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Primary School Learners' Age and Academic Achievement in Ghana. The Moderating Effects of School Types

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Author Note

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Abstract: *The study explored the extent learners' age variances impacted their achievement in a national education assessment in Ghana and how these were moderated by the types of schools (i.e., private and public) they attended. A multistage sampling method was used, and the data were analyzed using a multilevel modeling technique. The sample comprised 19,210 primary grade 3 and 17,088 primary grade 6 learners from 525 and 499 schools, respectively. Relatively younger learners outperformed their older peers in both subjects except for primary 3 mathematics achievement. Schools marginally reduced the age effect on both subjects except primary 3 mathematics achievement, where there was an increase. Moreover, there was a statistically insignificant difference in private and public schools' impact on age-linked effects on subjects except for primary 3 mathematics. The study concludes that being relatively overage for a specific grade level is not beneficial, especially for English language achievement. Hence, enrolling learners at the prescribed age and school term is highly recommended.*

Keywords: age, achievement, school, mathematics, English language, Ghana

The importance of early childhood and primary education to later educational outcomes is substantial and long-lasting. This is because the consequences of receiving a good or poor educational foundation at these stages are often lifelong (Bendini & Devercelli, 2022; Irwin et al., 2022; United Nations [UN], 2022). Given this knowledge, there is a global drive to ensure that all children access quality education regardless of their diverse backgrounds, as unequivocally captured in SDG 4 (Maguth & Hilburn, 2015; UN, 2022). In achieving this global-driven goal, priority is given to providing complete, free, and compulsory quality basic education for all learners (World Education Forum, 2000).

According to Delprato & Sabates (2014) and Bashir et al. (2018), though there are policies on age-of-entry to schools in many developing countries where many children are out of school, these policies are not rigidly enforced. This is evidenced by the characteristic multi-aged learners in the same grade in most basic schools in these countries. This practice counters what exists in

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the developed world, where there are regulated age-of-entry requirements (Urruticoechea et al., 2021; Cáceres-Delpiano & Giolito, 2018; Brower, 2020; Olkun, 2018). For instance, children in Sweden enter school at age 7, while those in New Zealand begin school on their fifth birthday (NICHD, 2007). Similar age-of-entry requirements are applicable in England, Wales, and several other European countries (Mavrić & Fetić, 2022; Stipek, 2009; Crawford et al., 2013; Herbst & Strawiński, 2016). In the United States, the age of entry varies for the States (Brower, 2020; Irwin et al., 2022).

In several African countries, the official entry age to primary school is either 6 or 7, with a few at 5 years (Delprato & Sabates, 2014; Bashir et al., 2018). In Ghana, children are expected to start early grade at 4 and primary school at 6. However, this policy is either flouted or overlooked because children are sent to early grade or primary schools at different ages as a result of varied reasons, including cost barriers, poverty, preschool unavailability (particularly in rural localities), and ignorance (Ministry of Education [MoE], 2016a; Ghana Statistical Service [GSS], 2012; 2021). Consequently, typical Ghanaian rural, public early, and primary grade classroom settings comprise learners with significant multi-age variances (MoE, 2014, 2016b).

This phenomenon of multi-aged learners in a class appears to be a characteristic of many Sub-Saharan African countries and households (Bauer & Riphahn, 2009; Nonoyama-Tarumi et al., 2010). For instance, Delprato and Sabates (2014) reported that in 2010, an average of 41% of children in 16 Sub-Saharan African countries started primary school two years or more above the official school entry age. Therefore, researchers and educationists are interested in investigating whether learners who are under, ideal, or overage for a specific grade or classroom equally benefit from schooling when other factors are controlled. This quest has resulted in many studies exploring learners' relative age effects age on their achievement in school subjects such as mathematics and English language (Sprietsma, 2010; Mavilidi et al., 2022; Vestheim et al., 2019; Thoren et al., 2016).

Significantly, many of these studies relied on national (Peña, 2017; Urruticoechea et al., 2021) and international assessment data (Urruticoechea et al., 2021; Bedard & Dhuey, 2006) whose sample characteristics significantly differed from the Ghanaian context. Moreover, the school systems from which these samples were drawn differed from one country to another in terms of the academic cycle, entry age, curricula, and selection criteria (Woessmann, 2016; Meyer & Benavot, 2013; Parker et al., 2018). These differences in school systems have been found to influence the quantity and quality of learning and learning outcomes (Meyer & Benavot, 2013; van Hek et al., 2019).

