Past Performance

Apart from questioning the absence of control variables in studies examining the difference between co-educational and single-sex schools, researchers highlighted the inequalities based on students' prior school quality and prestige. Studies found that single-sex high schools are normally private, fee paying, prestigious schools that are fed with students who perform exceptionally well in national elementary/primary examinations (Harker, 2000; Jackson, 2010). Therefore, they point to a meritocratic system of selection that places the highest achieving students in these private, prestigious schools. Performance differences among school types are therefore, merely reflecting a continuous system of meritocracy that is **not controlled** for. This was the case in the United States, New Zealand and Trinidad and Tobago where secondary single-sex schools for girls in particular, dominated national exams (Harker, 2000; Jackson, 2010). In the case of Trinidad and Tobago, most government secondary schools (public) are co-ed, whereas denominational schools (i.e. owned, operated or connected

to a church) are single sex. Most of the single-sex schools in Jamaica are regarded as prestigious; hence these schools' intake is predominantly from among the top performing students from primary and preparatory schools. In this regard, the Jamaican Prime Minister, Andrew Holness in his 2015 budget presentation stated that the education system is a "kind of Darwinian survival of the brightest" … "Yes, it is a meritocracy, the brightest children, through GSAT, get access to the best schools, which invariably have the best teachers" (Holness, March, 2015, p. 17). Similarly, one study out of New Zealand reported that,

> Whatever the criteria for selection may be, it seems clear that the outcome could be much the same (for girls and boys alike) - the single-sex schools end up with a more socially exclusive group of pupils whose prior achievement levels are considerably higher than for pupils at co-educational schools". (Harker, 2000, p. 3)

Studies have also tended to ignore the selection process that places these students into the respective schools. For example, Jackson (2010) informs that in Trinidad and Tobago at the end of the fifth grade, students are required to take an exam to qualify for secondary school. Each student is given four choices of a traditional high school. The top performing primary level students as can be expected, normally request the top performing secondary schools as perceived by the students, their parents and their teachers. Jackson further states that the possibility of students obtaining their first choice increases with the quality of their average scores. Subsequently, high achieving students are sent to the top performing schools with their high performing peers. This selection process was found to be directly linked to the performance differences at the secondary level (Jackson, 2010). The placement model used in Trinidad and Tobago mirrors that used in Jamaica where students are given five choices of a high school when they sit the Grade Six Achievement Test (GSAT). Students are ranked based on their scores and are placed in the high school of their choice (MOE, 2018). To gain entry to the top performing high schools, which is usually their first choice, students must obtain average percent scores, which range from the upper 80's to the mid 90's. For example, Jamaican MOE data for GSAT 2018 indicated that for top performing traditional high schools such as Campion College, Immaculate Conception High School for Girls, Wolmer's Boys' School and Westwood High School for Girls, the average mathematics score for new entrants in Grade 7/Form 1 was 98%, 96%, 95% and 89% respectively. By contrast, for non-traditional high schools such as Charlie Smith, Clan Carthy, Denham Town and Edith Dalton James High Schools, students entered with an average mathematics score of 37%, 54%, 33% and 46% respectively (MOE, 2018). Similarly, in the UK, traditionally single-sex schools occupy the top positions in the national league tables as opposed to co-educational institutions. Coincidentally, they

account for the intake of only the higher performing students from the primary level which led Malacova (2007) to reason that "the differences between schools could be the result of those schools using selection tests to admit only pupils with higher ability" (Malacova, 2007, p. 1).

METHOD

This study aims to answer an important question about students' performance in CSEC mathematics based on the school type they attend in Barbados, Jamaica, St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago. In particular, it addresses the question: How does the quality of passes in mathematics for students attending single-sex schools compare with those attending co-ed secondary schools?

Data on Caribbean secondary school students' performance on CSEC mathematics from 2013 to 2017 were obtained from CXC for Barbados, Jamaica, St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago. These countries were selected because they have retained single-sex secondary schools and they enter a substantial number of students to write CSEC subjects. Barbados has also gone the route of converting their single-sex schools to co-ed institutions. They have, however, retained one all-girls and one all-boys school to provide parents with an option for this school type if required. St. Lucia and St. Vincent and the Grenadines are the next largest in numbers of students entered to sit CSEC subjects, and they both have maintained single-sex schools. Table 2 shows the total number of students sitting CSEC mathematics for the years 2013 to 2017 based on school type.

