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Predictors of Socio-economic Profiles and Mathematics Achievement in Grade Eight Students' in Ghana

BOFAH, EMMANUEL ADU-TUTU

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Students Name: BOFAH, EMMANUEL ADU-TUTU

University of Helsinki

Faculty of Social Sciences

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Tiivistelmä – Referat – Abstract

This study used the Trends in International Mathematics and Science Study (TIMSS 2011) dataset for Ghana, which measures the trends in Mathematics and Science Achievement at the fourth and eighth grades. The focus of the present study is on the eighth grade Ghanaian students' with a sample size 7323 (47% girls) who participated in TIMSS2011. The mean age was 15.81 with standard deviation of 1.50.

This paper first addresses the issue of measuring socio-economic background in the context of the TIMSS 2011 data set using students' home resources. This is based on the fact that the literature indicates that data on home possessions/resources collected from young children are much more reliable compared to the information they provide about their parents' education, jobs, and income as such this study uses data on home resources as a measure of students Socio-Economic Status (SES).

Applying a two-level mixture modeling technique by accounting for the clustering in the data set, the study explored the profiles of students' (SES). Latent class analysis was used for the profiling. The two-level latent class analysis takes into account the measurement error and the variation of the latent class indicators across different class/schools. The detail process involved in obtaining the index of students' socio-economic profiles from home possessions/resources items using latent class analysis is described. Once the SES measure was obtained, a discriminant analysis was used to validate the students SES. The relationship between the demographic variables (e.g., parental education, language spoken at home, parental involvement and gender) and students' SES were examined.

The analysis identified three latent classes of students based on reported home resource namely: the high SES, the intermediate SES, and the low SES group. The discriminant analysis based on the eleven household items was able to correctly classify 92.2% of the individual students into their appropriate SES group. Furthermore, the variables that had the most significant association with students' socio-economic profile were investigated. Multinomial logit latent-class regression models were posited.

The final analysis used the hierarchical regression analysis to access the clusters of variables to evaluate the relative importance of the predictors for students' mathematics achievement. The results indicated that gender, parental education, SES, students' educational aspiration, language spoken at home, and parental involvement variables significantly predict students' mathematics achievement. When the variables were entered as six blocks, students' educational aspirations were found to have the greatest variance explained for mathematics achievement. Gender and parental education explained additional 2% and 2.9% respectively of the variance in mathematics achievement. Speaking English always at home and being in the low SES group did not have any significant effect on students' mathematics achievement.

The findings of this study provide information to educators, researchers, parents, teachers, and policy makers about the effect of home resources on students' academic achievement. This thesis advocates that governments should provide financial support for students from low SES. In addition, financial incentives to schools in low income areas should be increase to help close the achievement gap between students' from the low-SES and high-SES.

Avainsanat – Nyckelord – Keywords

Socio-economic status, socio-economic profiles, parental education, educational aspirations, gender, parental involvement, structural equation modeling, latent class analysis, discriminant analysis, achievement.

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1. **Introduction**

Ghana is sub-Saharan African country with medium level human development index, which place Ghana above the regional average (United Nations Development Programme, 2013). In Ghana education has been seen as the most powerful and influential weapon against poverty and social inequality. In Ghana, adult illiteracy, inequity and poverty among the population are a serious concern (UNESCO, 2012).

It is well established that education plays a significant role in determining social and economic status in adulthood (Bane & Ellwood, 1994; Hill & Sandfort, 1995). Poverty (De Civita, 2004; McLoyd, 1998), and lower level of parental education (Aunio & Niemivirta, 2010; Hakkinen, 2003; Nonoyama-Tarumi & Willms, 2010) has been found to be associated with lower academic achievement. In Ghana, the poverty headcount ratio at national poverty line —percentage of the population living below the national poverty line, is 28.5% (as of 2006) (The World Bank, 2013). Access to educational materials that will foster early knowledge and skills needed for future academic success—books, computers, study desk/table depend on the family financial resources (Ormrod, 2011). In Ghana, many parents have few basic academic skills to share with their children. This fact is indicated by adult (15+) literacy rate of only 67% (The World Bank, 2013; UNESCO Institute for Statistics, 2013). Some low-income parents are educated (perhaps have a university degree) but the financial burden do not allow them to impact positively on their children's education. A higher parental education is a proxy of a higher socioeconomic status (SES) and children with higher parental education are more likely to enjoy improved socioeconomic conditions. Persistent poverty may affect children's academic development by dampening parents' hopes about their child's educational aspirations.

Studies have shown that affluent families are more supportive of their children's early learning than less affluent families (Aunio & Niemivirta, 2010; J. Lee & Bowen; Siegler, 2009; White, 1982). Greater parental involvement fosters children's positive attitudes toward school, improves homework habits, reduces absenteeism and dropping out, and enhances academic achievement (Astone & McLanahan, 1991; Epstein, 1987; Hoover-Dempsey et al., 2005; Hoover-Dempsey & Sander, 1995; Lareau, 1987; Sheldon, 2002; Sui-Chu & Willms, 1996).

2. The present study

The present study includes three research questions. First, what are the socio-economic profiles (SEP) or SES of Ghanaian eight-grade students and do these profiles differ based on parental education, parental involvement and gender. Second, what is the relationship between SES, parental education, students' educational aspirations and mathematics achievement? Third, do the SES of students relate to their subsequent educational aspirations, parental involvement in the child's education and academic achievement (mathematics achievement). In the present study, the concepts of students SEP and SES will be used interchangeably.

The following hypotheses guide the study:

Hypotheses 1: there are no less than two or three students' SEPs and the membership in the different profile groups is associated with several demographic covariates and parental involvement and achievement.

Hypotheses 2: Parental involvement, parental education, students' gender, and academic achievement differ among students with different socioeconomic backgrounds.

Hypotheses 3: A positive relationship is expected between students' parental education, SES, educational aspiration, and mathematics achievement.

The study is also based on the fact that most theories and studies on SES are based on constructs in the western hemisphere. The study will add up to the established universal theories on SES. Furthermore, there is a paucity of SES studies and achievement in the Ghanaian context.

2.1. Student Demographics and Home Background

In Ghana, children come from vastly different backgrounds and with different experiences and cultures. Research have shown that there is a relationship between children achievement in mathematics related subjects and home background factors (e.g. socioeconomic background, language spoken at home, books at home) and gender (e.g., Else-Quest, Hyde, & Linn, 2010). Moreover, the number of books in the home, the

presence of a study desk, computer, and an internet connection has been found to influence children's academic achievement (Laffey, Espinosa, Moore, & Lodree, 2003; National Center for Education Statistics, 2006; Woessmann, 2004; Mullis, Martin, Foy, & Arora, 2012; Mullis, et al., 2009). Other factors such as having a calculator at home, dictionary at home, clean water and electricity have also been found to be a key influential factors in students' overall educational aspirations and achievement (Mullis, et al., 2012; Mullis, Martin, Ruddock, O'Sullivan, & Preuschoff, 2012).

2.2. Parental education and academic achievement

On parental education, the literature on achievement has consistently shown that higher parental education is a predictor of students' academic performance (Davis-Kean, 2005; Haveman & Wolfe, 1995; Klebanov, Brooks-Gunn, & Duncan, 1994) and educational aspirations (Howie, 2013; Teachman, & Paasch, 1998). Moreover, there is a strong relationship between parental education and the emphasis that parents place on the value of education, parental commitment to the child's school activities—for example homework help (e.g., Sy, 2006). Moreover, research on parenting have shown that the social climate at home (e.g., physical environment, provision of learning experiences, and warmth of the mother), is related to parent education. Parental education and family socioeconomic status have been found to be significant predictors of the physical environment, warmth, and the Childs' learning experiences in the home (Davis-Kean, 2005; Klebanov et al., 1994). From the above discussion, Sui-Chu and Willms (1996, p.126) argue "… the association between students' outcomes and parents' background is probably attributable to different levels of parental involvement in school-related activities.

Conclusively, the above literature indicates that, socio-economic status or profiles, parental level of education or occupational class positively impact on students' academic achievements (Bradley & Corwyn, 2002; Haveman & Wolfe, 1995; Sui-Chu & Willms, 1996). For instance students' from higher-SES backgrounds is reported to have higher academic achievement, whereas, lower-SES students record lower academic achievement as well as higher school dropouts rates (J. Lee & Bowen, 2006; McLoyd, 1998).

2.3. Parental involvement and academic achievement

Research has shown that when parents participate in their child's education, both at home and at school, it improves the child's motivation/attitudes towards education and their academic achievement (Dearing, Kreider, & Weiss, 2008; Epstein, 2008; Fan & Chen, 2001; Hughes & Kwok, 2007). For instance, the meta-analyses by Fan and Chen (2001) and Jeynes (2007) found that children's educational outcomes are positively influenced by their parents' involvement in their child's education. Moreover, Sheldon, (2002) found that parents are socio actors with social networks that can influence the way that they get involved in their children's education, which subsequently may have a significant impact on the child's education. High expectations, high support and encouragement from parents have been shown to increase students' self-confidence (Ormrod, 2011). Moreover, when parents are involved in their children's education, children tend to achieve better reading and writing skills, their school attendance is improved, and they exhibit fewer behavioral problems (Balli, 1996; Epstein, 2008). Such parental involvement can include activities such as volunteering, parenting, communicating, learning at home, decision making, and collaborating (Epstein, 2010). For the purpose of this study, parental involvement is divided into two: parental child-discussion (PCD) and home-work help discussion (HHD) (Epstein, 2010; Sheldon, 2002). Various researchers have given different definitions to parental involvement but because of the multi-dimensional nature of parental involvement, most of the definitions are specific to a particular aspect of the parental involvement (e.g., home involvement). For instance parental involvement at home have been describe by some authors as "the curriculum at home" (e.g., Walberg, 1984) or have been defined as parent child interactions on school related activities (Sheldon, 2002). Other operational definitions about parental involvement can be found in other studies such as Campbell and Mandel (1990), Fan and Chen (2001), Shumow and Miller (2001), Singh et al (1995), and Sui-Chu and Willms (1996).

