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How Do Student and School Characteristics Influence Youth Academic Performance in Ghana?

A Hierarchical Linear Modeling of Baseline Data from the YouthSave Ghana Experiment

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How Do Student and School Characteristics Influence Youth Academic Performance in Ghana? A Hierarchical Linear Modeling of Baseline Data from the YouthSave Ghana Experiment

Student and school characteristics are associated with academic performance of high school students. However, few attempts have been made to examine the simultaneous influence of student and school factors on academic performance of youth in sub-Saharan Africa. Using hierarchical linear modeling, we examine student- and school- level predictors of academic performance of Ghanaian junior high school students. As other researchers have found, we note that age and gender are significant predictors of academic performance. Student traits, including academic self-efficacy and commitment to school, are positively associated with math and English scores. Class size and presence of a toilet facility are significant predictors of English scores. No school-level characteristic is significantly associated with math performance. Through this study, we suggest that student characteristics have more impact on youth's academic performance than school characteristics.

Keywords: *educational economics, human capital, academic performance, Ghana, student traits, school characteristics*

Introduction

Decades of research on the effects of student, family, household, and school characteristics on student academic achievement have attempted to find a global explanation for school success or failure. Worldwide studies conclude that student characteristics (e.g., gender, social background, and future outlook) play varying roles in achievement gaps and enrollment disparities (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996; Filmer, 2005; Lee, Zuze, & Ross, 2005). Family responsibilities, parental involvement, and available resources are some household factors that influence student achievement and aspirations (Jeynes, 2003; Sackey, 2007; Salami, 2008). However, conclusions are inconsistent across countries (Bowers & Urick, 2011; Mensch & Lloyd, 1998; Wößmann & West, 2006), and there is a long-standing debate of whether student and family or school characteristics have larger effects on academic performance. Since the release of the Coleman Report (Coleman et al., 1966), researchers have investigated whether academic achievement is more strongly predicted by student or school factors (Baker, Goesling, & LeTendre, 2002; Card & Krueger, 1996; Heyneman & Loxley, 1983; Nonoyama-Tarumi & Willms, 2010; Willms, 2006).

Despite widespread attention, few attempts have been made to systematically investigate various student and school characteristics that may affect academic performance among youth in sub-Saharan Africa (SSA). Most of what we know comes from studies conducted more than 20 years ago (Heyneman, 1976; Heyneman & Loxley, 1983; Lockheed, Fuller, & Nyirongo, 1989). Prior studies also focus mainly on examining the role of family background characteristics—particularly economic status—on educational outcomes (Cockburn & Dostie, 2007; Filmer & Pritchett, 1999; Glick &

Sahn, 2000; Grimm, 2011). Few studies in SSA examine the effects of student traits (e.g., academic self-efficacy and level of commitment to school) and social background on academic performance. In this study, we seek to provide evidence on the relationship of student and school characteristics with academic performance of Ghanaian junior high school (JHS) students. We go beyond an examination of household economic status as a potential predictor of youth's academic performance and examine the role of student traits and school characteristics.

Our study begins with a brief review of empirical evidence on the relationship of student and school factors with educational outcomes, including academic performance. We review a subset of studies from SSA and other countries, highlighting parallels and differences in student, household, and school factors that influence educational outcomes. We include studies conducted with youth ages 7 to 30. We then present data from YouthSave (a large, countrywide experiment in Ghana), methods used to examine our empirical questions, and a discussion of our findings.

Definition and measurement of *academic achievement*

Included in this research overview is the use of different definitions and measurements of academic achievement and schooling. Achievement is defined as outcomes that include individual student marks in a given year, school achievement examinations or standardized test scores in core subjects, grades or GPA, and teacher rating scales (Asante, 2010; Jegede, Jegede, & Ugodulunwa, 1997; Jeynes, 2003; Kiamanesh, 2005; Salami, 2008). We assess achievement using a composite score of these factors. Schooling often is measured by attendance, attainment of goals, enrollment, or completion (Fentiman, Hall, & Bundy, 1999; Glick & Sahn, 2000; Sackey, 2007; Salami, 2008).

The effect of student characteristics on schooling and academic achievement

Gender

Worldwide gender disparities exist in schooling, academic achievement, and school experiences. For example, in some countries in Central, Northern, and Western Africa and South Asia, enrollment is significantly lower for girls than boys (Filmer, 2005). Several factors, including household or domestic responsibilities (e.g., taking care of younger siblings), negatively affect school enrollment for girls more often than boys (Glick & Sahn, 2000). The high cost of schooling remains a barrier that compels lower income parents to send only boys to school (Elder, Houston, & Skryzpek, 2010). Further, parental education—particularly a mother's schooling—has been shown to have a more significant effect on girls' enrollment than boys (Behrman & Wolfe, 1984; Glick & Sahn, 2000; Tansel, 1997, 2002).