Table 2

Number of Students by Country and School Type Entered for CSEC Mathematics (2013 – 2017)

Countries	Number Co-Ed Girls	Number Co-Ed Boys	Number Single-Sex Boys	Number Single-Sex Girls	Total
Barbados	1563	1498	477	596	4134
Jamaica	16060	14164	8045	14660	52929
St. Lucia	1682	812	595	711	3800
St. Vincent & Grenadines	1082	647	882	1066	3677
Trinidad & Tobago	3468	2707	10173	11135	27483

For Barbados, the schools selected were the only two public single-sex schools, one for boys and one for girls, and co-ed schools. It should be noted that the co-ed schools in the Barbados sample were all formerly prestigious traditional grammar single-sex

secondary schools that were converted to co-ed in the 1980s. Even as co-ed schools, they maintain their prestige. In the case of Jamaica, the data represent students' performance from the 7 single-sex boys' and the 15 single-sex girls' schools, and the 20 co-ed high schools. These schools comprise the traditional high schools[1] in Jamaica. All the government-aided single-sex schools in St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago which are traditionally grammar schools were selected. The co-ed schools were purposely selected based on the number of students entered each year which was greater than 30. Many of the secondary schools in these countries are small and so they enter low numbers of students for CSEC mathematics. When the data is disaggregated by gender, school type and grade, some sub-groups would have too few or no student data for analysis. As a result, the larger co-ed schools had to be selected. Additionally, the schools had to be among the top 10 schools in CSEC mathematics. The results were examined to identify schools with the highest performance levels in CSEC mathematics among the co-ed schools in each of these countries. The rigid selection process, which is based on performance on the various primary school exit examinations would have placed the highest performing students in the single-sex schools and the others would have been placed in co-ed schools usually of the students' choice. The higher performing schools were selected to reduce the bias inherent in those schools where students of a similar lower level of achievement were placed.

Students from Trinidad and Tobago represent 12 single-sex girls' schools, 13 single-sex boys' schools and 9 co-ed schools. Data for St. Lucia represent 1 single-sex girls' and 1 single-sex boys' school and 3 co-ed schools. Schools selected for St. Vincent and the Grenadines represent 2 single-sex girls and 2 single-sex boys' school and 4 co-ed schools. Overall sampled schools accounted for a total of 92,023 students over the 5-year period for all countries.

The Performance Criterion

The CSEC results are reported on a scale of 1 (distinction) to 6. Students whose performance falls outside of this scale are given the letter U for ungraded which usually indicates that the paper was cancelled or no School Based Assessment (SBA) was submitted. In the case of mathematics, there was no SBA during the period under study. For students who missed the exam "Abs" is assigned. For the purpose of this study, the data was disaggregated by the passing grades (1, 2, 3) and the failing grades (4 – 6

[1] Traditional high schools are the prestigious high schools, which are predominantly church owned and government grant-aided. Traditionally they were grammar schools and they represent only 30% of places in high schools in Jamaica. They are highly sought after and extremely competitive to enter. Most students selected for these schools usually have an average score of 85% on the Grade Six Achievement Test. For the top performing traditional high schools, the average entry score can be as high as 96%.

combined) and "Other" to indicate those who were absent or whose paper was cancelled. The number of students sitting mathematics for the five-year period was tallied by grade received. The pass rate reported is the total number of students achieving grade 1-3, and the failure rate is the number of students receiving grade 4-6. The percentage of students passing, failing or falling in the "Other" category is calculated based on the total cohort sitting over the 5 years.

RESULTS

Barbados

Table 3 shows the performance of girls and boys by school type and disaggregated by grade received.

Table 3

Grade Achieved by Students Sitting CSEC Mathematics in Barbados by School Type (2013 – 2017)