Moreover, parental child-discussion involves parental help by discussing what goes on in school. For instance what the child is learning in school. This also involves getting to know what happens in the child's school, it helps parents to get a first-hand information about the school (Muller & Kerbow, 1993).

Others studies have researched parental involvement globally, using unidimensional construct by merging other aspect of the involvement into one variable (Miliotis, Sesma, & Masten, 1999). Moreover, unidimensional analysis of parental involvement makes it difficult to make a sound conclusion because is it difficult to determine which components of parental involvement are driving the association between parental involvement and academic achievement (Sheldon, 2002; Sui-Chu & Willms, 1996). It has been found that parental involvement in their children's education is influenced by role construction for involvement, sense of efficacy for helping the child succeed in school, perception of invitations of involvement (from school, teacher, and student), life-context variables (skills and knowledge , time and energy), and school responsiveness to these life-context variables (Hoover-Dempsey et al., 2005; K. Hoover-Dempsey & Sander, 1995; K. V. Hoover-Dempsey & Sandler, 1997; Walker, Wilkins, Dallaire, Sandler, & Hoover-Dempsey, 2005) (see also K. Hoover-Dempsey & Sander, 1995; K. V. Hoover-Dempsey & Sandler, 1997; Walker et al., 2005).

On the other hand, in a longitudinal study involving more than 800 children and their parents' between1987 through 2000 in the United States, Davis-Kean and colleagues (Davis-Kean, et al., 2007) found that parental attitudes were important determinants of children's mathematics performance and later interests. The study found that girls' interest in mathematics decreases as their fathers' gender stereotypes increase, whereas the contrary was found for boys. The study further reported that parents provided a more mathematics-supportive environment for boys than girls, including purchases of toys and time spent on activities.

A study of parental involvement, (J. Lee & Bowen, 2006) found that parent-child educational discussions and parental homework help were positively associated with academic outcomes. Other studies have found either negative association (Campbell & Mandel, 1990; Epstein, 1988; Desimone, 1999) or had no relationship with mathematics achievement (Kifer & Robitaille, 1989; Schmidt & Kifer, 1989). For instance, Epstein (1988) found a negative relationship between student mathematics and English achievement and parental help with homework. Similarly, Desimone (1999) found a

negative relationship between parents who check their children homework frequently and achievement irrespective of socio-economic background.

From the above review, there is a clear indication that parental participation at home is an important contribution to students' achievement but there is also a clear indication that unsolicited parental involvement may affect children's self-perception (Graham, 1990; Jacobs & Bleeker, 2004) about the subject matter resulting in lower achievement (Epstein, 1990; Campbell & Mandel, 1990; Jacobs & Bleeker, 2004). Jacobs and Bleeker, (2004, p. 9) summarized the relationship between parental involvement in child's education as "bidirectional"— a reciprocal relationship exists between parental involvement and achievement. Jacobs and colleagues further argue that "when parents see that their children are not trying hard enough or are failing despite high effort, parents may intensify their involvement or change tactics (p. 9).

2.4. Socioeconomics differences

The concept of SES has been measured by various indicators; including parental education, parental occupation, family income, prestige, wealth, home literacy resources, power, and a certain lifestyle (Buchmann, 2002; Hauser, 1994; House, 1981; Mueller & Parcel, 1981; Ormrod, 2011; Schulz, 2006; Yang & Gustafsson, 2004). SES is known to correlate positively with many aspect of learning (Buchmann, 2002; Schulz, 2005; Sirin, 2005; Woessmann, 2004). Family socioeconomic status—whether high-SES, middle-SES, or low-SES gives as the sense of what educational opportunities are available (Aikens & Barbarin, 2008; Brooks-Gunn, Linver, & Fauth, 2005; Siegler, 2009).

Schulz, (2005) argue that, students' socio-economic background may affect learning outcomes in numerous ways: first, children from higher socio-economic parents are able to get the necessary financial support and home resources for individual learning. Second, children from higher SES are more likely to have a more conducive stimulating learning environment at home to promote cognitive development. Third, children from higher SES groups are more likely to attend better schools in countries where there are differentiated

school system, strong school segregation system and clear advantages of private schools system over public schools.

Typically, questionnaires developed in the West have been used to obtain data on students' socio-economic background. The three variables normally used to measure students'/family SES in educational research (either as single indicators or in combination) is: (i) parental education, (ii) parental occupation and (iii) household resource items (Schulz, 2006). Although as limited, many studies using this approach have made important contributions to educational research on students' SES. It has been suggested that data on home possession/resources collected from young children are much more reliable compared to the information they provide about their parents' education, jobs, and income (e.g., Yang & Gustafsson, 2004) as such this study uses data on home amenities as a measure of students' SES.

In his meta-analysis White (1982) found that among traditional indicators of SES, parental occupation and parental education correlated the highest with academic achievement. Among eighth graders in the National Education Longitudinal Study in the United States, Lee and Croninger (1994) found out that, home support and demographic variables (e.g., books at home, parent-child school discussion, parental education) significantly reduced the effect of poverty on literacy development by more than half. Home resources (e.g., books, computers) have been found to significantly influenced children's academic growth (Entwisle, Alexander, & Olson, 1997).

Moreover, other studies shown that middle-income parents engage in a wide range of mathematical activities with their children more often than low-income parents (Clements & Sarama, 2007; Starkey, Klein, & Wakeley, 2004). Lareau (1989) indicated that parents of high-SES underachieving children are the most involved in their children's schooling. Students' from low-SES turns to fall further and further behind students from high-SES as they progress through their education (Farkas, 2008; Jimerson, Egeland, & Teo, 1999). To that, Siegler in a study on improving children numeracy in low-SES concluded, "children who start behind generally stay behind" (Siegler, 2009, p. 118).

In an analysis of the Trends in International Mathematics and Science Study (TIMSS) Cyprus dataset, Papanastasiou (2002) found that family educational background directly affect students' SES, attitudes toward mathematics, school climate and beliefs related to success in mathematics.

3. Methodology

3.1. Participants

TIMSS is an international assessment of mathematics and science at the fourth and eighth grades organized by The International Association for the Evaluation of Educational Achievement (IEA) every four years since 1995 (Mullis, Martin, Foy, & Arora, 2012). TIMMS is an international assessment idea developed by the International Association for the Evaluation (IEA) of Educational Achievement to allow participating nations to compare students' educational achievement across countries. In TIMSS2011 students from 63 countries were involved. For more detail about TIMSS 2011 and TIMSS in general see *Methods and procedures by* Martin and Mullis, (2012) and *TIMSS 2011 Assessment Frameworks* by Mullis, Martin, Ruddock, O'Sullivan and Preuschoff (2009).The present study, the focus is on the eighth grade (second year in junior secondary school (JSS2)) students which includes 45 countries. The 7323 (47% girls) Ghanaian students who participated in TIMSS2011 formed the sample in the present study. The mean age was 15.81 with standard deviation of 1.50. All students were in the eighth grade (JSS2) involving 163 schools, and a further Sampled of one classroom per school. TIMSS 2011 used a stratified two-stage cluster sample design. Students are sampled in two stages, first by randomly selecting a school and then randomly selecting a class from within the school. Weighted school, class, and student participation rates were 100% for both school and class participation and 97% for student participation. School-level exclusions consisted of special education schools (0.6%), and small schools (school measure of size (MOS) < 10).

Ghana operates on a 6-3-3-4 system of education: Primary School—6 years, Junior High School—3 years, Senior High School—4 years and University Bachelor's degree –4 years. On a more detail note, the education in Ghana is in three phases: the compulsory basic education for ages between four and fifteen (kindergarten (Age 4-6), primary school (age 6-11), and junior secondary school (12-15)), secondary education (senior secondary school, technical and vocational education) and tertiary education (universities, polytechnics and training colleges). Children enter primary school the calendar year of their

6th birthday. Promotion is automatic in Grades 1–6 and dependent on academic progress for Grades 7–9. In public schools, promotion is mostly automatic whereas in the private school is mostly based on assessment.

The sole language of instruction is mainly English except at the kindergarten whereby students are taught in the native language spoken at the vicinity of the school. All prescribed textbooks and materials used in various schools are in English.

Based on education for all global monitoring report (UNESCO, 2012), 87% of students from low SES homes enter primary school, but only 72% completes, compare to 100% enrolment of children form high SES homes, of which 80% complete the primary education. Moreover, 60% of children from Low SES enter primary school at least two years older than official age, compared to 32% for children from the high SES.

3.2. Weighting and clustering

Analysis was based on TIMSS TOTWGT—which ensures that the weighted sample corresponds to the actual sample size. Another reason for using the sampling weights is to avoid bias (Bosker & Snijders, 1999). Class was used as the clustering variable because class was used to uniquely identify the sampled classrooms in the data.