Though the ages of learners reflect their intellectual and cognitive abilities (Piaget, 1970; Woolfolk, 2019), evidence suggests that learners' age effect on achievement is moderated by several other factors, including the types of schools they attend (Ndaji et al., 2016; Woesmann, 2016; van Hek et al., 2019; Rosén et al., 2022). Nonetheless, how school types widen or narrow the impact of age on achievement is still a subject of interest to researchers, educators, and school administrators. This current study extends the knowledge base in this area in the Ghanaian and African contexts by exploring learners' relative age-linked impact on achievement and how it is moderated by the types of schools they attend.

LITERATURE REVIEW

THEORETICAL FRAMEWORK: COGNITIVE DEVELOPMENT THEORY

The study anchors on the Cognitive Development Theory by Piaget (1970). The theory suggests that a person's age facilitates or inhibits the achievement of specific intellectual, cognitive, and academic tasks. Thus, children's cognitive ability unfolds qualitatively through the sensori-motor, preoperational, concrete operational, and formal stages (1970). Hence, all other things being equal, a relatively older learner is expected to achieve higher than a relatively younger learner. However, the theory highlights the role of the quantity and quality of stimulating interaction in moderating the effects of the abilities of persons at specific Piagetian stages.

Consequently, children could master concepts deemed above their "Piagetian ability" when the appropriate environment or opportunity is provided. In contrast, others could be deficient in cognitive abilities below their "Piagetian ability" if they were denied conducive learning opportunities at home or school. Therefore, a learner's age per se may only be an indicator but an insufficient guarantee of academic excellence if other cooperating factors are not favorable (Fosnot, 2005; Vygotsky, 1978; Piaget, 1970).

EMPIRICAL REVIEW

The impact of learners' age on their cognitive, social, and academic capabilities and achievement has been proven empirically (Passaretta et al., 2022; Navarro et al., 2015; Mavilidi et al., 2022; Attar & Cohen-Zada, 2018). Many of these studies have suggested that relatively older learners attain higher academic achievement than younger ones (Norbury et al., 2015; Cáceres-Delpiano & Giolito, 2018; Aguayo-Téllez & Martínez-Rodríguez, 2020; Dhuey et al., 2019). This conclusion appears to be consistent for different samples from different study contexts, such as the UK (Crawford et al., 2014; Crawford et al., 2011; Sharp, 2002), USA (Elder & Lubotsky, 2009; Woessmann, 2016; Irwin et al., 2022), other parts of Europe (Ordine & Rose, 2018; Sprietsma, 2010; Cáceres-Delpiano & Giolito, 2019; Vestheim et al., 2019) and Asia (Kawaguchi, 2011; Nam, 2014). For instance, in Japan, learners who begin school younger perform worse than their older counterparts in primary school results (Kawaguchi, 2011).

In another context, Sharp et al. (2009) found that relatively younger learners in a cohort year underachieved in attainment tests in mathematics, reading, writing, and average attainment across subjects when compared with their older counterparts. The advantage of relatively older learners over younger ones from much earlier studies was consistent and supported by a surplus of evidence (Stipek, 2002). Most of these studies concluded that the oldest children performed better than the youngest children in kindergarten, first, second, and fourth grades. Nonetheless, relying on different waves of PISA assessments, Suggate (2009) found no relationship between entry age to school and reading achievement.

In contrast, data from the Sub-Saharan African (e.g., SEACMEQ) showed that younger learners scored higher than their older counterparts in reading and mathematics (Hungi, 2011). Similarly, Delprato and Sabates (2014) found a link between over-aged enrolment, low levels of achievement, premature dropout, and gendered differences in participation in Africa. This study's mean ages for primary grade 3 (hereafter P3) and primary grade 6 (hereafter P6) learners were 10.8 and 13.6, respectively (see Table 1) instead of the expected 8 and 10 years. Given the varied age-linked effects on academic achievement from different study contexts, this study further explores the importance and dynamics of this personal characteristic using a national achievement dataset from Ghana. Specifically, the study examines the extent learners' age accounted for the variances in English language and mathematics achievement and how these variances were moderated differentially by private and public schools. This objective is achieved through two research questions and a hypothesis.

RESEARCH QUESTIONS

1. How much variance can learners' English language and mathematics achievement be attributed to their age?
2. To what extent do private and public schools moderate the impact of learners' age on English language and mathematics achievement?

