Teachers, Schools and Child Development in Benin

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Abstract

This study investigates the relative importance of teachers and schools' effects, with a specific focus on female teachers, on the cognitive skills (math and reading test scores) among the 2nd year primary school pupils in Benin. We use data from the 2014 Program for the Analysis of Education Systems of CONFEMEN (PASEC). Our findings reveal that female teachers demonstrate a positive influence on students' cognitive skills, particularly in math and reading. Furthermore, our analysis uncovers that students with higher math scores benefit significantly from female teachers, particularly female students. We explore the underlying mechanisms of these results, demonstrating that female teachers invest more effort in teaching and employ a mix of traditional and modern teaching practices. These findings have important policy implications, suggesting the need to promote and support female educators in primary schools and to further investigate the specific teaching practices that contribute to improved cognitive skills.

JEL Codes: C38, I21, J13.
Keywords: Child Development, Skill Formation, Teacher effects, School investment, Primary education.

1. Introduction

Early childhood development is not only the cornerstone of a child's future but also a catalyst for a nation's progress (UNICEF, 2014). The substantial variability in measured human capital among children and its strong relationship with later life outcomes has prompted a renewed interest in understanding the determinants of skill formation among children (Heckman and Mosso, 2014). Children's lives are shaped by a complex interplay of factors, including family environments, neighborhoods, peer influences, and the vital roles played by teachers and schools. A central question in this context revolves around quantifying the relative significance of these factors at different stages of child development.

This paper seeks to contribute to this discourse by estimating the importance of teachers' characteristics on students' cognitive skills, with a specific focus on the pivotal role of female teachers. Extensive research has revealed that, among the myriad factors influencing students' academic achievements, teachers wield the most substantial influence (Barber and Mourshed, 2007; Filmer et al., 2018; Glewwe et al., 2011; McEwan, 2015). Teachers contribute not only to implementing school curricula, managing classrooms and schools, and directly tutoring students but also to reducing socio-economic inequalities in children's educational attainment (OECD, 2012). This is particularly salient in developing countries, where teachers often stand as the most accessible and crucial figures in the educational development of children from disadvantaged backgrounds, who face limited access to educational resources and may lack support and mentoring at home (Nyatsikor et al., 2020).

Observable characteristics of teachers that enhance children's learning include their classroom practices (Aslam and Kingdon, 2011; Glewwe and Kremer, 2006; Harris and Sass, 2011), teaching experience (Gerritsen et al., 2017; Kini and Podolsky, 2016; Ladd and Sorensen, 2017), and educational backgrounds (Lee and Lee, 2020; Nyatsikor et al., 2020). However, Hanushek (2001) and Hanushek and Rivkin (2006) have shown that these observable characteristics exhibit limited predictive power regarding students' academic abilities, as measured by test scores. Moreover, numerous unobservable teacher attributes substantially impact student performance. These attributes encompass pedagogical approaches, classroom management skills, teaching philosophies, communication abilities, motivation, and an array of individual traits and preferences (Tanaka et al., 2020).

In light of this, our study aims to investigate the heterogeneity in home life and school quality and how these factors affect child development in Benin. It further delves into the mechanisms underpinning these influences, with a specific interest in the role of female teachers. Specifically, we seek to answer the following research question: "To what extent do teachers' characteristics, including the influence of female teachers, impact the cognitive skills of primary school students in Benin, and what mechanisms underlie these effects?"

In the course of our study, we unearthed significant findings that underscore the crucial role of female teachers in enhancing students' cognitive skills. Our research unveils that female teachers exhibit a greater propensity to bolster students' skills in mathematics and reading. Furthermore, we have identified a pronounced interaction effect, revealing that students with higher math scores benefit more from female teachers, with a particular impact on female students. Investigating the mechanisms underlying these results, we found that female teachers devote greater effort to teaching than their male counterparts. Notably, these female educators employ a versatile blend of both traditional and modern teaching practices

to facilitate student learning. We argue that the positive effects of female teachers would stem from the creation of a supportive and empowering learning environment. Female teachers would often serve as relatable role models, breaking down gender stereotypes and inspiring confidence in their female students.

In Benin where traditional gender norms limit girls' educational aspirations, female teachers would act as mentors, encouraging girls to actively participate and excel in subjects traditionally perceived as challenging. Several studies also argue that female students tend to ask more questions, engage in discussions, and seek extra help in the presence of female teachers, leading eventually to improve understanding and mastery of math and reading concepts. Moreover, female teachers would often be more attuned to the unique challenges faced by their female students, offering targeted guidance and encouragement. This individualized support would help girls overcome barriers to learning, resulting in enhanced academic performance. The impact is not limited to subject knowledge; female students taught by female teachers often exhibit higher levels of self-esteem, motivation, and a belief in their own capabilities. Consequently, investing in female teachers in Benin would not only improve educational outcomes but also would foster gender equality, empowering the next generation of women leaders.