3.3. Achievement

TIMSS (Martin & Mullis, 2012) used item response theory (IRT) to scale and report students' achievement scores (e.g., mathematics) into five plausible values— which are random numbers drawn from the distribution of scores that could be reasonably assigned to each individual. In mathematics, the content domains that students' were accessed are algebra, data and chance, number, and geometry. With advice from TIMSS2011 (Foy, Arora, & Stanco, 2012) user guide the five plausible values was used as measures of student achievement. Ghana had significant percentages of very low eighth-grade performing students (percentage of students with achievement too low for estimation exceeded 25%) (Mullis, Martin, Foy, & Arora, 2012) as such any interpretation on achievement should be done with caution. The Cronbach's alpha reliability for the five plausible values is 0.946.

3.4. Measures

The measures included students' response to question about themselves. It includes student gender, 11 instruments asking students to either response to having some selected socioeconomic items at home or not. The items are shown in table 1 (Items a-k) and the basic statistics and the correlations between these 11-items are shown in Table 2. Items (a-e) were common to all participating countries but items g-k was specific to Ghanaian students (see Foy, Arora, & Stanco, G. (2013a, b). Other question ask students to report their guardian's highest level of education, (i.e., what is the highest level of education completed by your mother (or stepmother or female guardian) and father (or stepfather or male guardian))? Response options: " Some primary school or did not go to school "; "Junior high School / middle school leaving certificate "; " Senior secondary / secondary technical / GCE O level "; " Post-secondary / teacher/ nursing training / GCE A level "; " National diploma "; " first degree"; "Post graduate"; "Not applicable". These responses were collapsed into 5-categories: "first degree and beyond = University or higher", "Post-secondary / teacher/ nursing training / GCE A level/National diploma = Post-Secondary Education but not University", "Senior secondary / secondary technical / GCE O level = Upper-secondary", "Junior high School / middle school leaving certificate = Lower-Secondary", and "Some primary school or did not go to school = Some primary or lower-secondary or Did not go to school". Using these categories, the higher value (i.e., higher education level) of the variables for the response female guardian and male guardian is retained (see Foy, Arora, & Stanco, G. (2013a, b).

Gender was coded '1' as females and '2' for males. Another background variable was whether students speak the language of instruction/exams at home. The question asks if the students speak the language of the test at home. The statement of the question is "How often do you speak English at home?" This variable was coded '4' for always, '3' for almost always, '2' for Sometimes, and '1' for Never.

For students Long-term educational aspirations, students were ask to report the highest educational level they want to achieve, (i.e., How far in your education do you expect to go?). Response options: "1 = Junior Secondary School (JHS)", "2 = Senior Secondary School", "3 = post sec/teacher/nursing training", "4 = polytechnic", "5 =

University/first degree", "6 = Beyond first degree". "7 = I don't know (recoded as part of those students who intend to finish JHS)".

Lastly, the students were asked to respond to four- items asking how their parents were involved in their education. Two parental involvement scales were constructed: parental child-discussion (PCD) and home-work help discussion (HHD). The PCD had two items (item 1 and item 2; table 2) with Cronbach's alpha reliability of 0.61, and PCD also had two items with Cronbach's alpha of 0.74.

Table 1. Study Variables

A: Socio economic measure			
Do you have any of these things at your home?	Coverage		Total Coverage %
	Yes (1)	No (2)	
a) Computer	24.76%	74.30%	99.05
b) Study desk/table for your use	48.85%	47.64%	96.49
c) Books of your very own (do not count your school books)	65.79%	30.86%	96.65
d) Your own room	30.91%	66.35%	97.26
e) Internet connection	10.87%	86.03%	96.91
f) Calculator	41.58%	55.51%	96.09
g) Dictionary	48.54%	48.33%	96.87
h) Electricity	69.32%	27.52%	96.84
i) Car/motorbike/bicycle	36.22%	60.78%	97
j) Tap water	39.04%	57.72%	96.76
k) Chalk/Blackboard	31.23%	66.25%	97.62
B: Parent education (female guardian and male guardian)	FG	MG	
	79.91%	77.18%	
1 = Some primary school or did not go to school	27.90%	17.86%	
2 = Junior high School / middle school leaving certificate	30.52%	22.74%	

3 = Senior secondary / secondary technical / GCE O level	10.91%	17.51%	
4 = Post-secondary / teacher/ nursing training / GCE A level	5.65%	8.49%	
5 = National diploma (HND)	1.47%	3.10%	
6 = First degree	1.84%	4.40%	
7 = Post graduate	1.61%	3.09%	
I don't know	10.80%	12.73%	
Parent education collapsed into 5-categories*[p]			85.17
1 = Finished some primary or lower-secondary or Did not go to school			17.33%
2 = Finished Lower-Secondary			26.36%
3 = Finished Upper-secondary			18.85%
4 = Finished Post-Secondary Education but not University			13.64%
5 = University including Master/Doctorate			8.99%
C: How often do you speak English at home?*			99.12%
4 = Always			16.85%
3 = Almost always			9.65%
2 = Sometimes			69.70%
1 = Never			2.91%
D:Students Long-term Educational Aspirations (LEA)			96.03
1 = Junior Secondary School (JHS)			3.16
2 = Senior Secondary School			4.19
3 = post sec/teacher/nursing training			12.37
4 = polytechnic			3.93
5 = University/first degree			41.83
6 = Beyond first degree			26.41
7 = I don't know[e]			4.14
E: Parental involvement*			

4 = Every day or almost every day,

3 = Once or twice a week

2 = Never or twice a month

1 = Never or almost never

F: Parental Involvement	
a) My parents ask me what I am learning in school	96.59
b) I talk about my schoolwork with my parents	94.49
c) My parents make sure that I set aside time for my homework	94.14
d) My parents check if I do my homework	94.41

* Scales were reverse so that higher value means higher response.
FG = Female guardian or parent
MG = Male guardian or parent
p. FG=female parent of female guardian, MG = male parent or male guardian. See Foy et al (2012) for detail process involving in creating this variable.
z. Parent involvement have two constructs parental child-discussion (PCD: a and b) and home-work help discussion (HHD: c and d)).
e. Later recoded as part of those students who intend to finish Junior Secondary School

Table 2 shows the relationship between the parental involvement items and the basic statistic associated with each variable. Table 3 shows the relationship and basic statistics associated with measures in the study. A detail look at the descriptive statistic (Table 1) for students with internet access in Ghana, only 10% of the students has access to internet at home and about 25% reported to have computers at home. With this, only 6% have computer with internet access. With this modern ICT age this is big problem.

Table 2. Description Statistics for the parental involvements items

Items	1	2	3	4
My parents ask me what I am learning in school (1)	1			
I talk about my schoolwork with my parents (2)	0.45**	1		
My parents make sure that I set aside time for my homework(3)	0.49**	0.39**	1	
My parents check if I do my homework (4)	0.53**	0.39**	0.59**	1

MEAN	3.32	3.02	3.28	3.07
SD	1.01	1.01	1.10	1.20

Table 3 Means, Standard Deviations and Correlations between all variables in the study

	1	2	3	4	5	6	7	8
Gender (1)	1							
LEA (2)	0.06**	1						
PEDU (3)	0.05**	-0.07**	1					
SES (4)	-0.03**	0.08**	-0.35**	1				
ACH (5)	0.15**	0.37**	-0.14**	0.12**	1			
PCD (6)	-0.01	0.07**	-0.17**	0.22**	0.09**	1		
HHD (7)	-0.02	0.08**	-0.23**	0.25**	0.12**	0.58**	1	
Lang (8)	0.02	0.05**	-0.08**	0.09**	0.00	0.15**	0.12**	1
Mean		4.53	3.38	1.94	330.83	6.21	6.25	2.39
SD		1.41	1.24	0.72	85.56	1.80	2.11	0.81

Parental Child-Discussion (PCD), Home-work help discussion (HHD), Students' Socioeconomic Status (SES), PEDU = Parental Education; LEA = Students' long term Educational Aspirations; LANG = speaks English at home—the language of instruction in Ghanaian schools, ACH = Maths achievement.
**$p < 0.01$ (2-tailed).

3.5. Missing values

Missing data analysis was conducted for each separate analysis. For the LCA, the analysis indicated that all the variables (100%) and 11.39% of the participants have at least one missing value (66.61% of the sample have sample complete data), but not many values were missing. Only 2.77% of the data points were missing. The missing data analysis shows that if listwise deletion is used, 11.39% cases will be lost. This made the use of imputation advisable. The variable with the most missing data was "having a study deck at home" (3.46%) with "having a computer at home" having the least missing values (< 1%).

For the multinomial logit latent-class regression, patterns of missing data shows that 60% of the variables and 16.80% of the respondents have at least one missing value, but not many values are missing (83.20%). Only 3.94% of the data are missing. This shows that one might lose as many as 16.80% of the cases if listwise deletion is used. The variable with most missing data is parental education (14.83%). This is due to the fact that 10.91 % of students reported that they do not know their female guardian or parent education whereas 13.28% reported that they do not know their male guardian or parent education (see Table 1)..

The missing includes students who reported that they don't know their parents education. This has the potential of reducing power and accuracy of results with this variable (more than 10% missing on a variable is problematic). Some form of imputation seems advisable.

For all analyses involving the use of the Mplus program (e.g., LCA) missing data was treated using Mplus feature of full information maximum likelihood (FIML). All the variables used in further analysis was incorporated into the LCA analysis as auxiliary variables. Table 1 indicates data coverage for each variable in the data set. All variables have almost complete data set (> 95%), except the parent education variable (female guardian and male guardian).