In some places in Ghana, there are gender disparities in retention with boys staying in school longer than girls (Fentiman et al., 1999; Filmer, 2005). This is consistent with other studies in Kenya, Ghana, and Botswana that show that girls are more likely to drop out of school than boys (Dunne & Leach, 2005; Mensch & Lloyd, 1998). Girls also achieve at a lower level as evidenced by performance gaps in mathematics and literacy in Ghana, Botswana, Zimbabwe, and Kenya (Asante, 2010; Dunne & Leach, 2005; Shabaya & Konadu-Agyemang, 2004).

All of these gender-related disparities may be explained in part by the gendered structure of the schooling experience, which reinforces roles for girls and boys in the delegation of student duties, treatment of authority figures, and behavior of students and staff (Dunne, 2007; Dunne & Leach, 2005; Mensch & Lloyd, 1998). In Botswana, Ghana, and Kenya, studies have shown that boys are often situated in the back and on the sides of classrooms (i.e., surrounding the girls) and tend to dominate classroom conversations, be favored by teachers, have higher levels of bullying and harassment toward girls, and are given high-status duties as prefects (Dunne & Leach, 2005; Mensch & Lloyd, 1998). In contrast, girls often are assigned domestic or menial duties, and even as prefects, they sit in the front of the classroom. Girls also are subjects of violence and harassment (Dunne, 2007; Dunne & Leach, 2005; Mensch & Lloyd, 1998). In Botswana and Ghana, even female authority figures experience resistance in the classroom from students, and stereotypical institutional practices (e.g., preference for male head teachers) are seldom challenged (Dunne & Leach, 2005).

Student traits and social background

A student's individual traits or social background can influence schooling and academic achievement. Research in SSA countries has shown that achievement is strongly related to students' social background in various ways (Lee et al., 2005). In Ghana, one indicator of dropout rates is a child's age at first enrollment in school (Fentiman et al., 1999). Older children are more likely to drop out because they are expected to help more at home by working and earning income as they age (Fentiman et al., 1999; Glewwe & Jacoby, 1995).

Throughout the world, how students think about schooling is a predictor of student achievement. Students' self-concept, self-efficacy, attitudes, and motivation are positively related to academic achievement (Ajayi, 2012; Bandura et al., 1996; Chevalier, Gibbons, Thorpe, Snell, & Hoskins, 2009; Jegede et al., 1997; Kiamanesh, 2005). In Iran, self-concept—or students' self-efficacy and attitudes toward mathematics—is highly correlated with math achievement (Kiamanesh, 2005). Similarly, in Nigeria, self-concept and academic motivation are significant predictors of students' attitudes toward math, personality traits (e.g., agreeableness and extraversion) predict student educational aspirations, and academic achievement itself predicts educational aspirations of students (Ajayi, 2012; Jegede et al., 1997).

In addition to these internal motivators, externalized behaviors influence academic achievement. Students who believed in their academic self-efficacy and who had high educational aspirations report that they did very well academically, were more willing to help others, experienced few behavioral or emotional problems, and were accepted by their peers (Bandura et al., 1996). Further, students who believed or were taught that they could attend college with financial aid assistance had higher grades and worked harder in school than students who believed or were taught that college is too expensive (Destin & Oyserman, 2009).

Students also vary in their engagement with or participation in school. Girls tend to be more engaged than boys, and younger students tend to be more attached and engaged than older students (Johnson, Crosnoe, & Elder, 2001). School attachment and commitment are positively linked with academic achievement (Stewart, 2007).

The effect of household factors on schooling and academic achievement

Wealth disparities in education exist globally. Across countries, income and wealth inequalities predict disparities in enrollment, attainment, and achievement (Chowa, Masa, Wretman, & Ansong, 2013; Filmer, 2005; Filmer & Pritchett, 1999; Lee et al., 2005; Lincove, 2009; Tansel, 1997). Decreased income affects school enrollment negatively in SSA (Grimm, 2011). For example, in Ghana and Côte d'Ivoire, having limited household income and resources reduces schooling investments and access to the most beneficial types of education, including postcompulsory education (Rolleston, 2011; Tansel, 1997). In other words, children from low-income and low-asset households are less likely to continue schooling beyond the mandated number of years, which limits their employment opportunities and perpetuates economic disadvantage.

The effect of school characteristics on schooling and academic achievement

Classroom characteristics

Teacher job satisfaction and quality (e.g., teacher's educational level, experience, and ability) are related to student achievement and educational outcomes in multiple countries (Greenwald, Hedges, & Laine, 1996; Lee et al., 2005; Michaelowa & Wittmann, 2007; Santibañez, 2006). When many students are enrolled in a school or when the school day is offered in shifts—in which teachers are responsible for teaching a day's worth of lessons to back-to-back groups of students to serve more children in one facility—student achievement and teacher satisfaction are reduced (Lee et al., 2005; Michaelowa & Wittmann, 2007).