HYPOTHESIS

There is no significant difference in private and public schools' impact on learners' age and achievement in English language and mathematics.

MATERIALS AND METHODS

This section describes the procedures for sampling schools, data management and analysis procedures, and the discussion of the results. In addition, the conclusions drawn and recommendations are presented.

DATA SAMPLING PROCEDURES

The study relied on the 2013 wave of the Ghana National Education Assessment data obtained from the primary owners after all ethical protocols had been met and approved. According to the technical report on the examination, the sampling process started by excluding schools with class sizes of less than 10 learners (MoE, 2014). Next, schools were stratified by each of the country's then 10 administrative regions and sorted by district (deprived or not deprived), locality (urban or rural), and school type (public or private).

Fifty five schools were randomly sampled with equal probability from each region to participate in the examination except in the Northern and Ashanti Regions, where 54 schools each were sampled because a randomly selected school was not in session when administering the test. All P3 and P6 learners in selected schools participated in the examination administered on July 9, 2013. A total of 19,458 P3 and 17,447 P6 learners participated in the examination, and a hundred per cent return rate was achieved (MoE, 2014).

DATA MANAGEMENT PROCEDURES FOR THIS STUDY

The study used data from 19,210 P3 and 17,088 P6 learners. Two exclusion criteria were applied to arrive at the final sample sizes. The first criterion excluded all learners who failed to indicate their ages. This led to the deletion of 78 P3 and 23 P6 learners' data. The second criterion was deleting schools with class sizes of less than 10 learners based on sample requirement guidelines for using the multilevel modeling procedure (Hox et al., 2017; Heck et al., 2022). This led to excluding 23 P3 and 49 P6 schools, respectively. Schools, learners' mean age, and achievement are presented in Table 1.

Table 1
Grade level, mean age, and achievement for private and public schools

Variables			Total	School type	
				Public	*Private*
P3	Number of Schools		525	417	108
	Sample size		19,210	15,712	3,498
	Mean Age		10.8	11.0	9.7
	Mean achievement	Eng. Lang.	12.9	11.5	19.0
		Mathematics	12.1	11.1	16.2
P6	Number of Schools		499	401	98
	Sample size		17,088	13,967	3,121
	Mean Age		13.6	13.8	12.6
	Mean achievement	Eng. Lang.	19.24	17.50	27.03
		Mathematics	15.2	14.48	18.38

INDEPENDENT VARIABLES

Two independent variables (learners' age and school type) interested the researcher. The characteristics of these independent variables are explained.

LEARNERS' AGES

The average ages for the P3 and P6 learners were 10.8 and 13.6, respectively. The average ages for P3 private and public school learners were 9.7 and 11.0, while those in P6 were 12.6 and 13.8. The statistics in Table 1 suggest that, on average, learners in public schools are relatively older than their peers in private schools at the same grade level. This is the case because private schools control their selection and age-of-entry requirements while public schools are mandated to admit all prospective learners in line with the national and global goal of providing access and compulsory quality education for all learners (UN, 2022; Constitution of Ghana, 1992; MoE, 2015).

SCHOOL TYPE (PRIVATE AND PUBLIC)

School types were designated private (coded 1) and public (coded 0). Private basic schools in Ghana are generally owned, managed, and financed by private individuals, entrepreneurs, faith-based bodies, and charitable organizations. Most private schools are in urban areas and, comparably, have high-quality educational resources to facilitate effective teaching and learning. Public primary schools are funded and managed by the state. There are more public schools in rural areas in Ghana than in urban areas. Comparatively, children attending public schools are more socio-economically disadvantaged than those attending private schools (MoE, 2016a, 2016b). Moreover, teacher supervision and utilization of instructional and contact hours are more effective in private than public schools (Abadzi, 2007, 2009; Ashley et al., 2014).

DEPENDENT VARIABLES

The dependent variables for the study are Mathematics and English language achievement scores for the P3 and P6 learners who participated in the 2013 wave of the Ghana National Education Assessment test. The USAID and RTI International assessed the learners in collaboration with the Ghana Education Service. It was to test learners' competence in

mathematics and English language subjects (MOE, 2013a; 2016a). Learners in P3 and P6 were assessed and scored over 30-item and 40-item objective tests, respectively. For both grade levels, the mathematics assessment covered five domains (i.e., basic operations; collect and handle data; measurement; space and shape; numbers and numerals) and English language, three (i.e., grammar; listening; and reading).