4. Analyses

The analyses proceeded in two stages. First, latent class analysis (LCA) or latent structure analysis (Goodman, 1974; Lazarsfeld & Henry, 1968) was used to classify students into groups based on their reported socio-economics indices (see Table 1: socioeconomic measure). Statistical package Mplus, Version 7.2 (L. Muthén & Muthén, 2013) was used for the LCA analysis. LCA is a statistical procedure similar to factor analysis that classifies individual into heterogeneous subgroups (latent classes) (Geiser, 2013). In contrast to factor analysis, which is concerned with the structure of the variables (i.e., their correlations), however, LCA provides classification of individuals (Muthén & Muthén, 1998-2012). LCA does seem more strongly related to cluster analysis than to factor analysis. LCA is exploratory in nature so that the relations between the items are explained by the presence of unknown a priori latent classes. That is "…individual differences in observed item response patterns are explained by difference in latent class membership, where each class shows a characteristics, class-specific response profile"(Geiser, 2013 , p. 232).

Analyses were based on the Mplus robust maximum likelihood estimator (MLR). To account for the clustering (hierarchical structure) of the data, the analysis involved Mplus complex mixture data analysis. To address any problem of local maxima, 2000 random sets of start values and 100 initial stage iterations were used (Geiser, 2013; L. Muthén & Muthén, 1998-2012; Uebersax, 2000).

Second, the LCA profiles were saved together with other background variables for subsequent analysis including analysis of variance (ANOVAs), discriminant function analysis, cross-tabulations, and regression analysis to analyses the relationship between class membership and external variables such as gender, parental education, parental involvement (two subscales: parental child-discussion (PCD) and home-work help discussion (HHD), and students' educational aspirations. Cross-tabulations, Analysis of variance (ANOVAs), hierarchical regression, and discriminant function analysis were done with IBM SPSS Statistics (IBM SPSS Statistics ver. 22, 2013). Moreover, all data cleansing were done in IBM SPSS Statistics (ver. 22).

Two types of regression models were carried out in the thesis. For the predictors of SES-profiles a multinomial logit latent-class regression models were used. For the multinomial logit latent-class regression models, after identifying the SES- profiles, using the SES-profiles as the dependent variable, parental education was recoded into a dichotomous dummy variable (coded 1 below the mean—below senior secondary and 0 above the mean—post senior secondary), achievement variable-composite of the five plausible values, parent-child discussion, parental home-work help, English spoken at home recoded as a dichotomous variable (coded 1 for 'never' and 'sometime' and 0 for 'almost always' and 'always'), students educational aspiration recoded as a dichotomous variable (1 'below the mean and 0 'above the mean (M = 4.54)) were included in the model as covariates.

For the predictors of students' achievement, hierarchical regression was conducted by entering: gender, parental education, student's SES, educational aspirations, speaks English at home, and parental involvement (parental child-discussion (PCD) and home-work help discussion (HHD) as predictor variables for achievement in that order. See Table 10 for detail reporting. Dummy variables were created for the students parental education (4 dummies), aspirations (4 dummies), speaks English at home (3 dummies), and student socioeconomic status (2 dummies).

Discriminant function analysis (e.g., Tabachnick & Fidell, 2001) is typically used to determine which variables discriminate between two or more previously identified groups and how accurately individuals can be classified into groups on the basis of selected variables. In the analysis phase, a classification rule is developed using cases for which group membership is known. Here we used discriminant function analysis to evaluate the validity of the SES groups.

4.1. Classifying Students into SES Profiles and Goodness of Fit

The first step in an LCA is to determine the number of groups which should be well-defined with well differentiated profiles (e.g., Marsh, Lüdtke, Trautwein, & Morin, 2009; Pastor, Barron, Miller, & Davis, 2007). The literature advice against the use of only goodness-of-fit in CFA research, as "golden rules" in identifying the number of latent class (Markland, 2007; Marsh, Hau, & Wen, 2004; Marsh, Hau, & Grayson, 2005; Marsh et al.,

2009). Because there are different opinions as to how best to get the appropriate number groups in LCA analysis, consistent with the norm in LCA, different solutions with different class solutions were estimated, and the one that makes sense in relation to substantive theory, common sense, the nature of the groups, and group interpretability was considered (Collins & Lanza, 2010). In addition, the goodness-of-fit indexes and tests of statistical significance were considered (Collins & Lanza, 2010; Marsh et al., 2009).

In the present study, to compare the fit of models with different number of classes: the Vuong-Lo-Mendell-Rubin (VLMR) (VLMR: Lo, Mendell, & Rubin, 2001 test in addition to the Baysian Information Criterion (BIC) were used. This have been shown to help identify the right number of latent profiles/classes (Nylund, Asparouhov, & Muthén, 2007; Tofighi. D., Enders, C. K., 2008). The Vuong-Lo-Mendell-Rubin (VLMR) test is based on the same principle as the LR difference test. A significant value of the VLMR test shows that the estimated model fits significantly better than the model with one class less (Nylund et al., 2007).

Lastly, the latent class probabilities (see Table 3) which indicates how individuals are assigned to their respective classes were used for the class profiling. Also the average latent class assignment probabilities will be accessed with values on the main diagonal being equal or greater than 0.80 (Geiser, 2013). As a guideline, the size of the smallest group of an acceptable solution should at least exceed 5% of the sample (Chow, Eccles, & Salmela-Aro, 2012; Marsh et al., 2009). The group membership information on each student was saved and used for further statistical procedures including cross-tabulations, and regression analyses to investigate the associations between SES profile membership, gender, parental education, parental involvement, and students' educational aspirations and achievement.

Table 4 lists the fit information for the models with one through five classes. The BIC indexes continue to decrease across the range of models considered, suggesting no specific number of groups. This may be due to the large sample size, as BIC is sample size dependent (Marsh et al., 2009). The result based on VLMR was not consistent. The Vuong-Lo-Mendell-Rubin (VLMR) was highly significant ($p < 0.001$) for the two-class solution. For the three-class solution the VLMR was marginally significantly ($p < 0.05$). The VLMR

solution of three-class solution was the best because the four-class solution was not interpretable as the three-class solution. Average latent class probabilities for most likely latent class membership were above the accepted cut-off mark (>0.70). All the groups in three-class solutions comprised group(s) with more than 5% of the cases (class 1: 24.39%, class 2: 30.25%, and class 3: 45.37%). An inspection of the log likelihood values indicated a shape decrease from the 2-class solution to the 3-class and very smooth decrease thereafter. The four-class solution contains a boundary estimate (two conditions response probabilities were estimated to be exactly 0). The three-class solution had the highest entropy estimate (0.63 vs. 0.57 for 3- and 4-class models respectively), suggesting there is greater classification uncertainty with the extraction of one additional class. The three-class solution was identified as the optimal solution, because it appears to provide a more reasonable representation of the data. The three-class solution was easy to interpret (and more parsimonious); a decision further confirmed by the unique characteristics across the groups of the three-class model. Also the log likelihood increases smoothly and reached a stable maximum in the 3-class solution compared to the 4-class model. Table 3 indicates the latent class probabilities and figure 1 shows the estimated probability plots for both responses.

Table 4 Indices for latent class analysis

Class	P	log likelihood (L)	BIC	Entropy	VLMR	Average Latent Class Probabilities		
						1	2	3
1	11	-47836.03	95769.88			0.85	0.00	0.15
2	23	-44162.14	88528.79	0.71	0.00	0.00	0.86	0.14
3	35	-43715.66	87742.55	0.63	0.04	0.10	0.10	0.80
4	47	-43584.91	87587.75	0.57	0.46			
5	59	-43470.07	87464.78	0.61	0.41			

NB: BIC = Bayesian information criterion; VLMR =Vuong-Lo-Mendell-Rubin, P = Number of Parameter estimates.

5. Results

5.1. SES Profiles

Table 5 contains the response probabilities—probability of being in a particular latent class and responding yes or no to the 11 latent class indicators obtained in the 3-class model. The first column (class-1) shows about 24% of the sample having high item response. The students in this class have the higher probabilities endorsement for all items (computer [0.69], study desk [0.74], books [0.87], own room [0.48], internet [0.31], calculator [0.80], dictionary [0.88], electricity [0.94], car/motorbike/bicycle[0.66], tap water [0.70], chalk/blackboard [0.64], own room [0.48] and internet [0.31]). For the "own room" and "internet" usage the probabilities were higher for not having them at home. But yet still, this class have the highest probability endorsement. Because the unique characteristic of the class, it was named as the high-SES.

Table 5. Latent class probabilities from 3-class model

Items	Class 1-High-SES 24.39%	Class 2-Low-SES 30.25%	Class 3-Intermediate-SES 45.37%
Computer			
Yes	0.69	0.10	0.07
No	0.31	0.90	0.93
Study desk			
Yes	0.74	0.16	0.63
No	0.26	0.84	0.37
Books			
Yes	0.87	0.36	0.79
No	0.14	0.64	0.21
Own room			
Yes	0.48	0.15	0.36
No	0.52	0.85	0.64
Internet			
Yes	0.31	0.01	0.07

No	0.69	0.99	0.94
Calculator			
Yes	0.80	0.06	0.46
No	0.21	0.94	0.54
Dictionary			
Yes	0.88	0.10	0.53
No	0.12	0.90	0.47
Electricity			
Yes	0.94	0.45	0.71
No	0.06	0.56	0.29
Car/motor/bicycle			
Yes	0.66	0.09	0.38
No	0.34	0.91	0.63
Tap water			
Yes	0.70	0.12	0.38
No	0.30	0.89	0.63
Chalkboard			
Yes	0.56	0.06	0.35
No	0.44	0.94	0.65

The second column (class-2), about 30% of the sample full within this category and had a very low item response endorsement probabilities. The two highest probabilities across this class is having an electricity [0.45] and books [0.36]. Due to the pattern of endorsement, the class shows a pattern of students with a very low-socioeconomic status (SES); as such the class was named as Low-SES.