The relationship between class size and academic achievement differs among countries. Generally, when class sizes are large and staff numbers are low, student achievement and teacher satisfaction tend to be lower. Conversely, smaller class sizes result in teacher satisfaction and are more beneficial in the early grades (Greenwald et al., 1996; Lee et al., 2005; Michaelowa & Wittmann, 2007; Nye & Hedges, 2000; Wößmann & West, 2006).

School characteristics

The location, structure, resources, and social atmosphere of a school often are related to students' academic success. In SSA, students who live far from school may not be able to afford costs related to travel, which reduces school enrollment rates and attainment (Fentiman, Hall, & Bundy, 1999; Shabaya & Konadu-Agyemang, 2004). Lower enrollment and attainment are associated with decreased student achievement and literacy and poor teacher satisfaction (Lee et al., 2005; Michaelowa & Wittmann, 2007; Tansel, 1997). In many countries, smaller schools with access to water and electricity, are associated with better student performance and academic achievement (Bacolod & Tobias, 2006; Greenwald, Hedges, & Laine, 1996; Lee et al., 2005). Increased per pupil expenditures and physical resources (e.g., office space, playgrounds, classroom furniture, and libraries) are associated with higher levels of achievement (Carnoy, Gove, Loeb, Marshall, Socias, 2008; Greenwald et al., 1996; Holmlund, McNally, & Viarengo, 2010; Lee et al., 2005). However, some studies have shown that the quality of school facilities does not significantly predict achievement (Bowers & Urick, 2011). School cohesion—an atmosphere of mutual trust and positive interactions between staff and students—is a predictor of better student grades (Stewart, 2007).

Interplay of student, household, and school factors

Student, home, and school factors can affect achievement. Wealth and gender interact to intensify achievement gaps between boys and girls, and increased income is associated with decreased dropout rates among girls in Guinea (Filmer, 2005). Age, wealth, and rural location affect school enrollment and attainment in Ghana (Fentiman et al., 1999). The effects of school and teacher resources on student learning depend on the student's SES and whether he or she has repeated a school grade (Lee et al., 2005). These interacting factors create a complex context for schooling and academic achievement.

Methods

Data and sample

YouthSave is a five-year research project that investigates the potential of savings accounts as a tool for youth development and financial inclusion in developing countries. Although YouthSave is implemented in four countries, the data in this study are taken from the Ghana Experiment, a cluster randomized study of 6,252 youth in 100 schools randomly selected from eight of Ghana's 10 regions. Fifty schools were assigned to the treatment condition, and another 50 schools were assigned to the control condition. Sixty students were selected randomly from each school with oversampling to take attrition into account.

YouthSave has two waves of data. Baseline data were collected in May and June 2011, and follow-up collection is scheduled for 2014. Data include youth's educational, health, psychosocial, and financial outcomes and youth and parent demographics and socioeconomic characteristics. Youth academic records and school characteristics also are collected from head teachers.

Missing data reduced the study sample to 4,993 youth and 89 schools. Bivariate comparisons using t and χ^2 tests show youth in the current study and youth excluded because of missing variables differ significantly ($p < .05$) on only one predictor variable: planned effort. However, math and English scores differ significantly ($p < .05$) because of missing variables. On average, the sample has higher math and English scores than the excluded youth.

Measures

Outcome variables

Outcome variables are math and English scores obtained by summing students' examination and continuous assessment scores collected from school records. Continuous assessment is the total score from all quizzes and assignments during the academic term, and the examination is taken at the end of the term. Because different schools use different proportions of the continuous assessment and examination scores to calculate final scores, we normalized them across all schools so that continuous assessment and examinations each account for 50% of the total score for each course. Both measures are continuous, and high values indicate high achievement in the subject.

Level 1 (within-school) variables

Student-level explanatory variables include demographics (i.e., gender and age), household economic status (i.e., asset ownership), student effort (i.e., academic self-efficacy, commitment to school, and planned effort), and future orientation. Age is an interval-level variable measured in years. Gender is a dichotomous variable coded 1 for male and 0 for female.

Asset ownership is a continuous variable measured by an asset index based on an approach recommended by Filmer and Scott (2012) and Filmer and Pritchett (2001). Youth were asked if their families owned each of 19 asset items and to identify the number of assets owned. Asset ownership provides a more stable and longer term measure of household economic status than income or consumption measures (Moser, 2007; Sherraden, 1991), and recall or measurement issues are less likely (Moser & Felton, 2007). Three broad categories of assets are included in the index: nine household possessions (i.e., radio, electric or gas stove, kerosene stove, electric iron, box iron, refrigerator, television, cellular phone, and land phone), six types of livestock (i.e., cattle, goat, sheep, donkey, pig, and chicken), and four transportation-related property (i.e., bicycle, motorcycle, canoe or boat, and car or truck). Using the equation $A_i = (b_1a_{1i}) + (b_2a_{2i}) + \dots (b_ka_{ki})$, where A_i is the asset index for household "i", $(a_{1i}, a_{2i}, \dots, a_{ki})$ are the k indicators of asset items, and $(b_1, b_2, \dots, b_k)$ are weights used to aggregate the indicators into an index, we conducted principal component analysis to determine the weight for each of the 19 asset items. A high index value indicates a high level of asset ownership.