For the P3 mathematics and English language tests, learners who correctly answered up to 10 items (i.e., below 35%) performed "below minimum competency." Learners who correctly answered 11 up to 16 questions (i.e., 35% - 54%) achieved "minimum competency". Finally, those who correctly answered at least 17 questions or better (i.e., ≥ 55%) were considered "competent". For the P6 assessment in both subjects, learners who correctly answered up to 13 questions (i.e., below 35%) performed "below minimum competency". Scores between 14 and 21 (i.e., 35% - 54%) were interpreted as "minimum competency", while those who correctly answered at least 22 items or better (i.e., ≥ 55%) were classified as "competent" in a subject. According to the Ghana National Education Assessment Technical Report (Varly et al., 2014), the reliability indices of the test items were established using the Kuder-Kuder-Richardson-20 (KR20) test. Respectively, alpha values of 0.89 and 0.84 were achieved for P6 Mathematics and English language tests and 0.82 and 0.84 for P3 Mathematics and English language tests.

CONTROLLED VARIABLES

The potentially confounding influence of three variables in the dataset, namely, school location, school district type, and gender, were controlled to enhance the confidence and accuracy of estimates attributed to the independent variables.

SCHOOL LOCATION (RURAL AND URBAN)

Urban schools (coded 1) are those in localities with more than 60% of their residents engaged in non-agricultural activities and having a minimum population size of 5,000 (GSS, 2012). Urban schools have relatively better (quantity and quality) educationally relevant resources than rural schools. Rural schools (coded 0) are those in communities that do not meet these two criteria for urban status. Rural communities in Ghana often lack basic needs such as electricity and educational resources. Parents of rural school learners are predominantly peasant farmers and are characterized by high poverty levels and illiteracy (GSS, 2012). According to Bashir et al. (2018), an important source of inequality in middle and low-income nations like Ghana is differences among schools, particularly those serving more and less advantaged students.

SCHOOL DISTRICT TYPE (DEPRIVED AND NON-DEPRIVED)

The designation of districts into deprived (coded 0) and non-deprived (coded 1) by Ghana's Ministry of Education is based on Ghana's poverty index (share of population below the poverty line) as well as education indicators. The education indicators are: (i) retention in primary education (enrolment in P6/enrolment in P1 based on all schools), (ii) retention in the basic cycle (enrolment in JHS3/enrolment in P1 based on all schools), (iii) share of girls enrolled in P6 (all schools), (iv) share of girls enrolled in JHS3 (all schools), (v) pass rate in the English language of the Basic Education Certificate Examination, and (vi) share of trained teachers in the public primary schools. In the Ghanaian context, these indicators are regarded as predictors of quality education. One-third of the districts are classified as deprived, per the education outcomes and resource indicators listed. Deprived districts usually have some schools operating under trees due to inadequate classroom space (MoESPR, 2016).

GENDER

Gender was a dichotomous variable coded 0 (for boys) and 1 (for girls).

DATA ANALYSIS PROCEDURE

Table 2

Fixed, random and moderated effects of P3 learners' age on English language achievement

Fixed part Intercept	*Model 0 Coeff (se)*	*Model 1 Coeff (se)*	*Model 2 Coeff (se)*	*Model 3 Coeff (se)*	*Model 4 Coeff (se)*
	-.109 (.194)	-1.037 (.566)	-1.054 (.557)	-.609 (.504)	4.062 (.506)
Controlled variables					
Learners' gender (boys)	-	-.053 (.068)	.002 (.068)	-.012 (.068)	-.020 (.068)
District type (deprived)	-	-1.883 (.395)	-1.849 (.389)	-.886 (.348)	-.503 (.289)
School location (rural)	-	-1.038 (.525)	-1.024 (.517)	-.856 (.466)	-.510 (.384)
School location (urban)	-	2.303 (.618)	2.270 (.609)	2.005 (.553)	2.015 (.455)
Predictor variables					
Learners' Age	-	-	-.186** (.022)	-.257** (.030)	-.212** (.030)
School type (public)	-	-	-	-	-5.773** (.347)
Random part					
Learner (%)	52.6	57.3	58.0	59.5	70.2
School (%)	47.4	42.7	42.0	40.5	29.8
-2LL (deviance)	114880	114456	114385	114240	114021
Change in deviance *(-2LL)*	-	424	71	145	219
X^2 (0.001)		18.47	20.52	20.52	22.46
df	-	4	5	5	6
Intercept variance	-	-	-	14.125 (.941)	8.808 (.605)
Intercept-slope Covariance	-	-	-	-.979 (.134)	8.808 (.605)
Slope variance	-	-	-	.182 (.029)	.163 (.027)