Looking at the third column (class-3) around 45% (4-items) have high probabilities endorsement (i.e. study desk [0.63], books [0.79], dictionary [0.53], electricity [0.71], and calculators [0.46]). Other items had a moderate endorsement probability except having a computer and internet access. Given the modest endorsement, the class was named as Intermediate-SES.

The class profile plot shown in figure 1, shows how the classes differ from one another. The largest class is the intermediate or middle SES, followed by the low-SES and the high-SES.

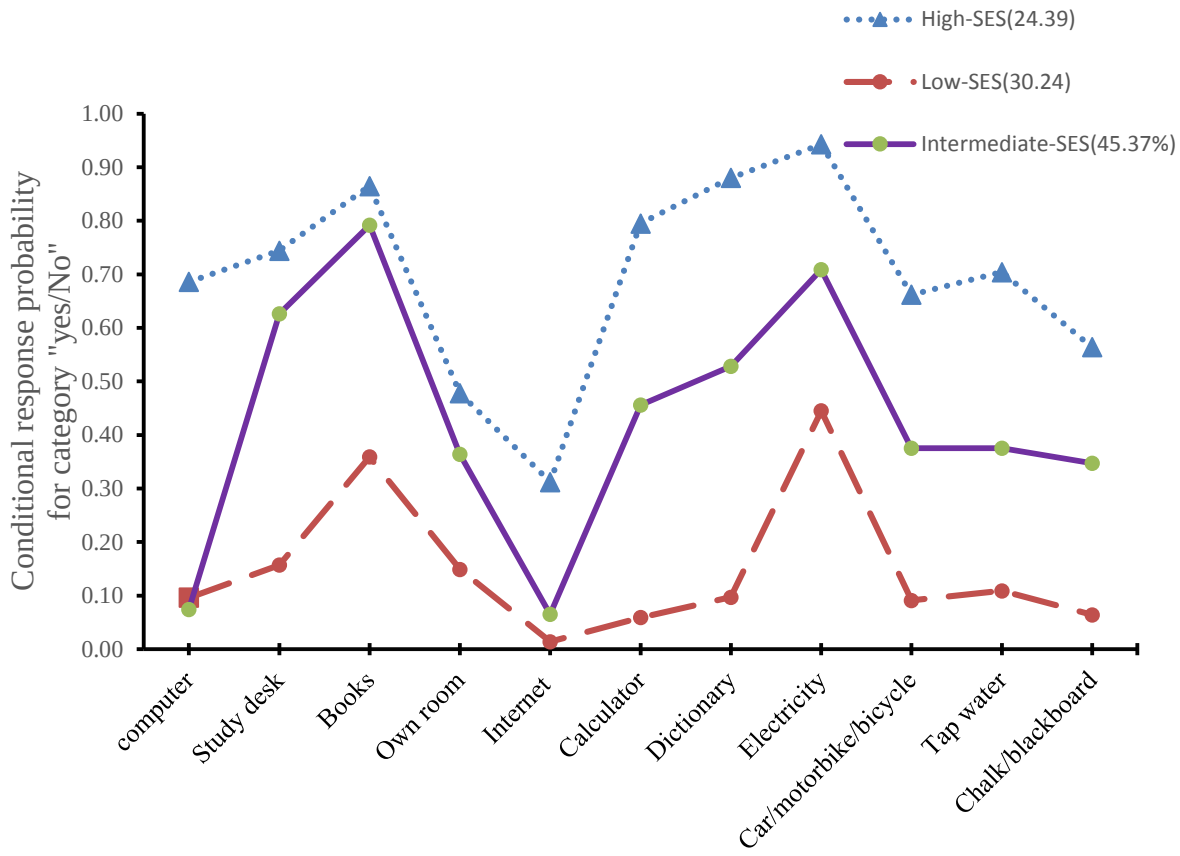

Figure 1: Estimated Probability Plots indicating the Socio-economic Profiles of the Students

5.2. Discriminant analysis

The discriminant analysis was used to verify the degree to which groups are accurately classified. The discriminant analysis revealed two discriminant functions (because there were three groups, only two discriminant functions are possible). The discriminant analysis based on the eleven household items was able to correctly classify 92.2% of the individual students into their appropriate SES group (based on the three LPA grouping).

The two discriminant functions were statistically significant. However, the first discriminant function accounts for 89.73% of the between-group (explained) variance while the second accounts for the remaining between-group variance (i.e., 10.27%). The squared canonical correlations, the effect sizes for the discriminant functions were $(0.91)^2 = 0.83$ and $(0.59)^2 = 0.35$.

The stability of the classification procedure was checked by a cross-validation run. Approximately 25% of the cases were withheld from calculation of the classification function in this run. For the 75% of the cases from whom the functions were derived, there was a 92.2% correct classification rate. For the cross-validation cases, classification was 92.1%.

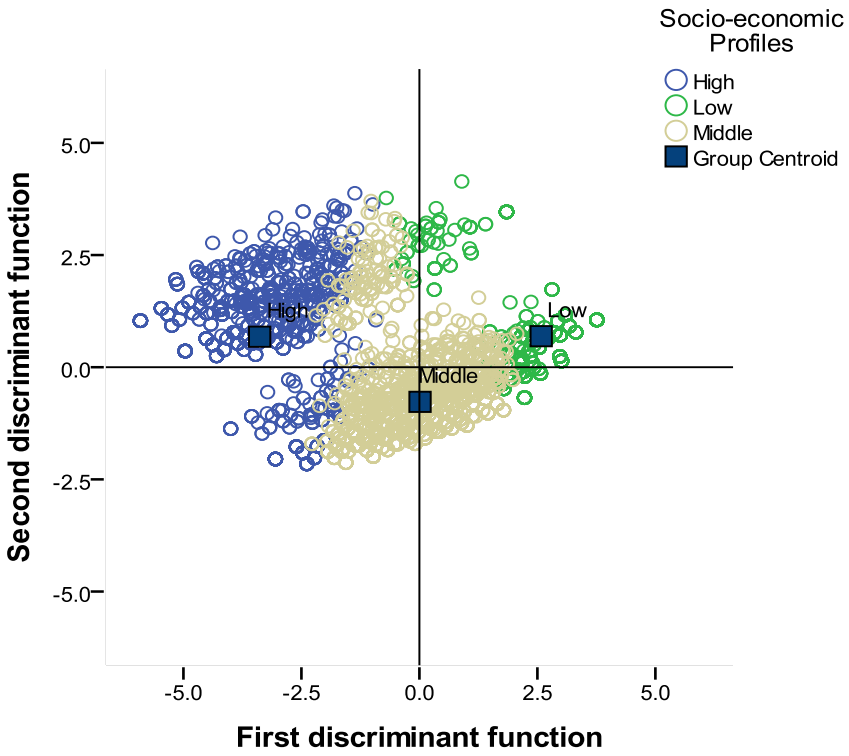

Figure 2. Centroids of the three socio-economic profiles on the two discriminant functions derived from data set.

This indicates a high degree of consistency in the classification scheme. The discriminant function plot (Figure 2) showed that the first function discriminated students

in the high SES from students in the Low SES group, and the second function differentiated the SES group from the two other groups (Low- High-SES). Other words, it takes both discriminant functions, to separate the three groups from each other. This finding provides support for the validity of the three groups derived from the LCA. Most of the variance could be explained in terms of two discriminant functions.

5.3. Test of invariance across gender

The gender invariance of the class probabilities was tested. The reason to ascertain if the class probabilities (Table 5) were the same across students' gender to help generalized the findings. Measurement invariance is testing the equivalence of the parameters (e.g., intercepts or thresholds of the item) of a measured construct in two or more groups (e.g., students' gender). Two models were tested, in the first model item thresholds and class probabilities across groups-gender (M1) were freely estimated, the second model the item thresholds across groups were freely estimated, and fixing class probabilities across groups and classes (M2) to be invariance(equal). The entropy were much the same (M1 vs. M2: 0.79 vs. 0.79) and BIC (97865.56 vs. 97864.25), L^2 (-48617.11: scaling correction factor 2.9712 vs. -48625.34: scaling correction factor 2.87). The difference between the unconstrained (M1) and constrained model (M2) was not significant, ΔL^2 (2) = 2.55, p = 0.279 (ΔBIC = 97865.56-97864.25 = 1.30), suggesting the constraints did not significantly affected the model fit. That is the two models are not significantly different. The models indicated the three SES were the same across students' gender. We can thus generalize that in Ghana both female and male students' socio-economic backgrounds can be classified into low, and high, based on amenities at home.

5.4. Linking parental involvement, achievement, gender, parental education, long-term educational aspirations, and language spoken at home to SES-profiles

After identifying the SES profiles, a multinomial logit latent-class regression models were posited to examine the association between SES-profiles and parental involvement, achievement, gender, parental education, students' long-term educational aspirations, and language spoken at home. As Table 6 shows, when using the High-SES as the reference

group, those in the Low-SES were less likely to have parent-child discussions (OR = 0.80, 95% CI [O.72, 0.90]) and Home-work Help Discussion (OR = 0.71, 95% CI [O.64, 0.78]). They were also more likely to be male (OR = 1.59, 95% CI [1.15, 2.20]) and are 13 times more likely not to have a highly educated parent (OR = 13.64, 95% CI [8.74, 21.28]), and almost twice more likely to have a lower educational aspirations (OR = 1.82, 95% CI [1.15, 2.90]). A look at the OR CI for mathematics achievement (OR = 0.994, 95%CI [O.991, 0.998]) and not speaking English at all at home (OR = 1.36, 95% CI [0.92, 2.03]) indicates that mathematics achievement and not speaking English at home are not significantly associated with students in the Low SES group.