Academic self-efficacy is a continuous variable measured using an eight-item, 10-point, Likert-type scale adapted from Muris (2001) that ranges from 0 (*cannot do at all*) to 10 (*highly certain can do*). Youth were asked how well they can get teachers to help them, study, pay attention in class, and succeed in school activities. A high value indicates a high level of academic self-efficacy. The Cronbach α was 0.75 at baseline. For each multi-item predictor, we calculated a composite score by summing the score of all items.

Commitment to school is a continuous variable measured using a nine-item, 10-point, Likert-type scale adapted from the Rochester Youth Development Study (Thornberry, Lizotte, Krohn, Farnworth, & Jang, 1991) that ranges from 0 (*strongly disagree*) to 10 (*strongly agree*). Youth were asked to describe their attitudes toward school, doing homework, and getting good grades. A high value indicates a high level of commitment to school. The Cronbach α was 0.70 at baseline.

Future orientation is a continuous variable measured using a 12-item, 10-point, Likert-type scale adapted from the School Success Profile Survey (Bowen, Rose, & Bowen, 2005) that ranges from 0 (*strongly disagree*) to 10 (*strongly agree*). Youth were asked about their attitudes toward the future and academic aspirations and expectations. A high value indicates a high level of positive future orientation. The Cronbach α was 0.74 at baseline.

Planned effort is a continuous variable measured in hours per week based on a question adapted from Destin and Oyserman (2009). Youth were asked how many hours per week on average they spend on school work outside of school. A high value indicates a high level of planned effort.

Level 2 (between-school) variables

School-level variables included measures of school structure (i.e., class size, student-to-teacher ratio, and number of teachers without a postsecondary certificate) and school facilities (i.e., electricity, drinking water, and toilet facility). All three measures of school structure are interval-level variables. A high value indicates a high level for the variable. All measures of school facilities are dichotomous. Electricity is coded 1 if the school is connected to electricity and 0 if not. Drinking water is coded 1 if the school has its own source of drinking water and 0 if not. Toilet facility is coded 1 if the school has its own toilet facility and 0 if not. Toilet facility includes flush toilets, pit latrines, or Kumasi Ventilated-Improved Pit (KVIP).

Analytical approach

Educational data are often hierarchical or multilevel because students are nested within schools. Thus, we used hierarchical linear modeling (HLM) to analyze the data. Conventional regression models such as ordinary least squares (OLS) are not appropriate for analysis of nested data because the presence of intraclass correlation (ICC) (Bryk & Raudenbush, 1988) among study subjects from the same group violates the assumption that observations are independent of one another (Raudenbush & Bryk, 2002; Singer & Willett, 2003). When an ICC is present, information coming from the same unit (e.g., students from the same school) tends to be more alike than information from independent units (e.g., a data set of *n* unrelated students). Therefore, some information in the nested educational data is redundant. Conventional regression models fail to take into account the nested nature of the data and the consequences (Raudenbush & Bryk, 2002), including biased standard errors (i.e., a smaller standard error that makes a finding spuriously significant) (Guo, 2005).

Conventional regression models also do not allow researchers to estimate between-school variations. In contrast, HLM takes the nesting of students within schools into account, allows the use of student and school variables at different levels, and permits calculation of between-school variances (Raudenbush & Bryk, 2002). Further, HLM allows simultaneous estimates of student-and school-level variance components on the outcome variable of interest, while maintaining the appropriate level of analysis for the sets of explanatory variables (Raudenbush & Bryk, 2002). HLM makes this simultaneous equation possible because each level in a multilevel analysis is represented by its own submodel. Each submodel reveals the association between the set of explanatory variables and the outcome at that particular level. Because our research questions aim to examine the association between the set of student- and school-level variables on math and English academic achievement performance of Ghanaian youth, HLM is the appropriate statistical method to use.

The proposed analysis employs two-level HLM to explore between-school variability and effects of student and school characteristics on the average student's math and English performance. Students are the study unit for level 1, and schools are the study unit for level 2. At level 1, we regressed the outcome variable of all students on student-level characteristics. Thus, the level-1 model estimated the average association between individual-level predictors and academic performance. The level-1 model produced an estimated intercept, a regression coefficient for each student-level predictor variable, and an error term. The intercept and regression coefficients at level-1 are called *fixed effects* because the effect is fixed for a given value of the level-1 predictor variable. At level 2, each level-1 fixed effect was treated as a dependent variable and regressed it on the school characteristics. Each level-2 regression equation then estimated intercept, the effect of each level-2 predictor variable, and an error term. The error terms of the level-2 equations are called *random effects* because the values vary by level-2 unit. For instance, the sample has 89 schools, and the model estimates 89 specific values for each level-2 error term.

