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RESEARCH ARTICLE

THE EFFECT OF GENDER AND SOCIAL ECONOMIC STATUS ON STUDENT MATHEMATICS ACHIEVEMENT IN THE PRIMARY LEAVING EXAMINATIONS IN UGANDA

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ABSTRACT

The study examined the effect of Gender and Social Economic Performance on Student Mathematics Performance. Data were from the Uganda National Examinations Board (UNEB) from the Primary Leaving Examinations (PLE) in the current academic year ($n = 898$). A Two-Factor ANCOVA was conducted to assess the effect of Sex (and SES) on student mathematics achievement controlling for mathematics pretest. The results indicate that there are significant differences between boys and girls on mathematics achievement controlling for prior mathematics ability. The adjusted means indicate that boys have higher mathematics achievement on average ($M = 4.10$, $SE = .09$) compared to girls ($M = 4.61$, $SE = .12$). Secondly, the pupils from higher SES ($M = 3.38$, $SE = .14$) have a higher math achievement as compared to their counterparts from low SES ($M = 5.33$, $SE = .07$). Note that the lower mean indicates better performance, and a higher mean indicates poorer performance on the PLE exams. (i.e., 1 is the highest score and 9 is the lowest score). These results seem to suggest the need to focus sex and poverty related interventions on students' mathematics achievements.

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INTRODUCTION

Learning performance (i.e., academic performance) remains a critical concern in most developing countries that have implemented the Universal Primary Education (UPE) policy, which is a plan to provide free primary education to children. Increasing learning performance, often discussed in terms of quality education, is one national strategy for economic development in Uganda. It is not only a national strategy for Uganda, but also recommended for other countries by the United Nations. That is, the 6th goal of the Dakar World Education Forum (2000) highlights the need for all countries to make efforts to "…improve all aspects of the quality of education and ensure excellence in order that recognized and measurable learning outcomes may be achieved by all, especially in literacy, numeracy and life skills" (United Nations Educational, Scientific, and Cultural Organization [UNESCO], 2000, p .17). The study examined the effect of Gender and Social Economic Performance on Student Mathematics Performance.

Pupil Socioeconomic Status (SES) and Achievement: Pupils' SES is one critical student factor that may impact student achievement in Uganda. Byamugisha (2010) examined the instances where parents pay additional tuition so teachers may give extra lessons to the pupils. The study found that these pupils performed better than those whose parents have low SES and cannot afford the extra fee. The MoES, however, considers this practice illegal and has put a ban on such tutorials. Byamugisha (2010) further adds that some teachers have taken on private tutoring as an opportunity to make money, causing a major concern Moreover, the excuse that the teachers normally give is lack of time to complete the set syllabus. Beyond Uganda, other studies have addressed student achievement as related to SES. For example, the SACMEQ found that student SES is the strongest predictor of pupil performance in reading and the second strongest in mathematics. Internationally, SES emerges in many studies (Anderson, 1991; Lee, Zuze, and Ross, 2005; Postlethwaite and Ross, 1992) presenting the relationship between pupil backgrounds and their performance. There are many factors that are proxies for SES that have been examined in relation to pupil achievement. For example, lack of transportation and distance to school (i.e., as an indicator of lower SES) impacts student achievement (Chowdhury, 1995). Another example is pupils having lunch at school. Byamugisa (2010) found that students who had lunch had better scores in mathematics, compared to students whose parents were unable to pay lunch (i.e., an indicator of SES). Other studies outside Uganda have found similar results concerning the relationship between students' meals and reading and mathematics performance (Etsey, 2005; Postlethwaite and Ross, 1992). Some studies have examined SES and student achievement in terms of the available books for students at home. Greaney and Kellaghan

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(2008) argue that the number of books in the home correlates positively and significantly with pupil performance in mathematics. Postlethwaite and Ross (1992) hold the same view, but add that if students can borrow books from the school library, then lack of books would not be related to SES. Nanyonjo (2007), as well, found a correlation between the number of books at home and students' performance.