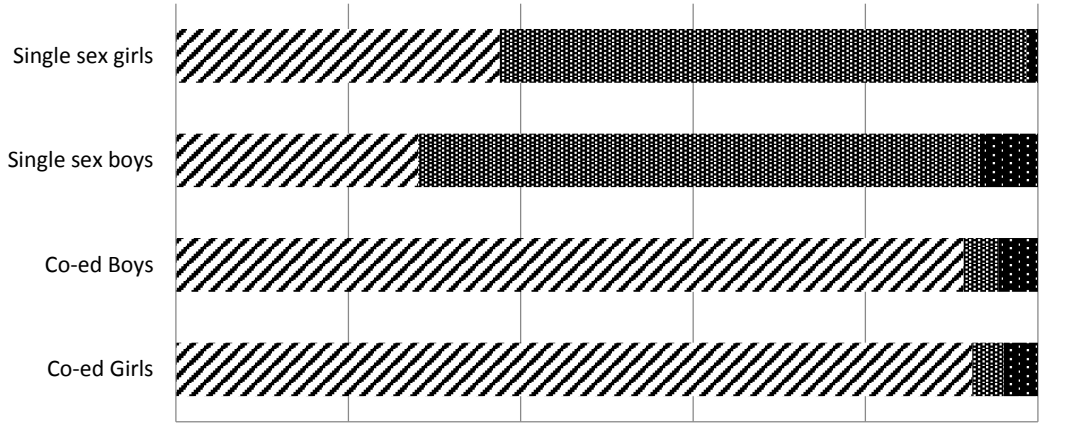
	Co-Ed Girls		Co-Ed Boys		Single-Sex Boys		Single-Sex Girls	
Grade	No.	%	No.	%	No.	%	No.	%
1	746	47.73	652	43.52	5	1.05	2	0.33
2	442	28.28	456	30.44	20	4.19	36	6.04
3	256	16.38	261	17.42	109	22.85	186	31.21
4-6	57	3.65	60	4.00	311	65.20	364	61.07
Other	62	3.97	69	4.61	32	6.70	8	1.34

Source: Caribbean Examinations Council CSEC Data from 2013-2017

Students in the prestigious co-ed schools (formerly single-sex schools) demonstrated superior performance with 92.39% of the girls and 91.38% of the boys gaining a pass over the 5-year period. Girls, with 47.73% gaining a grade 1 (distinction), performed marginally better than boys with 43.53%.

As seen in Figure 1, boys in the lone single-sex boys' school in Barbados demonstrated a 65.20% failure rate. Of the 28.09% who passed, 22.85% obtained the lowest passing grade 3, and only 1% obtained a distinction. Girls in the single-sex schools had a similar performance as 61.07% failed mathematics, 31.21% obtained the lowest passing grade and 0.33% got a distinction. Boys in the single-sex school were more likely to be absent or have their paper cancelled as 6.7% fell in the "Other" category.

Figure 1. CSEC Mathematics Pass Rate by School Type in Barbados



	Co-ed Girls	Co-ed Boys	Single sex boys	Single sex girls
Pass Rate	92.39%	91.38%	28.09%	37.58%
Failure Rate	3.65%	4.00%	65.20%	61.07%
Other	3.97%	4.61%	6.70%	1.34%

Jamaica

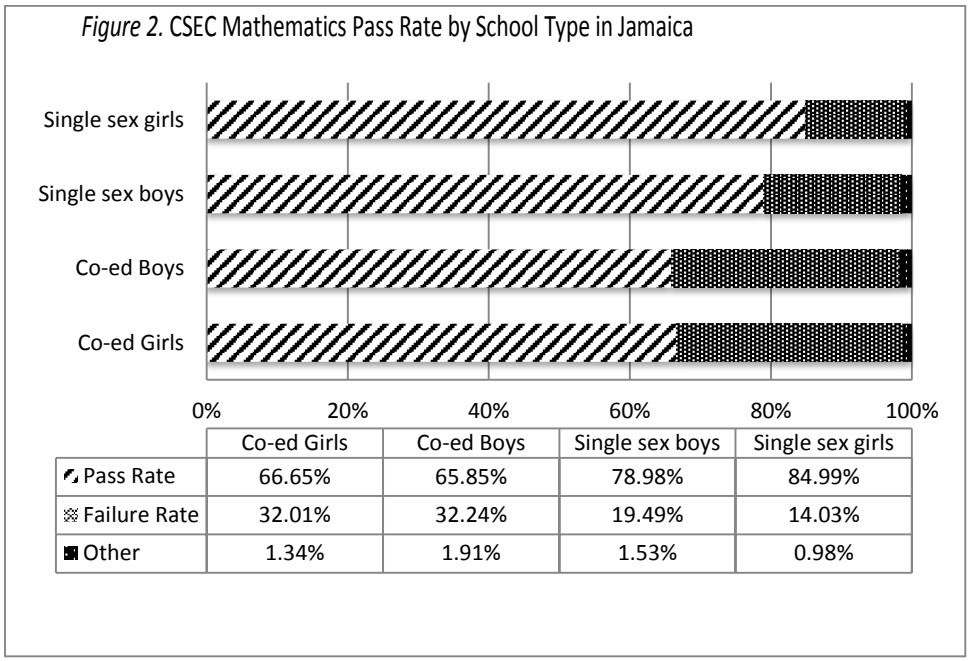
Co-ed girls in Jamaican traditional high schools had a mathematics pass rate of 66.45% with approximately 20% obtaining a distinction. By contrast, girls in single-sex schools had a pass rate of 84.99%, and 33.96% obtained a distinction. Boys in co-ed schools had a 65.85% pass rate with 21.20% obtaining a distinction, compared to 78.98% pass rate for their counterparts in single-sex schools. Approximately 24.38% of boys in single-sex schools obtained a distinction. As seen in Figure 2, girls in single-sex schools had the highest pass rate, followed by boys in single-sex schools, girls in co-ed and boys in co-ed schools. Less than 2% of students in all school types fell in the "Other" category.