We estimated four models in this study. First, we estimated one-way ANOVA with random effects to determine ICC or overall between-school variance for the outcome measure. Second, we estimated regression with means-as-outcomes to obtain the proportion of variance explained by level-2 predictors. Third, we estimated the random coefficient model to obtain the proportion of variance explained by level-1 predictors. Fourth, we estimated the intercepts-and-slopes-as-outcomes model to examine the effects of student and school characteristics on math and English scores. We controlled for individual-level predictors in the estimation of school-level effects and included gender, age, academic self-efficacy, future orientation, and planned effort as random effects when estimating effects on math performance. We included age, gender, academic self-efficacy, and planned effort as random effects when estimating effects on English performance. We performed a two-tailed test (with $\alpha = .05$) for each predictor. The final model for math performance takes the form of the following combined equation:

$$\begin{aligned} Y_{ij} = \; & \gamma_{00} + \gamma_{01}(size)_j + \gamma_{02}(ratio)_j + \gamma_{03}(teacher)_j + \gamma_{04}(electricity)_j + \gamma_{05}(water)_j + \gamma_{06}(toilet)_j + \\ & \gamma_{10}(gender)_{ij} + \gamma_{20}(age)_{ij} + \gamma_{30}(asset)_{ij} + \gamma_{40}(efficacy)_{ij} + \gamma_{50}(commit)_{ij} + \gamma_{60}(future)_{ij} + \\ & \gamma_{70}(effort)_{ij} + u_{0j} + u_{1j}(gender)_{ij} + u_{2j}(age)_{ij} + u_{4j}(efficacy)_{ij} + u_{6j}(future)_{ij} + \\ & u_{7j}(effort)_{ij} + r_{ij}, \end{aligned}$$

where Y_{ij} is the math score for student *i* in school *j*, γ_{00} is the adjusted average math score across 89 schools, γ_{01} to γ_{09} are the school-level regression coefficients (after centering of level-2 variables) for school *j* (γ_{01} is the regression coefficient of class size on math score, γ_{02} is student-to-teacher ratio, γ_{03} is the number of teachers without a postsecondary certificate, γ_{04} is availability of electricity in the school, γ_{05} is availability of a drinking water source in the school, and γ_{06} is availability of a toilet facility in the school), γ_{10} to γ_{70} are the student-level regression coefficients (after centering of level-1 variables) for student *i* in school *j* (γ_{10} is the regression coefficient of gender of youth on math score, γ_{20} is age of youth, γ_{30} is asset ownership, γ_{40} is academic self-efficacy, γ_{50} is commitment to school, γ_{60} is future orientation of youth, and γ_{70} is planned effort), u_{0j}, u_{1j}, u_{2j}, u_{4j}, u_{6j} and u_{7j} are the six random effects (or error terms at level 2) of school *j* on math score (u_{0j} is the random effects of the intercept, u_{1j} is gender, u_{2j} is age, u_{4j} is academic self-efficacy, u_{6j} is future orientation, and u_{7j} is planned effort), and r_{ij} is the error term at level 1.

The final model for English performance takes the form of the following combined equation:

$$\begin{aligned} Y_{ij} = \; & \gamma_{00} + \gamma_{01}(size)_j + \gamma_{02}(ratio)_j + \gamma_{03}(teacher)_j + \gamma_{04}(electricity)_j + \gamma_{05}(water)_j + \gamma_{06}(toilet)_j + \\ & \gamma_{10}(gender)_{ij} + \gamma_{20}(age)_{ij} + \gamma_{30}(asset)_{ij} + \gamma_{40}(efficacy)_{ij} + \gamma_{50}(commit)_{ij} + \gamma_{60}(future)_{ij} + \\ & \gamma_{70}(effort)_{ij} + u_{0j} + u_{1j}(gender)_{ij} + u_{2j}(age)_{ij} + u_{4j}(efficacy)_{ij} + u_{7j}(effort)_{ij} + r_{ij} \end{aligned}$$

The notation used in the equation of the math model also applies to the equation of the English model. However, we excluded the random effects of future orientation (u_{6j}) when estimating the effects on English performance because results of a likelihood ratio test indicated that the random effects of future orientation was not necessary. We analyzed data with STATA statistical software, version 11.0.