Pupil Gender and Achievement: Discussion of how student gender may impact educational outcomes has been a crucial topic in Ugandan education services, as differences in power and status between men and women continue to be a passionate societal issue. Notably, Ugandan pupils live in a society where gender structures are strictly defined, and gender beliefs persist when they enter the school. This section identifies research where the gender gap may impact the performance in mathematics. Gender concerns are not unique to Uganda. Mathematics and science disciplines are traditionally dominated by men. Even in the most progressive societies, some maintain that girls are mathematically inferior to boys, with more pronounced differences expected during adolescence (Zuze and Leibbrandt (2011). Girls who choose careers in these fields may face challenges, even open hostility. Recent studies have suggested that expectations for students play a crucial role in how girls and boys perform. For example, Dweck (1986) noted that girls may fail to attain full academic potential if they are made to believe that it is beyond their gender or social ability. When Uganda embraced UPE, the challenge was not only for school children, but for quality and equality at the primary level. Gender equality took center stage among other issues. Byamugisha (2011) enumerates them as follows: (1) gender equality of access, (2) retention, and (3) performance in science and mathematics. Muhwezi (2003) notes that a number of projects dealing with the above aspects were established by the Ministry of Gender, Labor, and Social Development, to formulate policies as well as monitor progress.

There was some progress in Uganda towards greater gender equality in enrollment, especially between 2000 and 2007 (Byamugisha, 2011). However, the SACMEQ noted that the enrollment trend excluded quality in learning achievement. It can be seen that studies indicate that some school resources are critical for keeping girls in school and motivating them to perform well. For example, these resources include safety measures such as fences, and sanitation like separate bathrooms for boys and girls (Byamugisha, 2011). Additionally, Kasente, Nakanyike and Balihuta (2003) argue that social roles of girls affect their achievement. It was noted that they are often apprentices of their mothers. Furthermore, Kasente and colleagues (2003) indicated that management of sex-related health issues in primary education does not meet the needs of female children. The authors report that schools have not been able to furnish the students with information about maturation, not to mention the provision of these essential facilities. Moreover, UNESCO (2012) noted that girls continue to participate in school activities during this time of their maturing bodies. Also, there is a lack of proper counseling services through which all students can be guided into safe livelihood. Consequently, these factors contribute to low achievement among children, particularly girls (UNESCO, 2012). Graven (2012) contends as well that the link between gender and student support in the home has a correlation with gender-based tasks that hampers school preparation. For instance, if girls have more domestic chores at the beginning and the end of each day, they will have less time to complete homework. For instance, these might include walking long distances to collect water or firewood, cooking, cleaning, and taking care of the younger siblings and elderly family members. Consequently, they may even be forced to miss days of school in order to focus on domestic tasks. Specifically, studies show that the low mathematics achievement is to a great extent due to social expectations. Parents assume that boys are superior to girls in mathematics, and consequently girls lose confidence. The social psychology literature on motivation has formalized the different gender-related attitudes toward mathematics that are transferred from parent and teacher to a student. According to Dweck (1986), ability in mathematics is thought to be inborn and unchangeable, and girls are made to think that they lack this innate aptitude. Boys, on the other hand, believe that skills in mathematics can be learned and improved as a result of working hard. Treatment by teachers reinforces these perceptions. Following this reasoning, student self-perceptions suggest that when boys underperform it is because they are lazy or bored with their work, but when girls do the same it is because of limited ability. Therefore, boys are encouraged to work harder whereas girls are advised to give up and face reality.

MATERIALS AND METHODS

This study was carried out in Wakiso, located in central Uganda. The Wakiso district was selected because of its distinguishing features. These included geographic and rural/urban divergence as well as its educational achievement disparities. For example, even though the district boasts some of the best performing schools in the country, it has also some of the most under-performing schools. Moreover, despite its diverse urban setting and closeness to the capital city, Wakiso also has a large rural farming area. Like elsewhere in the country side, the main economic activity in the Wakiso villages is subsistence agriculture. These villagers still use rudimentary tools such as hand-held hoes, forks, and so on for agriculture. Many of the villages do not have electricity, tarmac, or permanent roads Data were from the Uganda National Examinations Board (UNEB) from the PLEs in the current academic year ($n = 898$). This was approved by School District. The PLE is a nationally standardized assessment that measures students' capabilities in mathematics, English, social studies, and science. According to Acana (2006), the PLE is a tool for placement into the next level of education (i.e., secondary level) as well as providing information on students' achievement at the end of the seven-year program (i.e., the primary level). Acana adds that UNEB exams focus on young students' abilities to use their knowledge and higher-order thinking skills.