Table 4

Grade Achieved by Students Sitting CSEC Mathematics in Jamaica by School Type (2013 – 2017)

	Co-Ed Girls		Co-Ed Boys		Single-Sex Boys		Single-Sex Girls	
Grade	No.	%	No.	%	No.	%	No.	%
1	3173	19.76	3003	21.20	1961	24.38	4979	33.96
2	3335	20.77	2787	19.68	2257	28.05	4040	27.56
3	4195	26.12	3537	24.97	2136	26.55	3441	23.47
4-6	5141	32.01	4566	32.24	1568	19.49	2057	14.03
Other	216	1.34	271	1.91	123	1.53	143	0.98

Source: Caribbean Examinations Council CSEC Data from 2013-2017



St. Lucia

As seen in Table 5,co-ed girls in St. Lucia had a pass rate of 73.47% with 10.87% obtaining a distinction. Girls in single-sex schools had a superior pass rate of 98.73%, with 63.15% obtaining a distinction. For boys in co-ed schools, the pass rate was 69.22% and 13.38% obtained a distinction. Boys in single-sex schools had a pass rate of 95.76% with 41.34% gaining a distinction. Figure 3 shows the rank order of the students based on school type. Girls in the single-sex school had the highest pass rate of 98.73% followed by boys in the single-sex school with 95.46%, then girls in co-ed

schools with 73.47% and boys in co-ed schools with 69.22%. With regards to the quality of passes, girls in the single-sex school topped the group with a high of 63.15% obtaining a distinction. Fewer than 2% of students in all school types fell in the "Other" category.

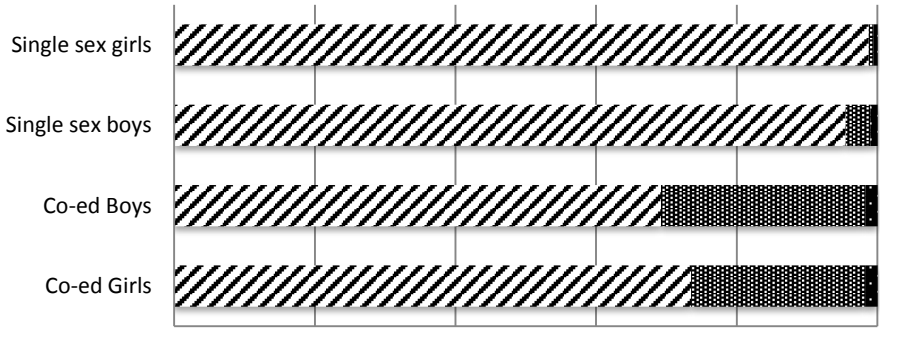
Table 5

Grade Achieved by Students Sitting CSEC Mathematics in St. Lucia by School Type (2013 – 2017)

	Co-Ed Girls		Co-Ed Boys		Single-Sex Boys		Single-Sex Girls	
Grade	No.	%	No.	%	No.	%	No.	%
1	183	10.87	91	13.38	246	41.34	449	63.15
2	482	28.65	182	26.00	214	35.97	191	26.86
3	571	33.95	260	29.84	108	18.15	62	8.72
Fail	418	24.85	267	29.09	21	3.52	5	0.70
Other	28	1.66	12	1.68	6	1.00	4	0.56

Source: Caribbean Examinations Council CSEC Data from 2013-2017

Figure 3. CSEC Mathematics Pass Rate by School Type in St. Lucia



	Co-ed Girls	Co-ed Boys	Single sex boys	Single sex girls
Pass Rate	73.47%	69.22%	95.46%	98.73%
Failure Rate	24.85%	29.09%	3.52%	0.70%
Other	1.66%	1.68%	1.00%	0.56%

St. Vincent and the Grenadines

Table 6 indicates that girls in co-ed schools in St. Vincent and the Grenadines had a very low pass rate of 13.95% compared to girls in single-sex schools with a pass rate of 88.37%. Over the 5 years, no girl in the co-ed schools obtained a distinction while 25.80% of the girls in single-sex schools achieved a distinction. Similarly, boys attending co-ed schools had a low pass rate of 19.01% with less than 1% obtaining a distinction. Boys attending single-sex schools had a pass rate of 76.98% with 19.16% gaining a distinction.