Random effects structure

Random effects are a level of heterogeneity for each level-2 unit. Although researchers are not particularly interested in the substantive meaning of the random effects, specification of random effects in the model corrects for biases triggered by ICC. With seven level-1 predictors, our models could have eight random effects. To determine which random effects should be included in the final models, we conducted a deviance (i.e., likelihood ratio) test. We ran several models that had exactly the same structure on fixed effects but different structure on random effects. Full maximum likelihood was used to conduct deviance tests. A *p*-value less than .05 indicates that the added random effects are appropriate (Snijders & Bosker, 1999). Results suggest that in addition to the random effects in the intercept equation, five random effects—gender, age, academic self-efficacy, future orientation, and planned effort—are appropriate for the final math model and four random effects—gender, age, academic self-efficacy, and planned effort—are appropriate for the final English model.

When we compared the model with only one random effect—intercept—to a model with six random effects—intercept, gender, age, academic self-efficacy, future orientation, and planned effort—for math and five random effects—intercept, gender, age, academic self-efficacy, and planned effort—for English, results of the deviance test suggested the additional random effects were necessary ($p < .05$). Thus, the final multilevel model for math and English included six and five random effects, respectively. We also conducted residual diagnostics to determine normality or multivariate normal distribution of random effects, including the level-1 residuals. Results showed that the assumption about multivariate normal distribution of the random effects may be reasonable.

Grand-mean centering

Raudenbush and Bryk (2002) recommend grand-mean centering for all predictors—including dummy variables—be applied when using HLM. Centering is particularly useful when one of the study's main interests is to estimate the association between a level-2 predictor and the mean of an outcome, adjusting for the net effects of level-1 predictors. In this study, we used grand-mean centering for all predictors. The centering variable was created as follows:

$x = X - (sample\ mean\ of\ X)$ for level-1 predictors; and $w = W - (sample\ mean\ of\ W)$ for level-2 predictors

Results

Description of the sample

Table 1 presents descriptive statistics of all predictor variables. The average math score is 54.09 (SD = 16.83), and the average English score is 54.49 (SD = 16.97). Forty-nine percent of youth are male, and the average age is 15. The mean asset-ownership index was 4.90, with a range of 0 to 66.25. On average, youth have high levels of academic self-efficacy, commitment to school, and future orientation. Youth planned to spend nearly eight hours on schoolwork outside school per week. The average class size is 44, and the average student-to-teacher ratio is 25. Across 89 schools, the average number of teachers without a postsecondary certificate is one. Six in 10 schools (61%) are connected to electricity, nearly four in 10 schools (37%) have their own source of drinking water, and seven in 10 schools (70%) have their own toilet facility. Table 1 also shows results of bivariate analyses between Math and English scores and each predictor variable.

Table 1. Descriptive Statistics and Bivariate Analysis Results

		Academic performance	
Variable	% or *M (SD)*	Math	English
Dependent variable			
Math score	54.09 (16.83)	-	-
English score	54.49 (16.97)	-	-
Student characteristics			
Gender (reference group is female)	49%	2.91*	1.70*
Age	15.31 (2.02)	-0.25*	-0.47*
Asset ownership[a]	4.90 (3.20)	0.50	1.14*
Academic self-efficacy	60.87 (10.00)	0.15*	0.22*
Commitment to school	77.39 (9.32)	0.14*	0.20*
Future orientation	61.89 (9.60)	0.01	-0.03
Planned effort	7.53 (4.81)	0.14*	0.12*
School characteristics			
Class size	43.91 (16.31)	0.09*	0.10*
Student-to-staff ratio	25.01 (12.36)	0.06*	0.09*
Number of teachers without postsecondary certificate	1.47 (2.53)	0.24*	-0.01
Electricity connection (reference group is no electricity)	61%	0.42	-0.41
Drinking water source (reference group is no water source)	33%	2.83*	-0.09
Toilet facility (reference group is no toilet)	70%	-2.73*	-3.48*
Number of students	4,993		
Number of schools	89		

*$p < .05$.
%, percentage distribution for categorical variables; *M (SD),* mean (standard deviation) for continuous variables
[a]Asset ownership was transformed using inverse hyperbolic sine transformation.

Multilevel analysis

A calculation based on unconditional ANOVA with random effects indicates an ICC coefficient of .45 for math and .40 for English, which means that 45% of the variation in math scores and 40% of the variation in English scores is between schools. The remaining variation is due to differences among students within schools. The level-1 predictors account for 5% of the student-level variance in math and 7% of the variance in English. The level-2 predictors account for 6% of between-school variance in math and 7% of between-school variance in English. Overall, level-1 and level-2 predictors explain 4% of the total variation in math and 5% of the total variation in English.

Table 2 presents estimated HLM coefficients and other statistics. The final HLM model for math performance includes six random effects, and the final model for English performance includes five random effects. We used the restricted maximum likelihood to estimate the final model. Results based on restricted maximum likelihood are very similar to those estimated by full maximum likelihood. The model-adjusted mean math and English scores for the study sample are 54.78 and 56.79, respectively.