p-value **p<0.001, *p< 0.01, Coeff. = Coefficient; se = standard error

Data were analyzed using the multilevel modeling technique and involved six stages for both grade levels. First, the researcher computed the null model (model 0) to determine the

multilevel analysis technique's suitability for the data (Hox et al., 2017; Heck et al., 2022). In the second stage, three covariates (rural and urban schools, deprived and non-deprived districts, and learner's gender) were introduced as controlled variables (model 1) to account for their potentially confounding effects on the independent variables. The third stage (model 2) was the introduction of the predictor variable (*learner age)* into the model to estimate its fixed effects on English language and mathematics achievement.

Table 3

Fixed, random and moderated effects of P3 learners' age on mathematics achievement

Fixed part Intercept	*Model 0* *Coeff (se)*	*Model 1* *Coeff (se)*	*Model 2* *Coeff (se)*	*Model 3* *Coeff (se)*	*Model 4* *Coeff (se)*
	-.008 (.148)	-.787 (.443)	-.781 (.445)	-.682 (.431)	2.948 (.440)
Controlled variables					
Learners' gender (boys)	-	.223 (.063)	.203 (.063)	.201 (.063)	.194 (.063)
District type (deprived)	-	-1.341 (.309)	-1.354 (.310)	-1.107 (.300)	-.634 (.256)
School location (rural)	-	-.694 (.410)	-.699 (.412)	-.668 (.399)	-.351 (.337)
School location (urban)	-	1.385 (.483)	1.397 (.486)	1.357 (.473)	1.299 (.398)
***Predictor variable*s**					
Learners' Age	-	-	.067** (.020)	.033 (.025)	.062* (.025)
School type (public)	-	-	-	-	-4.393** (.297)
Random part					
Learner (%)	62.7	65.8	65.6	66.4	74.4
School (%)	37.3	34.2	34.4	33.6	25.6
-2LL (deviance)	111850	111437	111426	111379	111196
Change in deviance *(-2LL)*	-	413	11	47	183
X^2 (0.001)	-	18.47	20.52	20.52	22.46
df	-	4	5	5	6
Intercept variance	-	-	-	9.113 (.615)	6.212 (.434)
Intercept-slope Covariance	-	-	-	-.297 (.087)	-.198 (.068)
Slope variance	-	-	-	.086 (.020)	.082 (.019)

p-value **p<0.001, *p< 0.01, Coeff. = Coefficient; se = standard error

The fourth stage (model 3) allowed the effect of learners' age on achievement to vary by school. This was done by adding the predictor variable "*learners' age*" to the fixed and random parts of the model. The fifth stage of the analysis (model 4) was the introduction of the school type variable into the model to estimate its moderating impact on learners' age. The resultant regression coefficients and their respective standard errors (in brackets) are presented in Tables 2, 3, 4, and 5, respectively, for P3 English language, P3 mathematics, P6 English language, and P6 mathematics achievements.

Table 4

Fixed, random and moderated effects of P6 learners' age on English language achievement

Fixed part Intercept	*Model 0* *Coeff* *(se)*	*Model 1* *Coeff* *(se)*	*Model 2* *Coeff* *(se)*	*Model 3* *Coeff* *(se)*	*Model 4* *Coeff* *(se)*
	-.904 (.267)	-2.582 (.742)	-2.564 (.720)	-2.132 (.678)	2.978 (.728)
Controlled variables					
Learners' gender (boys)	-	.520 (.093)	.720 (.093)	.721 (.092)	.716 (.092)
District type (deprived)	-	-2.904 (.522)	-2.657 (.506)	-1.426 (.472)	-.940 (.422)
School location (rural)	-	-1.773 (.688)	-1.709 (.667)	-1.166 (.627)	-.631 (.554)
School location (urban)	-	3.676 (.813)	3.591 (.788)	3.028 (.743)	3.514 (.655)
***Predictor variable*s**					
Learners' Age	-	-	-.741** (.034)	-.801** (.051)	-.748** (.050)
School type (public)	-	-	-	-	-6.425 (.509)**
Random part					
Learner (%)	50.9	57.7	58.6	58.9	66.4
School (%)	49.1	42.3	41.4	41.1	33.6
-2LL (deviance)	111118	110856	110399	110199	110063
Change in deviance *(-2LL)*	-	262	457	200	136
X^2 (0.001)		18.47	20.52	20.52	22.46
df	-	4	5	5	6
Intercept variance	-	-	-	23.417 (1.619)	17.017 (1.198)
Intercept-slope Covariance	-	-	-	-1.740 (.300)	-1.128 (.247)
Slope variance	-	-	-	.552 (.076)	.517 (.073)