Figure 4 shows the rank order of the students based on school type. Girls in single-sex schools had the highest pass rate of 88.37% followed by boys in the single-sex school with 76.98%, then boys in co-ed schools with 19.01% and girls in co-ed schools with 13.95%. Girls in single-sex schools received the highest percentage of distinctions with 25.80% obtaining a Grade 1. All school types except for co-ed girls had fewer than 1% of their students falling in the "Other" category. For co-ed girls, this was 2.03%.

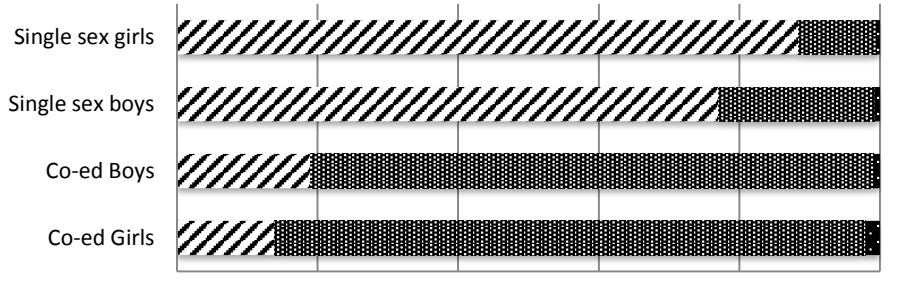
Table 6

Grade Achieved by Students Sitting CSEC Mathematics in St. Vincent and the Grenadines by School Type (2013 – 2017)

	Co-Ed Girls		Co-Ed Boys		Single-Sex Boys		Single-Sex Girls	
Grade	No.	%	No.	%	No.	%	No.	%
1	0	0.00	3	0.46	169	19.16	275	25.80
2	17	1.57	11	1.70	232	26.30	347	32.55
3	134	12.38	109	16.85	278	31.52	320	30.02
Fail	909	84.01	518	80.06	196	22.22	118	11.07
Other	22	2.03	6	0.93	7	0.79	6	0.56

Source: Caribbean Examinations Council CSEC Data from 2013-2017

Figure 4. CSEC Mathematics Pass Rate by School Type in St. Vincent and the Grenadines



	Co-ed Girls	Co-ed Boys	Single sex boys	Single sex girls
Pass Rate	13.95%	19.01%	76.98%	88.37%
Failure Rate	84.01%	80.06%	22.22%	11.07%
Other	2.03%	0.93%	0.79%	0.56%

Trinidad and Tobago

Girls attending co-ed schools in Trinidad and Tobago had a pass rate of 54.78% with 20.21% receiving a distinction. The pass rate for girls in single-sex schools was a high of 87.64% and 55.51% obtained a distinction. Boys attending co-ed schools had a pass rate of 59.98% and 26.15% gained a distinction, while boys attending single-sex schools had a pass rate of 82.15% with 46.12% gaining a distinction.

Figure 5 shows the rank order of the students based on school type. Girls in single-sex schools had the highest pass rate of 87.64% followed by boys in single-sex schools with 82.15%, then boys in co-ed schools with 59.98% and girls in co-ed schools with 54.78%. Girls in single-sex schools received the highest percentage of distinctions as 55.51% obtained a Grade 1. Girls and boys in co-ed schools are more likely to be absent from the exam or had their paper cancelled as 13.8% of the girls and 11.53% of the boys in these schools' grades were classified as "Other". In the single-sex schools the rate is a low of 3.2% and 1.75% for boys and girls respectively.