Table 2. Estimated HLM coefficients of student and school characteristics on Math and English scores

Fixed and random effects	Outcome variables	
	Math	English
Fixed effects		
Student-level		
Intercept	54.78***	56.79***
Gender (reference group is female)	2.17***	0.97*
Age	-0.75***	-1.10***
Asset ownership	-0.03	0.30
Academic self-efficacy	0.16***	0.19***
Commitment to school	0.07**	0.11***
Future Orientation	-0.02	-0.03
Planned Effort	0.08	0.03
School-level		
Class size	0.13	0.15*
Student-to-staff ratio	0.05	0.05
Number of teachers without a postsecondary certificate	0.70	0.44
Electricity connection (reference group is no electricity)	-2.32	-1.22
Drinking water source (reference group is no water source)	3.33	1.71
Toilet facility (reference group is no toilet facility)	-5.17	-5.76*
Random effect (variance component)		
Intercept	137.85***	147.57***
Gender	3.78***	6.20***
Age	1.33***	2.28***
Academic self-efficacy	0.01***	0.02***
Future orientation	0.004***	-
Planned effort	0.06***	0.03

Each predictor was centered on its grand mean.
**p* < .05, ***p* < .01, ****p* < .001, two-tailed test.

Math scores

In math, four level-1 predictors are statistically significant ($p < .05$). Controlling for other variables, boys' math scores are 2.17 points higher than girls'. Other things being equal, a one-year increase in age decreases math grade by 0.75 points. Two measures of students' school effort are statistically significant ($p < .05$). Other factors being equal, one unit increase in youth's academic self-efficacy increases math grade by 0.16. Other things being equal, one-unit increase in commitment to school increases math scores by 0.07.

Results suggest that (a) male students have higher math scores than females, (b) younger students have higher math scores than older students, and (c) students with higher academic self-efficacy and commitment to school have higher math scores than students with lower academic self-efficacy and commitment to school. The other student-level predictors—asset ownership, future orientation, and planned effort—are not statistically significant at a .05 level. None of the six school-level predictors are statistically significant ($p > .05$), but average class size and availability of a toilet facility showed a statistical trend ($p < .10$).

English scores

Four student-level characteristics—gender, age, academic self-efficacy, and commitment to school—are statistically significant predictors of English performance ($p < .05$), which is consistent with statistically significant predictors of math performance. Other things being equal, boys' English scores are 0.97 points higher than girls'. Controlling for other variables, a one-year increase in age decreases English scores by 1.10 points. Two measures of students' school effort are statistically significant if other factors are equal: a one-unit increase in academic self-efficacy increases English scores by 0.19, and a one-unit increase in commitment to school increases English scores by 0.11.

Results suggest that (a) male students have higher English scores than females, (b) younger students have higher English scores than older students, and (c) students with higher academic self-efficacy and commitment to school have higher English scores compared with students with lower academic self-efficacy and commitment to school. The other student-level predictors—asset ownership, future orientation, and planned effort—are not statistically significant at a .05 level. Two of the six school-level predictors are significant ($p < .05$). Other things being equal, a one-student increase in class size increases English scores by 0.15. Students in schools with toilet facilities have lower English scores ($\beta = -5.17$) than students in schools without toilet facilities. The other four school-level predictors are not significant ($p > .05$) predictors of English performance.

Discussion

This study illustrates the effects of student- and school-level variables on Ghanaian youth's academic performance in math and English. The variance decomposition indicates that more than 40% of the variation in math and English is between, rather than within, schools. Overall, we find evidence to support substantial associations between student-level predictors and academic achievement. Our results suggest that gender, age, and measures of student efforts (i.e., academic self-efficacy and commitment to school) are consistent predictors of math and English scores of Ghanaian youth. In our sample, boys have higher math and English scores than girls, and increasing age associated negatively with academic achievement. On average, younger students have higher math and English scores than older students. Academic self-efficacy and commitment to school are positively associated with academic performance, which is consistent with earlier research in the United States (Johnson, Crosnoe, & Elder, 2001). The significant association between gender and math scores also is consistent with studies in the United States (Fan, Chen, & Matsumoto, 1997; Konstantopoulos, 2006).

Although prior studies show that females outperform males in reading (Calvin, Fernandes, Smith, Visscher, & Deary, 2010; Konstantopoulos, 2006), we did not find similar findings in our Ghanaian sample. On the contrary, we find that male students outperform female students in English. One possible explanation is that some parents have higher expectations of boys' academic performance than girls' because of cultural and customary influences. Certain families may be more interested in boys' success in school as future self-sufficient breadwinners and household heads. Some teachers also accept the normalcy of gender differences, which may be reflected in the different levels of questioning and praise in the classroom (Kyei, Apam, & Nokoe, 2011). Classroom dynamics (e.g., seating assignments or bullying and harassment) may hamper girls' active participation and engagement (Dunne & Leach, 2007; Mensch & Lloyd, 1998). All of these factors may have unfavorable consequences for girls' academic performance.