p-value **p<0.001, *p< 0.01, Coeff. = Coefficient; se = standard error

Table 5
Fixed, random and moderated effects of P6 learners' age mathematics achievement

Fixed part Intercept	*Model 0 Coeff (se)*	*Model 1 Coeff (se)*	*Model 2 Coeff (se)*	*Model 3 Coeff (se)*	*Model 4 Coeff (se)*
	-.319 (.129)	-1.494 (.375)	-1.489 (.368)	-1.354 (.350)	.688 (.398)
Controlled variables					
Learners' gender (boys)	-	.775 (.064)	.856 (.064)	.863 (.064)	.860 (.064)
District type (deprived)	-	-1.293 (.264)	-1.195 (.259)	-.780 (.244)	-.564 (.231)
School location (rural)	-	-.539 (.347)	-.511 (.340)	-.334 (.324)	-.115 (.303)
School location (urban)	-	1.485 (.409)	1.451 (.401)	1.241 (.383)	1.417 (.356)
***Predictor variable*s**					
Learners' Age	-	-	-.299** (.024)	-.343** (.032)	-.314** (.031)
School type (public)	-	-	-	-	-2.546** (.277)
Random part					
Learner (%)	68.9	72.5	73.1	74.2	77.7
School (%)	31.1	27.5	26.9	25.8	22.3
-2LL (deviance)	97953	97627	97467	97372	97296
Change in deviance *(-2LL)*	-	326	160	95	76
X^2 (0.001)		18.47	20.52	20.52	22.46
df	-	4	5	5	6
Intercept variance	-	-	-	5.620 (.408)	4.649 (.345)
Intercept-slope Covariance	-	-	-	-.386 (.086)	-.248 (.077)
Slope variance	-	-	-	.164 (.028)	.153 (.027)

p-value **p<0.001, *p< 0.01, Coeff. = Coefficient; se = standard error

The sixth stage explored the differential effects of public and private schools on the age-linked differences in achievement in both subjects. To achieve this, model 5 was re-run with the command to analyze the data separately for P3 public and private schools (models 6a & 6b) and P6 public and private schools (models 7a & 7b). The results for the differential impact of public and private schools on age-linked effects on English language and mathematics are presented in Tables 6 and 7, respectively.

Table 6
Differential impact of P3 schools on Age for English language and Mathematics Achievement

	Public school	*Private School*	*Public school*	*Private School*
	Model 6a English language Coeff (se)		*Model 6b Mathematics Coeff (se)*	
Intercept	-2.135(.425)	5.229(1.345)	-1.635(.374)	3.122(1.152)
Controlled Variables				
Gender (boys)	-.158(.030)	-.268(.192)	.199 (.067)	.177(.169)
District type (deprived)	-.613(.286)	-.272(1.072)	-.609(.251)	-1.010(.921)
Rural School	-.199(.402)	-1.662(1.058)	-.162(.354)	-.864(.902)
Urban School	2.167(.486)	1.326(1.151)	1.639(.429)	.389(.971)
Predictor Variable				
Learners' Age	-.158** (.030)	-.555** (.105)	.078* (.026)	-.040 (.083)
Random part				
Learner (%)	71.6	68.4	76.6	69.9
School (%)	28.4	31.6	23.4	30.1
-2LL (deviance)	91395	22189	89698	21289
Intercept variance	7.340(.561)	14.116(2.215)	5.119 (.403)	10.255(1.599)
Intercept-slope Covariance	-.470(.088)	-.888(.434)	-.123(.064)	-.290(.274)
Slope variance	.130(.023)	.337(.152)	.079 (.019)	.113 (.073)

p-value **p<0.001, *p< 0.01, Coeff. = Coefficient; se = standard error

RESULTS

The three controlled covariates significantly decreased the respective deviances (*-2LL*) from *model 0* to *model 1* for both subjects and grade levels (*see Tables 2-4),* signifying their statistically significant impact on learners' achievement.