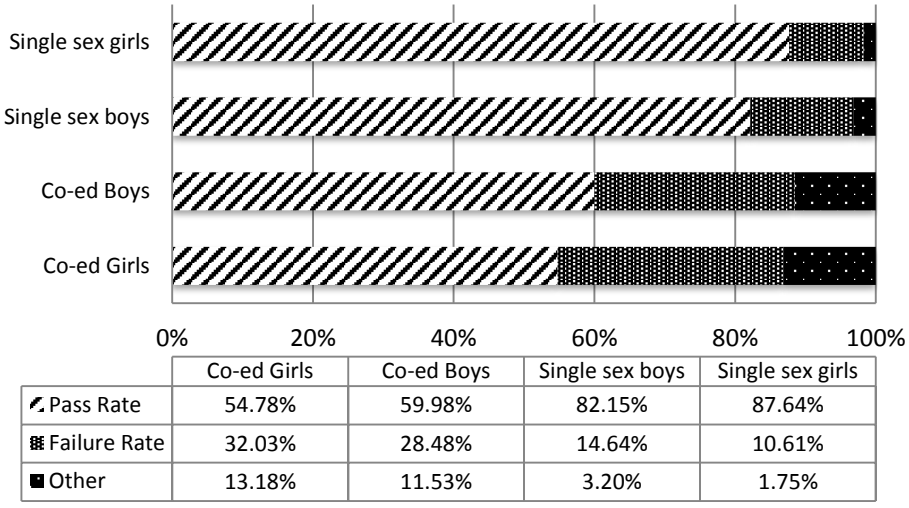
Table 7

Grade Achieved by Students Sitting CSEC Mathematics in Trinidad and Tobago by School Type (2013 – 2017)

	Co-Ed Girls		Co-Ed Boys		Single-Sex Boys		Single-Sex Girls	
Grade	No.	%	No.	%	No.	%	No.	%
1	701	20.21	708	26.15	4692	46.12	6181	55.51
2	547	15.77	453	16.73	1983	19.49	2167	19.46
3	652	18.80	463	17.10	1683	16.54	1411	12.67
4 – 6	1111	32.03	771	28.48	1489	14.64	1181	10.61
Other	457	13.18	312	11.53	326	3.20	195	1.75

Source: Caribbean Examinations Council CSEC Data from 2013-2017

Figure 5. CSEC Mathematics Pass Rate by School Type in Trinidad and Tobago



The Countries at a Glance

Pass Rate

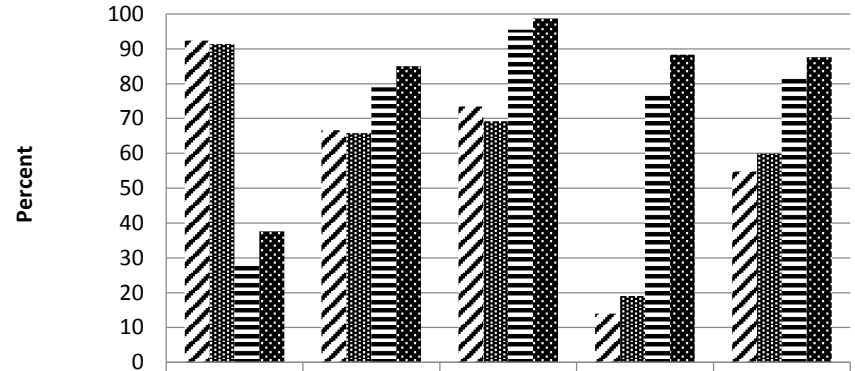
The mathematics pass rate for girls in single-sex schools as seen in Figure 6 is the highest of all school types in Jamaica, St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago. The reverse is evident for Barbados where girls and boys in the traditional grammar-type co-ed (formerly single-sex) schools, had the highest pass rate.

This indicates that despite the transformation from single-sex to co-educational schools, the schools have retained their traditional grammar school status and continue to produce top performing students. Overall, for the Caribbean, girls in the single-sex school in St. Lucia had the highest pass rate of 98.73% followed by boys with 95.46%. The findings of the current research for Trinidad & Tobago agree with Jackson (2016) and appear to lend support to the radical decision taken by this government to transform one-fifth of its low performing secondary schools from co-ed to single-sex institutions. Notwithstanding the aforementioned, undoubtedly, further research is needed to gain further insights into other structural and administration factors which may be relevant to the case of Trinidad and Tobago and which may explain the current findings.

The gap in pass rate between boys and girls in single-sex schools is marginal in all countries, ranging from a low of 5 percentage points in Trinidad and Tobago to 11 in St. Vincent and the Grenadines. For single-sex schools in each country, the gap favours the girls. The gap, although marginal between boys and girls in co-ed schools, favours girls in Barbados, Jamaica and St. Lucia. For St. Vincent and the Grenadines, boys tended to perform better in co-ed schools than girls, so the gap was in their favour.