Data Analysis

This research question (i.e., "What is the relationship between a pupil's sex and achievement on the PLE (i.e., 7th grade) in Uganda?") was analyzed using a Two-Factor Analysis of Covariance (ANCOVA). This was conducted to determine the relationship between a pupil's sex and achievement on the Primary Leaving Examinations (PLE) in Uganda, while controlling for pupils' prior mathematics achievement/ knowledge. That is, there were two IVs (i.e., the two factors) – sex and Social Economic Status (SES). There was one covariate – prior achievement/ knowledge (i.e., PLE pretest

scores in mathematics). Finally, there was one DV – mathematics scores on the PLE. Outliers were screened and assumptions were examined in the ANCOVA model including: (1) Independence, (2) Homogeneity of Variance, (3) Normality, (4) Linearity, (5) Independence of the Covariate and the IVs, and (6) Homogeneity of Regression Slopes. Outliers and assumptions were examined before generating the ANCOVA results (Lomax & Hahs-V*aughn*, 2012). The main null hypothesis included that there is no statistically significant difference in mathematics achievement on the PLE (i.e., after controlling for prior achievement/knowledge) between males and females. The alternative hypothesis included that there is a statistically significant difference in mathematics achievement on the PLE (i.e., after controlling for prior achievement/ knowledge) between males and females, with males having higher scores.

ANCOVA Assumptions: The assumption of Independence was tested via a scatterplot of residuals. A random display of points of the residuals against values of independent variables (i.e., sex and SES) provided evidence that the assumption of independent errors was met. Normality was tested on the covariate (i.e., pretest mathematics test scores), the dependent variable (i.e., posttest mathematics test scores), and separately in each group of the independent variables (male and female and day and boarding). For all the above, the assumption was tested via examinations of Shapiro-Wilk (S-W), skewness and kurtosis, histograms, and Q-Q plots. *Z* scores for skewness (*S*) and kurtosis (*K*) were calculated by taking the statistic divided by the standard error and comparing the value to $\pm$ 1.96. Overall pretest mathematics (*S* = -7.84, *K* = -6.25) and posttest mathematics (*S* = 1.94, *K* = -6.54), as well as boys pretest (*S* = -2.80, *K* = -5.29) and girls pretest (*S* = -8.69, *K* = -2.12) indicated significant skewness and kurtosis in most instances. The same was found for boys posttest (*S* = 4.09. *K* = 3.88), but not girls posttest mathematics (*S* = -.58, *K* = 4.06). For boarding schools and day schools, the boarding pretest (*S* = 2.88, *K* = -2.90) and day school pretest (*S* = -11.27, *K* = -.83), and boarding posttest (*S* = 8.23. *K* = 5.74) and day schools' posttest (*S* = -.31, *K* = -5.14) were significantly skewed and kurtotic in most groups. The S-W test for normality yielded significant results across all variables ($p < .05$), which indicates that normality has been violated. However, histograms and Q-Q plots suggested relatively normal distributional shapes across the variables and groups. In most cases, the pretest was negatively skewed with many higher scores (i.e., in this case, higher is poorer performance), compared to the posttest. This scenario is expected as pupils tend to improve their scores from pretest to posttest. Overall, except for the S-W test, which tends to be conservative, there is evidence of normality. Assumption of the independent variable are approximately equal in size (Harwell, 2003), as was the case with sex. Linearity of the dependent variable with the covariate was examined with scatterplots, both overall and by group. Overall, the scatterplots suggested a positive linear relationship. Homogeneity of Regression Slopes was examined by similar regression lines evidenced in the scatterplots of the dependent variable and covariate by the independent variable (reported earlier as evidence for linearity). This assumption was confirmed by a nonstatistically significant interaction (F (1, 898) = .410, p = .522). The Homogeneity of Variance assumption was not satisfied ($p < .05$), which may be a product of the disparate group sizes for SES. Additionally, research suggests that violation of this assumption is minimal when the groups.