RESEARCH QUESTION 1

How much variance can learners' English language and mathematics achievement be attributed to their age?

Regarding research question 1, learners' age accounted for -.257 and .033 marks in the P3 English language and mathematics achievement, respectively, while -.801 and -.343 marks of P6 learners' English language and mathematics scores were attributed to their age. As fixed and random effects, learners' age had statistically significant negative impacts on achievement in P3 (English language only) and P6 (mathematics and English language). As a random effect, age had a statistically insignificant yet positive effect on P3 mathematics achievement.

Table 7
Differential impact of P6 schools on Age for English language and Mathematics Achievement

	Public school	*Private School*	*Public school*	*Private School*
	Model 7a English language Coeff (se)		*Model 7b Mathematics Coeff (se)*	
Intercept	-3.771 (.659)	3.037 (1.636)	-1.915 (.355)	.279 (.966)
Controlled Variables				
Gender (boys)	.680 (.101)	.818 (.219)	.867 (.069)	.816 (.165)
District type (deprived)	.651 (.437)	2.666 (1.394)	.500 (.236)	1.192 (.825)
Rural School	-.157 (.625)	-2.626 (1.164)	-.064 (.337)	-.355 (.699)
Urban School	3.953 (.748)	1.302 (1.264)	1.499 (.403)	.998 (.771)
Predictor Variable				
Learner's Age	-.641** (.054)	-1.441** (.106)	-.252** (.032)	-.705** (.087)
Random part				
Learner (%)	66.1	64.9	77.8	77.6
School (%)	33.9	35.1	22.2	22.4
-2LL (deviance)	89728	20281	78684	18475
Intercept variance	16.978 (1.340)	19.438 (3.238)	4.359 (.359)	5.880 (1.061)
Intercept-slope Covariance	-1.359 (.266)	.689 (.580)	-.216 (.076)	-.186 (.246)
Slope variance	.522 (.078)	.041 (.132)	.128 (.026)	.094 (.092)

p-value **p<0.001, *p< 0.01, Coeff. = Coefficient; se = standard error

RESEARCH QUESTION 2
To what extent do private and public schools moderate the impact of learners' age on English Language and mathematics achievement?

Concerning research question 2, adding the *school type* variable to the model marginally reduced the age effect on achievement in both subjects and grade levels except for P3 mathematics. For the P3 English language, the age effect reduced from β = -.257 to β = -.212, while it increased from β = .033 to β = .062 for mathematics. For the P6 sample, school types reduced the age effect on English language achievement from β = -.801 to -.748 and mathematics from β = -.343 to β = -.314.

HYPOTHESIS
There is no significant difference in private and public schools' impact on learners' age and achievement in English language and mathematics.

The study found a statistically insignificant difference in private and public schools' impact on learners' age and achievement for P3 (English language only) and P6 (both subjects) at $p = 0.001$. There was, however, a statistically significant difference in public and private schools' impact on learners' age and P3 mathematics achievement. Private schools nullified the statistically significant effect of age to insignificance ($\beta = -.040$), while in public schools, age had a positive ($\beta = .078$) and statistically significant ($p < 0.01$) effect.

DISCUSSION

The study results confirm the importance of learners' age in explaining achievement variances in school subjects (Aguayo-et al., 2020; Cáceres-Delpiano & Giolito, 2019; Mavrić & Fetić, 2022). However, unlike many other studies, particularly from the more developed world where relatively older learners in a class were found to outperform their younger peers (Nalova & Etomes, 2019; Navarro et al., 2015; Cáceres-Delpiano & Giolito, 2019; Larsen et al., 2020), in the Ghanaian context, relatively younger learners generally outperformed their older peers, especially in P3 and P6 English language. Nonetheless, the study's findings do not interrupt prior findings that relied on African data (Hungi, 2011; Delprato & Sabates, 2014) and elsewhere (Stipek, 2009).

Though the dynamics underlying age effects on achievement are yet to be fully unraveled, two possible reasons why older learners were disadvantaged in this study are proffered. First, the assessments are meant to test grade level expected competencies, skills, and knowledge with no regard to the multi-age composition of the learners at that grade. In the Ghanaian context, P3 and P6 learners, on average, are expected to be 8 and 10 years old, respectively; hence, the assessment items targeted these age groups compared to the overly above mean ages of 10.8 and 13.6 of this study's sample (see Table 1). Therefore, the excess years characterizing the relatively older learners may not be advantageous because the difficulty level of items was appropriate for the prescribed age for that specific grade level.