Table 6. The relationship between SES and background variables

Variables	High-SES vs. Low-SES			High-SES vs. Intermediate-SES		
	Odds Ratio	95% CI for Odds Ratio		Odds Ratio	95% CI for Odds Ratio	
PCD	0.80	0.72	0.90	0.89	0.80	0.99
HHD	0.71	0.64	0.78	0.83	0.75	0.91
ACH	0.994	0.991	0.998	0.995	0.991	0.998
GENDER	1.59	1.15	2.20	1.43	1.01	2.02
LANG	1.36	0.92	2.03	1.50	1.10	2.04
PEDU	13.64	8.74	21.28	4.50	3.12	6.48
LEA	1.82	1.15	2.90	1.87	1.21	2.88

Parental Child-Discussion (PCD), Home-work help discussion (HHD), students' achievement (ACH), Students' Socioeconomic Status (SES), PEDU = Parental Education; LEA = Students' long-term Educational Aspirations; LANG = speaks English at home—the language of instruction in Ghanaian schools.

Using the same reference class comparison, being a member of the Intermediate-SES group was associated with a lower likelihood of having parent-child discussions (OR = 0.89, 95% CI [0.80, 0.99]) and Home-work Help Discussion (OR = 0.83, 95% CI [0.75, 0.91]). The OR CI (OR = 0.995, 95% CI [0.991, 0.998]) for mathematics achievement indicates that mathematics achievement is not significantly associated with any of the SES group. Intermediate-SES are also more likely to speak some English at home (OR = 1.50, 95% CI [1.10, 2.04]), were more than 4 times less likely to have a highly educated parent

(OR = 4.50, 95% CI [3.12, 6.48]), and almost twice more likely to have a low educational aspirations (OR = 1.868, 95% CI [1.213, 2.879]).

Moreover, a chi-square analysis was used to give a detail analysis between SES and students' gender. There was a significant association between students' socioeconomic background and student Gender χ^2 (2) = 8.04, $p < 0.05$, Cramer's V =0.03. Cramer's' V though significant ($p < 0.005$) do not indicate a strong relationship. As table 7 indicates, there was no significant difference between the proportion of boys and girls in the high socioeconomic class. There was a significant difference between the proportion of boys (30.6%) and girls (27.7%) in the low socioeconomic class. To be more specific, more boys were found to belong to the low-SES than girls. The columns with different subscripts have significantly different column proportions.

Table 7. Students' socio-economic status by gender

				Gender of Student		
				Girl	Boy	Total
Socioeconomic status	Low	Count		956_a	1169_b	2125
		%	within Gender	27.70%	30.57%	29.21%
	Intermediate	Count		1678_a	1817_a	3495
		%	within Gender	48.62%	47.52%	48.04%
	High	Count		817_a	838_a	1655
		%	within Gender	23.67%	21.91%	22.75%
Total		Count		3451	3824	7275
		%	within Gender	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of gender categories whose column proportions do not differ significantly from each other at the .05 level.

From the students' socio-economics profiles, the Chi-Square test for contingency table was used to study the relationship between students' socio-economic profile and parental education. The findings indicate that students' socio-economic profiles and

parental education are significantly related, Pearson χ^2 (8) = 874.26, $p < 0.001$, Cramer's V =0.27 (see table 8).

Table 8. Contingency Table of students' socio-economic status by Parental Education

			socioeconomic status			
			low	intermediate	high	total
Parental education	some primary, lower secondary or no school	Count	659_a	530_b	71_c	1260
		% within SES	34.74%	17.95%	5.13%	20.21%
	lower secondary	Count	732_a	1005_b	306_c	2043
		% within SES	38.59%	34.03%	22.13%	32.78%
	upper secondary	Count	252_a	724_b	371_b	1347
		% within SES	13.28%	24.52%	26.83%	21.61%
	post-secondary but not university	Count	158_a	449_b	359_c	966
		% within SES	8.33%	15.20%	26.96%	15.50%
	university or higher	Count	96_a	245_b	276_c	617
		% within SES	5.06%	8.30%	19.96%	9.90%
Total		Count	1897	2953	1383	6233
		% within SES	100.0%	100.0%	100.0%	100.0%

NB: Each subscript letter denotes a subset of socioeconomic status categories whose column proportions do not differ significantly from each other at the .05 level.

Within the Low-SES students the percentage of students with parental education lower than upper secondary was higher. The Intermediate-SES is mostly of parents with lower secondary to post-secondary but not university (e.g., teacher training, nurses), whereas the high-SES is parents with education within and above upper secondary. There is no significant difference between the proportion of students in the Intermediate-SES and High-SES whose parents' education is the upper secondary schools.

5.5. Relationship between Gender, SES, and parental involvement

Hear the analysis involve using multivariate analysis of variance (MANOVA) with the two parental involvement (PCD and HHD) constructs as the dependent variables. The independent variables included in these analyses are gender and SES. Pillai's criterion statistical measure was used because it is immune to violations of the assumptions underlying MANOVA (e.g. unequal sample sizes) and still maintains the greatest power.

Table 9. Multivariate and Univariate Analysis of Variance for Parental Child-Discussion (PCD) and Home-work Help Discussion (HHD).

Source	Multivariate	Univariate	
	F^a	Parental Child-Discussion[b]	Home-work Help Discussion[b]
Gender	0.24	0.45	0.27
SES	122.43*	150.63*	233.03*
Gender x SES	0.81	0.33	0.80
Mean Square Error (MSE)		2.99	4.16

Note: Multivariate f-ratios were generated from Pillia's Trace.
a. Multivariate *df* = 2, 6749 (students gender), 4, 13500 (students SES)
b. Univariate *df* = 1, 6750 (students gender), 2, 6750 (students SES)
*$p < 0.001$

Using Pillai's trace (see table 9), parental involvement was significantly ($p < .001$) affected by the main effect of SES $F(4, 13500) = 122.43$, Pillai's trace = 0.07, Partial $\eta^2 = .04$. However, gender (2, 6749) = 0.24, Pillai's Trace = 0.00, partial $\eta^2 = .00$, and the interaction effects with SES $F(4, 13500) = 0.81$, Pillai's Trace = 0.00, partial $\eta^2 = .00$ have no influence on parental involvement.

Table 10. Mean Scores and Standard Errors for Measures of Parental Child-Discussion (PCD) and Home-work Help Discussion (HHD) as a function of students Socioeconomic Profile

	Parental child-Discussion (PCD)		Home-work Help Discussion (HHD)	
Groups	*M*	*SE*	*M*	*SE*
Low SES	5.77^{a}	0.04	5.53^{x}	0.05
Intermediate SES	6.33^{b}	0.03	6.34^{y}	0.04
High SES	6.78^{c}	0.05	7.02^{z}	0.05

Note: Column Means with different superscripted letters are significantly different at the 0.001 level by means of a Bonferroni post hoc test.

A further analysis using a Bonferroni adjusted alpha, showed that the three SES groups differed significantly on PCD ($F(2, 6750) = 150.63$, Partial $\eta^2 = .04$), and on HHD ($F(2, 6750) = 233.03$, Partial $\eta^2 = .07$). This effect sizes indicated a medium size effect. The results indicated that in both of these subsets the mean of parental involvement in the any of the SES were statistically different from each other (Table 9).The means shown in Table 10, indicated that parental involvement (PCD, HHD) were stronger in the high-SES homes, followed by the Intermediate-SES and lastly the low-SES Homes.

The summary chi square relationships between students backgrounds variables indicated that there was a significant relationship between background variables and students socioeconomic backgrounds. For the parental education, the chi-square indicated that students in the intermediate SES group were students who parents have upper secondary education and a professional degree (e.g., teacher training, nurses), whereas the high-SES were mainly students whose parents have education above the upper secondary to the university and above. There was no significant difference between the proportion of students in the Intermediate-SES and High-SES whose parents' education is the upper secondary schools.

With respect to the relationship between educational aspirations and SES, there was no significant difference between the proportion of students whose educational aspirations

were Junior High School, or Polytechnic, or the university. For all educational aspirations from the post-secondary but not university and above, there was no significant different between the proportion of students within the Low-SES and Intermediate-SES. Most students who aspire to go to university and above were mostly students within the High-SES. For Low-SES and Intermediate-SES the educational aspiration were above post-secondary inclusive. Very perplexing finding was that students more often aspire to go to the post-secondary education rather than to professional education (e.g. nursing and teacher training) than to the countries polytechnics. This may be due to the negative perception that polytechnic education is inferior to university education in Ghana (see Gyasi, 2014).

5.6. Linking SES group membership to Long-term Educational Aspirations

The relationship between students' socio-economics status and parental education was significant, Pearson $\chi 2$ (10) = 136.49, $p < 0.001$, Cramer's V =0.10. Cramers' V though highly significant ($p < 0.001$) indicates a very weak relationship (see table 11). In table 11, the columns with different subscripts have significantly different column proportions. A look at the table indicated that there is no significant difference between the proportions of students whose educational aspiration were Junior High School, Polytechnic, and the University for all SES groups. For all educational aspirations from the post-secondary but not university and above, there was no significant difference between the proportion of students within the Low-SES and Intermediate-SES groups. Educational aspiration within the High-SES was mostly University and above, for Low-SES and Intermediate-SES the educational aspirations were above post-secondary inclusive. An interesting funding was that students aspire to go to the post-secondary education related to professional education rather than to polytechnics.