The picture changes when a comparison is made across school types between boys attending single-sex and co-ed schools, and girls attending single-sex and co-ed schools. The gap tends to be wider than within school types. For example, the gap between girls in single-sex schools and girls in co-ed schools range from a low of 18.34 percentage points for Jamaican students to a high of 74.42 for students in St. Vincent and the Grenadines. For boys in co-ed and boys in single-sex schools the range is from 13.13 percentage points for Jamaican boys to 63.29 for boys in Barbados. In all countries, except Barbados**,** boys tended to perform better in single-sex schools than their counterparts in co-ed schools.

Figure 6. CSEC Mathematics Percentage Pass Rate by School Type for all Countries



	Barbados	Jamaica	St. Lucia	St. Vincent and the Grenadines	Trinidad and Tobago
Co-Ed Girls	92.39	66.65	73.47	13.95	54.78
Co-Ed Boys	91.38	65.85	69.22	19.01	59.98
Single-Sex Boys	28.09	78.98	95.46	76.98	82.15
Single-Sex Girls	37.58	84.99	98.73	88.37	87.64

Table 8

CSEC Mathematics Pass Rate and Percentage Point Gap between School Types for All Countries

	Co-Ed Girls	Single-Sex Girls	Gap	Co-Ed Boys	Single-Sex Boys	Gap
Barbados	92.39	37.58	54.81	91.38	28.09	63.28
Jamaica	66.65	84.99	18.34	65.85	78.98	13.13
St. Lucia	73.47	98.73	25.26	69.22	95.46	26.24
St. Vincent and the Grenadines	13.95	88.37	74.42	19.01	76.98	57.97
Trinidad and Tobago	54.78	87.64	32.86	59.98	82.15	22.17

Source: Caribbean Examinations Council CSEC Data from 2013-2017

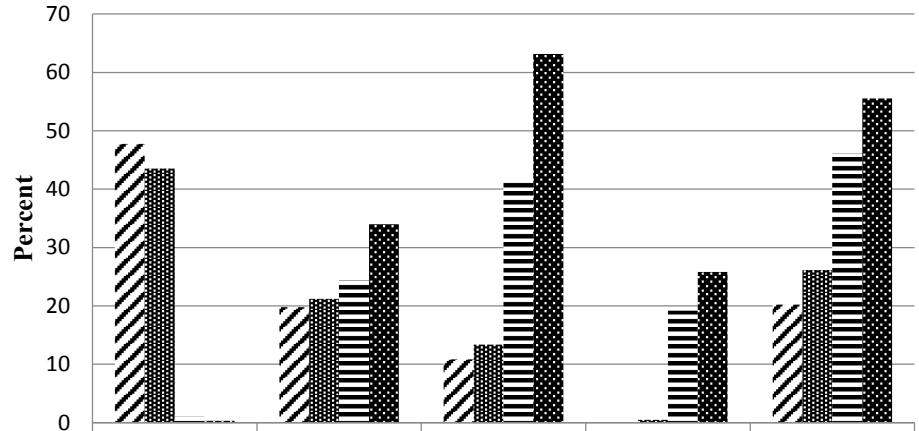
Quality of Passes

Girls in single-sex schools in Jamaica, St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago, and girls in co-ed schools in Barbados as seen in Figure 7 had the highest percentage of distinctions (Grade 1) in CSEC mathematics. St. Lucia led the way

with 63.15%, followed by Trinidad and Tobago with 55.51%, Barbados, 47.73, Jamaica, 33.96% and St. Vincent with 25.8%.

With the exception of Barbados (where the co-ed schools included in the investigation were formerly traditional single-sex grammar schools), females in single-sex schools overall performance on the CSEC mathematics was found to be superior to that of males in any school type. Additionally, they outperformed the boys in quality of pass as they tended to achieve a higher percentage of distinction. The girls in the Barbados co-ed schools also had the highest pass rate and percentage of distinctions.

Figure 7. CSEC Mathematics Percentage of Students with Distinction by School Type for all Countries



	Barbados	Jamaica	St. Lucia	St. Vincent and the Grenadines	Trinidad and Tobago
Co-Ed Girls	47.73	19.76	10.87	0	20.21
Co-Ed Boys	43.52	21.2	13.38	0.46	26.15
Single-Sex Boys	1.05	24.38	41.34	19.16	46.12
Single-Sex Girls	0.33	33.96	63.15	25.8	55.51