RESULTS

A Two-Factor ANCOVA was conducted to assess the effect of Sex (and SES) on student mathematics achievement controlling for mathematics pretest. The IVs were Sex and SES. The DV was scores on the PLE mathematics exam (i.e., the posttest) that is administered following completion of 7th grade. Scores on a mock mathematics test administered at the beginning of the 7th grade were used as the covariate (i.e., the pretest). The results indicate that there are significant differences between boys and girls on mathematics achievement controlling for prior mathematics ability. Specifically, the adjusted means indicate that boys have higher mathematics achievement on average (M = 4.10, SE = .09) compared to girls (M = 4.61, SE = .12). Note that the lower mean indicates better performance, and a higher mean indicates poorer performance on the PLE exams. (i.e., 1 is the highest score and 9 is the lowest score).

Table 1. Analysis of Covariance Summary

Source	Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Pretest	4906.91	1	4906.91	478.64**	.001	.18
Sex	527.20	1	527.20	36.96**	.001	.08
SES	472.505	1	472.505	166.35	.001	.14
Error	144.53	898	4.98			

**p < 0.01

The results of the ANCOVA suggest a statistically significant main effect of the covariate on the DV (F = 478.64, df = 1, 898, p< .001). There were a statistically significant main effects of Sex (F = 36.96, df = 1, 898, p< .001) and SES (F = 166.35, df= 1, 898, p< .001) on the posttest adjusting for the pretest. There was also a nonsignificant interaction effect between Sex and SES (p = .124). The effect sizes for Sex and SES were small (partial η^2 = .08) and large (partial η^2 = .14), respectively. Observed power was strong for both main effects. The results were analyzed for SES, the findings demonstrate that there are significant differences between day and boarding schools on mathematics achievement controlling for prior mathematics ability. Specifically, the results show that the mathematics achievement adjusted mean for boarding schools (i.e., indicating a higher SES; M = 3.38, SE = .14) is higher compared to the day schools (i.e., indicating a lower SES; M = 5.33, SE = .07). That is, the pupils with a higher SES have a higher level of math achievement than their counterparts who have a lower SES controlling for prior mathematics ability.

DISCUSSION OF RESULTS

For mathematics performance, regarding sex differences, the current study found that there are statistically significant differences in mathematics achievement on the PLE (i.e., after controlling for prior achievement/knowledge) between males and females, with males having higher scores. These results concur with the findings of prior studies that show that males outperform females in mathematics (UNESCO, 2012). The results also conform to one Ugandan study that showed that in mathematics, boys perform better than girls (Kasente, Nakanyike and Balihuta, 2003). Additionally, girls' intelligence is underrated in the society. According to Dweck (1986), ability in mathematics is thought to be hereditary and external factors cannot change it. Girls, as a result, are demoralized and do not see themselves capable to perform at

the same level as boys. This suggests that when girls do not perform as expected, it is because of limited ability. Consequently, the society indirectly encourages boys to work harder, and not girls. This, coupled with the belief that girls are "inferior" to boys in Uganda may have a far reaching effect on girls' learning outcomes. Negative social attitudes, as well as cultural practices may, therefore, explain why boys outperform girls. Another potential explanation for the differences includes research by Graven (2012). The author contends that achievement differences due to sex in developing countries like Uganda are more pronounced because of a "third variable." That is, there is a correlation with gender-based tasks that hamper school preparation. For instance, if girls have more domestic chores at the beginning and the end of each day, they will have less time to complete homework. For instance, these might include walking long distances to collect water or firewood, cooking, cleaning, and taking care of the younger siblings and elderly family members. Consequently, they may even be forced to miss days of school in order to focus on domestic tasks. This may contribute to the differential mathematics performance between boys and girls. Additionally, it may be an explanation to the statistically significant results in this current study.

Conclusion

These results seem to suggest the need to focus sex-related interventions on mathematics achievement for girls, instead of focusing on "access" and "participation." There is a need to have in place a community adult education, as well as media to promote parents interest in the education in the education of their children. Additionally, The Ministry of Education should make themes of gender equality part of the core curriculum. Secondly, there were differences in student SES (i.e., boarding and day schools) on mathematics and achievement, with boarding (i.e., higher student SES) school students performing better than their day school student counterparts. Based on these significant findings, there is need for equal distribution of school in-puts across all schools.

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