Table 11. Contingency Table of students' socio-economic status by Educational Aspirations

			Socioeconomic Status(SES)			
			Low	Intermediate	High	Total
Educational aspirations	junior high school	Count	92_a	111_a	51_a	254
		% within SES	4.76%	3.46%	3.31%	3.80%
	senior high school	Count	136_a	148_b	45_c	329
		% within SES	7.03%	4.61%	2.92%	4.92%
	post-secondary or teacher/nursing training	Count	303_a	509_a	143_b	955
		% within SES	15.67%	15.87%	9.27%	14.29%
	Polytechnic	Count	94_a	170_a	65_a	329
		% within SES	4.86%	5.30%	4.22%	4.92%
	university/first degree	Count	845_a	1433_a	666_a	2944
		% within SES	43.69%	44.67%	43.19%	44.05%
	beyond first degree	Count	464_a	837_a	572_b	1873
		% within SES	23.99%	26.09%	37.09%	28.02%
Total		Count	1934	3208	1542	6684
		% within SES	100.0%	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of Class SES categories whose column proportions do not differ significantly from each other at the .05 level.

5.7. Predictors of mathematics achievement

For the predictors of students' achievement, hierarchical regression was conducted (Table 12). Multicollinearity diagnostic indicated that there was no presence of multicollinearity. Six regression models were involved. The observed variance inflation factor (VIF) for the six regression models were found to lie between 1 and 1.14 (*Tolerance* [0.88, 1.00]) which

was within the acceptable limit (Bowerman & O'Connell, 1990; Field, 2013; Menard, 2002).

The first model predicted mathematics achievement from students' gender. Results indicated a significant gender gap, $b = 0.14$, $p < 0.001$ with boys' having an average mathematics scores that is .014 standard deviations (about 11 points) above those of girls'. The model explained 2% of variance on students mathematics achievement and statistically significant $F(1, 5567) = 0.02$, $p < 0.001$.

In the second model parental education was added. The reference category was "no education or primary education". The gender achievement gap increases, $b = 0.15$, $p <. 001$. This indicates that gender moderates the relationship between students' parental education and students' achievement. Higher parental education predicted higher achievement (University, $b = 0.19$, $p < 0.001$; Post-secondary but not University, $b = 0.12$, $p < 0.001$; Upper secondary, $b = 0.14$, $p < 0.001$; lower Secondary, $b = 0.10$, $p < 0.001$). The model explains 4.9% of the variance in students' mathematics achievement (Adjusted $R^2 = 0.05$).

In the third model students' socioeconomic class was added. With the exception of gender ($b = 0.15$, $p <. 001$), all the achievements gaps in parental education shrank (University, $b = 0.16$, $p < 0.001$; Post-secondary but not University, $b = 0.09$, $p < 0.001$; Upper secondary, $b = 0.12$, $p < 0.001$; lower Secondary, $b = 0.08$, $p < 0.001$, high-SES, $b = 0.08$, $p < 0.001$; Low-SES, $b = -0.03$, $p < 0.05$). This is a possible indication that students' SES mediates the relationship between achievement and parental education. The model explained significantly more variance (R^2 change =0.007, $F(2, 5561) = 21.54$, $p < 0.001$). The model explains 5.6% of the variance in students mathematics achievement (Adjusted $R^2 = 0.06$).

The fourth model additionally included students' educational aspirations. The association with gender diminished compared to the third model ($b = 0.13$, $p <. 001$). There was a slight increase in the achievement predicting of students whose parents have lower secondary school certificate, $b = 0.09$, $p < 0.001$. All the achievements gaps in parental education shrank (University, $b = 0.13$, $p < 0.001$; Post-secondary but not University, $b =$

0.07, $p < 0.001$; Upper secondary, $b = 0.10$, $p < 0.001$; high-SES, $b = 0.06$, $p < 0.001$; Low-SES, $b = -0.02$, n.s). The model indicated that educational aspirations is a significant predictor of achievement (University and above, $b = 0.47$, $p < 0.001$; Polytechnic education, $b = 0.08$, $p < 0.001$; post-secondary including teacher training and nursing colleges, $b = 0.17$, $p < 0.001$; Upper Secondary, $b = 0.05$, $p < 0.05$). The model explained significantly more variance (R^2 change =0.10, $F(2, 5561) = 168.83$, $p < 0.001$). Interestingly, the predicting power of students who aspire to the polytechnics was lower than those who aspire to the professional institutes. The model explains 15.8% of the variance in students mathematics achievement (Adjusted $R^2 = 0.16$).

The fifth model additionally included English language spoken at home. The model indicated that speaking English always at home was not a significant predictor of students' mathematics achievement, $b = 0.05$, n.s; but speaking it almost always, $b = 0.15$, $p <.0.001$; or sometimes, $b = 0.14$, $p <.0.001$) was a significant predictor of students achievement. The model explained significantly more variance (R^2 change =0.01, $F(3, 5554) = 28.28$, $p < 0.001$). The model explains 17.10% of the variance in students mathematics achievement (Adjusted $R^2 = 0.17$).

The sixth and the final model added the two parental involvement subscales (parental child-discussion (PCD) and home-work help discussion (HHD). After introducing all the additional predictors, the model indicated a clear gender gap (Gender $b = 0.13$, $p <. 001$), differences in achievement based on parental education (University, $b = 0.12$, $p < 0.001$,; Post-secondary but not University , $b = 0.07$, , $p < 0.001$; Upper secondary, $b = 0.09$, $p < 0.001$; lower Secondary, $b = 0.08$, $p < 0.001$), students' socioeconomic status (high-SES, $b = 0.05$, $p < 0.001$; Low-SES, $b = -0.02$, n.s), students' educational aspirations (University, $b = 0.46$, $p < 0.001$; Polytechnic education, $b = 0.08$, $p < 0.001$; post-secondary including teacher training and nursing colleges, $b = 0.17$, $p < 0.001$; Upper Secondary, $b = 0.06$ $p < 0.05$), language spoken at home (always, $b = 0.04$, n.s; almost always, $b = 0.14$, $p <.0.001$; sometimes, $b = 0.13$, $p <.0.001$), and parental involvement (PCD, $b = -0.03$, $p < 0.05$, HHD, $b = 0.07$, $p < 0.001$).

The results indicated that boys are expected to have an average mathematics score of .013 standard deviations (about 10 points) above those of girls after controlling for

parental education, students educational aspirations, parental involvement, and language spoken at home. The most important predictor of achievement was high parental education. The model indicated that students with parents whose education was university and above are expected to have average mathematics achievement scores that is 0.46 standard deviations (about 35 points) above others, followed by parents with professional education (e.g., nurses and teachers) about 12 points, and those who speak English almost always (about 11 points) at home and sometime at home (about 10 points). One paradoxical finding was that speaking English always at home was not a significant predictor of mathematic achievement. The other no-significant predictor was low-SES. The model explained significantly more variance (R^2 change =0.003, $F(2, 5552) = 9.14$, $p < 0.001$). The final model explains 17.4% of the variance in students mathematics achievement (Adjusted $R^2 = 0.17$).

Table 12. Hierarchical Regression Analysis Predicting Mathematics Achievement

Model		B	*SE*	B	t	*p*	R^2	Adj R^2	ΔR^2 %
1	(Constant)	303.71	3.26		93.23	< 0.001	2%	2%	
	Gender[a]	21.62	2.03	0.14	10.68	< 0.001			
2	(Constant)	282.28	3.90		72.60	< 0.001	4.9%	4.8%	2.9***
	Gender	22.97	2.00	0.15	11.47	< 0.001			
	Parental Education								
	University[b]	46.58	3.85	0.19	12.10	< 0.001			
	Post sec but not University[b]	24.38	3.38	0.12	7.22	< 0.001			
	Upper Secondary[b]	26.04	3.10	0.14	8.40	< 0.001			
	Lower Secondary[b]	15.61	2.85	0.10	5.48	< 0.001			
3	(Constant)	283.83	4.08		69.59	< 0.001	5.6%	5.5%	0.7***
	Gender	23.24	2.00	0.15	11.65	< 0.001			
	University	38.93	4.02	0.16	9.69	< 0.001			
	Post sec but not University	17.92	3.52	0.09	5.09	< 0.001			

	Lower Secondary	13.37	2.87	0.08	4.66	< 0.001			
	Upper Secondary	21.16	3.21	0.12	6.60	< 0.001			
	Socioeconomic status								
	High-SES[c]	13.71	2.59	0.08	5.30	< 0.001			
	Low-SES[c]	-5.33	2.41	-0.03	-2.21	< 0.05			
4	(Constant)	223.45	6.34		35.26	<0.001	15.8%	15.7%	10.2***
	Gender	19.68	1.91	0.13	10.32	< 0.001			
	University	33.09	3.81	0.13	8.70	< 0.001			
	Post sec but not University	15.49	3.33	0.07	4.65	< 0.001			
	Lower Secondary	14.28	2.71	0.09	5.27	< 0.001			
	Upper Secondary	18.95	3.03	0.10	6.25	< 0.001			
	High-SES	10.37	2.45	0.06	4.23	< 0.001			
	Low-SES	-3.94	2.28	-0.02	-1.73	0.08			
	Educational Aspirations								
	University Degree and above[d]	81.66	5.23	0.47	15.62	<0.001			
	Polytechnic[d]	30.04	6.70	0.08	4.48	<0.001			
	Post-secondary Teacher/Nursing[d]	37.40	5.71	0.17	6.55	< 0.001			
	Senior secondary[d]	18.14	6.73	0.05	2.69	< 0.01			
5	(Constant)	202.85	7.83		25.90		17.10%	16.9%	1.3***
	Gender	20.03	1.90	0.13	10.55	< 0.001			
	University	32.76	3.80	0.13	8.67	< 0.001			
	Post sec but not University	15.27	3.31	0.07	4.62	< 0.001			
	Lower Secondary	13.93	2.70	0.09	5.17	< 0.001			
	Upper Secondary	18.23	3.01	0.10	6.05	< 0.001			
	High-SES	10.31	2.44	0.06	4.23	< 0.001			