DISCUSSION

Girls attending single-sex schools in Jamaica, St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago, and those attending traditional grammar co-ed schools in Barbados had a higher percentage pass rate for mathematics. In addition, they demonstrated a higher quality of pass by outperforming boys in achieving a distinction. These findings are similar to that of other international studies (Ivinson & Jackson, 2013; Lee & Lockhead, 1990). With the exception of Barbados, boys achieved a higher

percentage pass rate in single-sex schools when compared to their peers in co-ed schools. Within the Barbadian context, where the former prestigious single-sex schools were converted to co-ed schools and where placement in these schools is based on performance on the Barbados Secondary School Entrance Examination (BSSEE) (Leacock, Thompson, Burnett, & Obidah, 2007), the boys in the co-ed schools achieved a higher pass rate than those in the single-sex school. It is apparent that the top performing boys are placed in these high performing prestigious co-ed schools, hence their superior performance at the CSEC level five years later over their counterparts in the single-sex school. This give some credence to the notion that type of school (co-ed versus single-sex) may not be the only factor influencing student performance in mathematics at the CSEC level. Further research into this phenomenon is implied here.

Proponents of single-sex schools have posited that single-sex school settings cater to the learning styles of girls, and moreover, girls are shielded from the dominance and stereotypes affiliated with co-ed classroom learning. (Cookson, 2009; Hayes et al., 2011; Sax, 2005). Could this be a factor in the region? To explore this and others, further studies need to be conducted to determine the variables impacting on girls' performance in CSEC mathematics which accounts for their dominance in this subject. In our setting, the superior performance must be interpreted with caution as the dominance of single-sex schools at the secondary level may be traced back to students' earlier performance at the primary level. Based on the meritocratic selection process used to place students at secondary schools, students entering single-sex all-girls' and all boys' schools in Jamaica, for example, have the highest GSAT average, followed by boys in single-sex schools (Harker, 2000; Jackson, 2010; Malacova, 2007). Past performance in primary school and placement mechanisms may impact the variation in CSEC mathematics pass rate and quality performance respectively. Based on the results, the apparent influence of school type may be attributed to the limitation of variable omission. That is, in the absence of other control variables such as: socio-economic background, motivation to learn, subject teacher qualification and prior performance, school type is appearing to be influential.

These findings are important because they add to the literature on achievement and gender within the Caribbean by not only focusing on mathematics performance in general, but on the quality of passes, which has not been the focus of research before. In this regard, it has added another dimension to the discussion on achievement and school type and has underscored the need for further research to unravel this important issue. This research is timely because the findings suggest that the achievement gap in favour of girls and single-sex schools identified over 20 years ago (Hamilton, 1985; Kutnick et al., 1997) is still generally in effect. As previously discussed this is problematic as they raise issues of equity, and social justice (Evans, 1997) within the

Caribbean education context which need to be urgently addressed. Additionally, it is undesirable because:

> school mathematics plays a significant role in organising the segregation of our society… keeping the powerless in their place and the strong in positions of power… an accusation that you 'can't do maths'… is a positioning strategy… It locates you as unsuccessful and lacking in intellectual capability; it locates you on the edge of the employment and labour market… Mathematics education thus serves as a "badge of eligibility for the privileges of society. (Gates & Vistro-Yu, 2003, p. 49)

IMPLICATIONS AND CONCLUSIONS

The aim of this paper was to investigate the performance of students in CSEC mathematics according to school type. Within the five countries studied, there is a difference in the performance of students according to school type. The performance of girls attending single-sex schools in the CSEC mathematics differs from boys attending single-sex schools, girls in co-ed schools and boys attending co-ed schools. The pass rate and quality of passes of girls attending single-sex schools was the highest.

Given the overwhelming evidence that girls are outperforming boys in all school types, the question then becomes: what measures must be put in place to ensure that students perform at a higher level to meet national targets in any school type in which they are placed? Also, what factors are causing boys and girls in co-ed schools to record the lowest pass rate in mathematics?

In response, it is of utmost importance that student performance at the primary level be improved if national targets for end of secondary are to be met, and for the gaps between boys and girls in the different school types to be narrowed and closed. In the case of the low performance by boys and girls in co-ed schools, it is recommended that a comparative case study be undertaken with boys and girls in co-ed schools to identify factors contributing to their underperformance. The findings from Barbados, where the students from the former traditional single-sex grammar schools, now co-ed, demonstrating superior performance, suggest that the quality of students and not the school type may be responsible for the high rate of success. Unlike the single-sex schools in the rest of the region, the two in Barbados tend to take in the lower performing students from primary schools. It is therefore, recommended that variables such as prior performance, teacher qualification, teaching styles, classroom context and motivation should be investigated.

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