Our results also suggest that school-level characteristics have statistically significant associations with English but not math performance among Ghanaian youth. We find that class size influences English performance. A larger class size is associated with higher English scores, which is counterintuitive and contradicts prior research. Because English includes reading, writing, and comprehension in this study, cross-country and cultural differences in subject content, teaching approaches, and learning curve might explain differences in findings from other studies (Wang, 2011). The current study also measures dependent variables as composite scores—an aggregate of examinations and continuous assessment scores—while most prior studies examine only examination/test scores. Another school-level characteristic that has a statistically significant association with performance is the presence or absence of a toilet facility. Students whose schools have a toilet facility have lower English scores than their peers in schools with no toilet facility.

We find no measures of school structure—class size, student-to-teacher ratio, and number of teachers without a postsecondary certificate—or school facilities—availability of electricity, drinking water, and toilet facility—to be significant predictors. Nonetheless, the nonsignificant effects of school characteristics are consistent with prior research in developing countries. For instance, research shows that class size has no effect on academic performance (Hanushek, 1996; 1999) and that there is no significant relationship between teacher education and student achievement (e.g., Buddin & Zamarro, 2009; Dash, de Kramer, O'Dwyer, Masters, & Russell, 2012; Hanushek, 1986). However, studies in developed and developing countries find strong and significant negative effect of higher class sizes on students' academic performance (Case & Deaton, 1999; Wößmann & West, 2006) and positive relationships between teacher education and student outcomes (Clotfelter, Ladd, & Vigdor, 2010; Greenwald et al., 1996; Hedges, Laine, & Greenwald, 1994; Kukla-Acevedo, 2009). Instead of affecting academic achievement directly, school-level characteristics may first affect school behaviors (e.g., attendance and participation), which lead to better academic performance.

Also, school-level characteristics might not have independent effects on academic achievement until they interact with individual-level characteristics. For instance, studies show that school and teacher resources have varying influences on student outcomes that depend on students' SES or repetition of a school grade (Lee et al., 2005). Even though most school-level characteristics do not seem to predict academic achievement, future studies could examine the relationships more closely to assess the interplay of student and school factors in explaining academic achievement disparities.

Study limitations

The use of cross-sectional data limits our ability to make causal inferences or establish the direction of the relationship between academic performance and student- and school-level characteristics. In this study, we examine only correlations. Nevertheless, because relatively few empirical studies on academic performance in Ghana exist, this is an important step toward testing causal relationships between student- and school-level characteristics and academic performance.

The second limitation of this study is the risk of omitted-variable bias. As in most studies, we cannot guarantee that we accounted for every student- and individual-level characteristic that can contribute to academic performance. Overlooked variables could affect the relationships between student- and school-level characteristics and academic performance in Ghana. However, because we consulted a wide range of earlier studies in developing and developed countries, there is high probability that we considered the most important and predictive variables.

The third limitation of this study is that the latent constructs for self-efficacy and future orientation used in the analyses may not have tapped into all possible dimensions of the constructs. To the best of our knowledge, this is the first time these scales have been adapted to fit the Ghanaian context. Hence, multiple validations with different groups and geographical areas are necessary to confirm the suitability of the scales. Without asserting perfection of the scales, we are confident that they are adequate given the rigorous multimethod pilot testing of the instrument in Ghana. The high validity scores of the scales further attests the adequacy of the scales.

Conclusion

This study describes how student characteristics compare to school characteristics when explaining academic performance among JHS students in Ghana. The main finding is that student- and school-level characteristics can explain individual academic performance, which has implications for how policymakers in Ghana reposition education policies and programs to better address the generally poor academic performance at the JHS level. More specifically, the evidence that student-level characteristics are more predictive of academic performance than school-level characteristics lends support to policies that focus on improving students' psychosocial outcomes (e.g., academic self-efficacy).

Issues of access to education dominate most discourse on education in Ghana. Most education-related policies and programs emphasize improving infrastructure through increasing the number of schools and teachers (Chowa et al., 2013). In this study, we find that better performance among students in some schools is partly related to increased self-efficacy and commitment to school. This school-level variance suggests that consideration of students' psychological traits (e.g., academic self-efficacy at the policy level) may be as important as investments in school infrastructure and access. Including interventions in programs and policies that boost students' self-concept might motivate them to perform better.

To conclude, this study builds on empirical evidence of factors that affect academic performance in Ghana by using strong methods. We had a large sample with adequate representation of all grade levels of JHS and used a multilevel modeling approach, a data analytic approach most suited to examining school-related data that often are nested. This study also provokes further investigation into the causal relationships between student- and school-level characteristics and academic performance and expands the range of factors that should be considered when examining academic performance at the basic school level in Ghana. Thus far, empirical studies on student characteristics (e.g., academic self-efficacy and future orientation) and academic performance in Ghana are lacking, but the growing body of evidence—including this study—shows that students' psychological characteristics are important predictors to consider.

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