A second reason may be that relatively younger and older learners in the same classroom are exposed to the same quantity and quality of teaching and learning experiences. These teaching and learning experiences are guided by the same curriculum content appropriate for particular age(s) and grade(s). Therefore, learners whose ages significantly deviate from the average age of learners appropriate for a specified grade, such as P3 and P6, do not benefit from the gains associated with their relatively advanced age and its associated cognitive abilities and capacities.

Compared, relatively older learners in studies using data from the more developed world are advantaged, while predominantly younger learners appear advantaged in this and largely other studies relying on African data (Hungi, 2011; Delprato & Sabates, 2014; MoE, 2016). This phenomenon may be explained by the extent of homogeneity (typically developed countries) and heterogeneity (typically developing countries) of learners' ages in the same classrooms. The homogenous age-grade classrooms characterizing the developed world ensure a small deviation from the average age effect on achievement in assessments for specific age groups. Because the spread of their ages is significantly small (perhaps a month or two difference), the gains associated with being a month or two ahead of peers may be compensated for by the difficulty level of assessment items.

On the other hand, the significantly heterogeneous classrooms characterizing many developing countries disadvantage the relatively older learners in terms of bigger deviation from the average effect of the appropriate age for which assessments are targeted. Thus, the

homogeneity and heterogeneity of classrooms in the more developed and developing countries partly contribute to the divergent age effects of learners belonging to these categories of countries.

In contrast, the statistically significant and positive effect of P3 learners' age on P3 mathematics achievement by public schools implied that relatively older pupils were advantaged. In private schools, the effect of age on achievement was nullified to insignificance and in favor of the relatively younger learners. Though the reason(s) for these divergent results may not be readily deduced, it is a probability that some of the mathematics test items required deeper thinking in abstraction (*evidenced by domains of the mathematics assessment*). This may have been an advantage for public school learners who were more advanced in the Piagetian formal cognitive stage. These older learners utilized their enhanced qualitative thinking in abstraction, resulting in superior performance to those who lacked the ability due to immaturity. Regarding the private school learners outperforming their relatively older peers, it can also be explained by Piaget's theory of cognitive development, which suggests that children at certain stages can perform or accomplish certain tasks beyond their Piagetian stage capacities when provided with appropriate quantity and quality learning experiences. Given that private and public school learners were examined on the same mathematics items, yet their ages predicted divergent effects suggests further investigation into the interactional effects of school-level variables and age characteristics of learners.

In conclusion, the study corroborates that learners' age characteristics significantly contribute to their achievement levels. Moreover, schools served as psychological environments moderating the extent and direction of age-linked effects on achievement, as evidenced by this and prior studies (Nalova, 2017; Bold et al., 2017; Wang et al., 2020; Nalova & Etomes, 2019). Thus, the cumulative differences in school-level variables such as school culture, climate, supervision, leadership, quantity, and quality of teaching differentially moderated age's effect on achievement in both subjects in public and private schools.

RECOMMENDATIONS

In the context of the study results, it is highly recommended that learners are enrolled in school at the prescribed age and time since, in Ghana, assessments are done concerning expected grade-level competencies and are not sorted or structured according to learners' age. It is also recommended that Government support for the Complementary Based Education program be reinforced and expanded to provide remedial and accelerated foundational numeracy and literacy skills for learners who lag in their grade-level competencies. It may also be useful to investigate age and domain-specific achievement in both subjects to help identify specific challenges and advantages learners in a multi-age classroom have to inform curriculum implementation and teaching practices.

LIMITATIONS OF THE STUDY

It is acknowledged that this study is non-experimental research; hence, the threat of confounding extraneous variables is virtually always present. Consequently, the results and findings from this study may not provide strong evidence for causality as experimental research does. Moreover, many factors at different levels, such as learners' characteristics (e.g., IQ, interest levels, socio-economic backgrounds), teacher characteristics (e.g., teaching experience and professional qualifications), school level variables (e.g., school leadership, supervision, culture, and climate) affect learning outcomes. Therefore, the absence of these variables in the dataset to

control for may have confounded the coefficient estimates attributed to learners' age and private and public schools on the dependent variables.

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