	Low-SES	-3.74	2.26	-0.02	-1.66	0.10			
	University Degree and above	79.93	5.19	0.46	15.39	< 0.001			
	Polytechnic	30.29	6.65	0.08	4.55	< 0.001			
	Post-secondary Teacher/Nursing	36.80	5.67	0.167	6.49	< 0.001			
	Senior secondary	20.09	6.71	0.06	2.99	< 0.001			
	speak English always at home[e]	9.46	5.27	0.05	1.80	0.07			
	speak English almost always at home[e]	38.95	5.61	0.15	6.95	< 0.001			
	speak English sometimes at home[e]	23.33	4.85	0.14	4.81	< 0.001			
6	(Constant)	199.37	8.31		24.00	< 0.001	17.40%	17.10%	0.3***
	Gender	19.95	1.90	0.13	10.53	< 0.001			
	University	31.178	3.80	0.12	8.21	< 0.001			
	Post sec but not University	13.63	3.34	0.07	4.09	< 0.001			
	Lower Secondary	12.90	2.70	0.08	4.77	< 0.001			
	Upper Secondary	16.89	3.03	0.09	5.57	< 0.001			
	High-SES	9.58	2.45	0.05	3.92	< 0.001			
	Low-SES	-2.96	2.28	-0.02	-1.30	0.19			
	University Degree and above	78.98	5.19	0.46	15.21	< 0.001			
	Polytechnic	30.05	6.64	0.08	4.52	< 0.001			
	Post-secondary Teacher/Nursing	36.15	5.66	0.17	6.38	< 0.001			
	Senior secondary	20.02	6.71	0.06	2.98	< 0.01			
	Speak English always at home	8.17	5.36	0.04	1.53	0.13			

Speak English almost always at home	37.90	5.66	0.15	6.70	< 0.001
Speak English sometimes at home	22.10	4.91	0.13	4.51	< 0.001
Parental child-discussion(PCD)	-1.37	0.66	-0.03	-2.07	< 0.05
Parental Home-work Discussion (HHD)	2.40	0.56	0.07	4.27	< 0.001

a. Reference category female
b. Reference category no education or primary education
c. Reference category Intermediate-SES (socioeconomic status or profile)
d. Reference category Junior Secondary school
e. Speaks language of instruction at School (English) at home. Reference category never speaks English at home
*** $p < 0.001$

6. Discussion

The main aims of this study were to: 1) examine students' statuses profiles; 2)investigate the relationship between students' SES and their other demographic characteristics such as parental education, language spoken at home, gender and parental involvement;3) determine whether the mathematics achievement levels differed among these differed by SES and other demographic variables (parental education, students aspirations, parental involvement—parent-child discussion, homework help discussion) in the grade eight students in Ghana. The study is based on the fact that most theories and studies on SES are based on constructs in the western hemisphere. The hypothesis was that students from different SES groups would exhibit different types of parental involvement based on their gender, parental education, and students' aspiration. A further hypothesis was that achievement levels would differ by SES, parental education, and educational aspirations.

6.1. Socioeconomic Background and the predictors

Latent class analysis was used to determine the socioeconomic profiles of 8th grade Ghanaian students. The study findings supported other studies that have identified three

classes of students SES (e.g., Sirin, 2005). The first profile was students' in the high socioeconomic class. These students' were mainly students with access to all the listed home resources items including computers, internet, and almost everyone having electricity and tap water at home. The most distinctive items that differentiated the high and intermediate SES students was access to computers, internet, and electricity at home. Those in the low socioeconomic class were students' with a high probability of not having any of the items listed. The present study shows that Ghanaian students from low-SES homes lack the basic access to educational materials (e.g. books). Accesses to these amenities are a function of students SES which is also a function of parental financial resources. In addition, this study indicates that some parents lack the basic academic skills to share with their children and most of these parents have children that fall within the low-SES group. However, there were about 5% of students in the Low-SES whose parents were highly educated (with a university degree) and may be well equipped to read and write to their children and provide other enriching educational experiences (Raikes et al., 2006).

After, being able to determine SES, the possible background factors that is associated with students' socioeconomic class were examined. The analysis indicated that parental education, gender, parental involvement with the child education, achievement, students' educational aspiration and speaking English at home were significantly associated with students' SES. For instance the results indicated that students' in the low socioeconomic class are more likely not to speak English at all at home (language of instructions in schools in Ghana), thirteen times more likely to have parent who is not educated , and more than twice likely to have a lower educational aspirations than students in high socioeconomic class. This findings support the other studies in the literature (e.g., Schulz, 2005).

6.2. Predictors of mathematics achievement

Hierarchical regression was used to estimate the predictors of students achievement from background variables like gender, parental education, SES, educational aspirations, speaks English at home, and parental involvement (parental child-discussion (PCD) and home-work help discussion (HHD)). In support of previous studies, the present study indicated that gender predicts maths achievement with boys performing better than girls (Eccles,

Jacobs, & Harold, 1990; Else-Quest, Hyde, & Linn, 2010; Eshun, 2004; Gil-Flores, Padilla-Carmona, & Suárez-Ortega, 2011).

Whereas parental home-work help positively predicted students' mathematics achievement, parents' child-school discussion negatively predicted students' mathematics achievement. This finding about child-help negatively predicting students achievement is in line with the literature (e.g., Campbell & Mandel, 1990; Desimone, 1999); Epstein, 1988; Epstein, 1990) The positive relationship between parental home-work help and students achievements is also is in line with the literature (e.g. Sui-Chu & Willms, 1996) . The possible cause of the negative relationship between parent-child discussion and achievement is maybe that the help that the parents gives their children is unsolicited, and may have negative effects on children's self-perceptions (Graham, 1990). This finding also indicates the bidirectional nature of parent-child influences (Jacobs & Bleeker, 2004). It also indicates that as parents see that their children are failing behind in mathematics, their involvement increases.

Perhaps the most paradoxical finding was that speaking English at home always was not a significantly associated with students' achievement. Ghana is very diverse ethnically, culturally and language-wise (Alesina, 2003; Easterly & Levine, 1997; Fearon, 2003). In Ghana although the language of instruction is English, English is mainly spoken among Intermediate-high socio-economic homes. As such was surprising to know that speaking English at home was not a significant predictor of students' achievement. However, this finding is supported in the literature (Mullis et al., 2008).

In line with other studies (e.g., Woessmann, 2004) students with parents who had higher education qualifications, had higher achievement scores. Interestingly, students whose parents had professional qualifications (e.g. Nurses and teachers) perform better in mathematics than students whose parents had polytechnic education. This is in line with the societal attitudes that the polytechnic education is inferior to university education in Ghana (Gyasi, 2014).

6.3. Strengths and Limitations of the Present Study

The most significant limitation of the study is that all the measures are self-reports and thus subject to desirability biases. Moreover, parental involvement has been identified in the literature as a multidimensional construct (Epstein 2010) but in this study only two aspects were measured. Another limitation is that, the home resources used as a measure of SES were not exhaustive enough. For example, it can be argued that items like tablets and mobile phone usage should be included in the next round of questionnaire. The strength of the study is that the data set is a country representation and the robust methodology allows generalisation of the results to Ghanaian grade eight students. Moreover, using a more advanced methodology such as structural equation modeling, the possible association between students SES and other background variables were invested with parental education being the most important predictor of students SES.

7. Conclusions

The present study indicates that, generally, the socio-economic measures derived from the student questionnaire is a more reliable source of measuring children's SES than other measures such as parental income and parental education in countries like Ghana where students often do not know their parents' education. The author of this paper will argue that, if there are no better mechanisms of getting a reliable parental education and parental income information, collecting a large number of student variables on socio-economic household resources/possessions is definitely the best way of measuring students' socio-economics profiles. This stem from the fact, the results from this thesis further indicate that students' reported household resources provide a comprehensive data on family background information that is associated with the differences in mathematics achievement. This indicates that at least in Ghana parental education is rather a predictor of students' SES than a measure of it. This contradicts studies using parental education as the main indicator of students' SES.

The current study identified a number of interrelations between that factors associated with students' mathematics achievement level and their SES. The study clearly indicated that, the predictors of students' achievement and students' socioeconomic status

are important for students' adjustment to school and life in general. For instance, there were significant evidence to support the argument that the higher the parental education, the higher socioeconomic class, aspirations and subsequent higher achievement Moreover, one needs to know that, students self-reported family background information are subject to a large amount of measurement error, therefore is advisable to use approaches such as structural equation modeling that take into account the measurement errors. In addition, the associations between students' achievement outcomes and parents' involvement maybe attributed to different levels of parental involvement. Policy makers and educators should therefore encourage strategies that will increase parental involvement so as to help improve achievement outcomes as well as reducing the inequities in achievement between students from different social backgrounds.

The findings of this study can help educators and policy makers understand the factors that influence children's SES and achievement and the effect of parental involvement in children's life. The findings can also help future researchers to explore other factors that might have an influence on students' SES and achievement. Most importantly, this study makes an important contribution to the field, as is impossible to get a reliable measure of students SES such as (i) parental education, and (ii) parental occupation. Moreover, the variables chosen do possess a strong theoretical consideration (Filmer & Pritchett 1999; Schulz, 2005) and to the best of my knowledge robust method have been used to explore these findings.

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