This study provides a profound contribution to the existing body of research on the influence of teachers and schools on student outcomes (Chetty et al., 2014; Fleche, 2017; Hanushek, 2001; Kane and Staiger, 2008; Rivkin et al., 2005) by elucidating the distinct and significant impact of female teachers in a developing country such as Benin. Our findings illuminate a previously underexplored dimension of the teacher-student dynamic, offering a compelling argument for the inclusion of female educators in primary schools as a strategic policy approach that can help bridge educational gaps and improve the nation's educational landscape in the country. In regions where limited resources and educational disparities persist, understanding the specific contributions of female teachers can guide the development of policies and practices geared towards optimizing the allocation of teachers. This, in turn, has the potential to significantly improve educational outcomes not only in Benin but also in comparable contexts around the world.

The remainder of this paper is organized as follows. The following section presents the education system and its quality in Benin. Section 3 provides the theoretical framework that is used to analyze the interplay between test scores, schools and students' family background. Section 4 describes our data and Section 5 presents the empirical framework of our analysis. We discuss results in Section 6 and conclude in Section 7.

2. Childhood and Primary Education in Benin

2.1. Childhood Education

In October 2006, the Benin Government has adopted a Ten-Year Development Plan for the Education Sector. The main goals include universal primary education, the reduction of school disparities across gender and regions, a reduction of grade repetition down to 10% by 2015, and the improvement of education quality through a more adequate resource provision and a better management of primary education. In 2003, girls in rural areas were specifically targeted with the elimination of tuition fees and costs of school supplies in all public schools. In 2007, a National Policy for Girls' Education was adopted by the Government to complement the initiative. It includes the Essential Educational Package (PEE) for accelerating girls' education, defined as part of the Ten-Year. The PEE includes a public campaign for girls' education "*Toutes les filles à l'école*" (All the Girls at School) with those words written upon huge billboards, on t-shirts, and in small leaflets to incite parents to register their daughters in school. The PEE program has contributed to some extent to a more equal participation of women.[1] To reduce schooling disparities and to promote universal primary education as targeted in the Millennium Development Goals, a key strategy adopted in Benin was to reduce costs borne by parents. In 2006, the Government announced the abolition of parent-paid tuition fees for all public schools in the primary and kindergarten levels. Subsidies to schools and increased resources to primary education support the decision. Government granted school subsidies to cover tuition fees and textbook acquisition depending on their location.

2.2. Primary Education System

The educational system in Benin was inherited from the French when the country achieved independence on August 1, 1960. It has since undergone many reforms to meet the needs of the country. The system is public and secular, and consists of two years of kindergarten education, six years of primary school, four years of junior secondary school, three years of senior secondary school, and a university. There are also three-year vocational or technical schools to attend in place of secondary schools. Primary education begins at six years and is free and compulsory. A national exam is given at the end of each level of schooling to determine eligibility for further education. Students graduating from primary (after 6 years of studies), junior secondary (4 additional years), and senior secondary schools (after 3 other years) receive the Certificate of Primary School (*Certificat d'études primaire*), Lower Secondary School Certificate (*Brevet d'études du premier cycle*) and Secondary School Certificate (*Baccalauréat*), respectively.

Benin households tend to be heavily reliant on public schools for children's education even though about 26.81% of schools are private.[2] Private schools are usually more expensive and attract more students from wealthier and more educated families. The central government is responsible for the development of educational programs and policies in Benin, including curriculum development, textbook selection, recruitment, and appointment of civil servant teachers.

2.3. Quality of Primary Education

[1] See, for example, Garnier, M. and P.A. Gbénou: « Évaluation de la mise en œuvre du paquet éducatif essentiel pour l'amélioration de la scolarisation des filles », 2011.
[2] See for example, PASEC: "PASEC 2014 – Perfromances du Système Éducatif Béninois : Compétences et Facteurs de Réussite au Primaire", 2016.

Benin has made commendable strides in primary school education, focusing on improving access, equity, and quality. The government has implemented various policies and initiatives to enhance the quality of education in primary schools, ensuring a more inclusive and supportive learning environment for children. One significant aspect of Benin's primary education system is its commitment to increasing enrollment rates. Efforts have been made to make education accessible to all children, including those in remote and marginalized communities. The construction of new schools and classrooms, coupled with infrastructural improvements, has facilitated this goal, ensuring that more children have access to primary education.

Additionally, the curriculum in primary schools has been revamped to meet international standards. Efforts have been made to enhance the quality of teaching by providing teachers with training and resources. Teacher training programs focus on modern pedagogical methods, ensuring educators are equipped with the skills to engage students effectively. Furthermore, there has been a push to reduce class sizes, enabling teachers to give more personalized attention to students, which significantly impacts the learning experience positively. Despite these efforts, challenges remain. Limited resources, inadequate infrastructure in some regions, and socio-economic disparities can affect the quality of education. However, the government, in collaboration with non-governmental organizations and international partners, continues to work diligently to address these challenges and further improve the quality of primary school education in Benin.

3. Theoretical Framework

In this section, we present a simple theoretical framework that for analyzing the interplay between test scores, schools and students' family background. We build upon the stylized model of skill development estimated in Cunha and Heckman (2007) and Cunha et al. (2010).

Child development unfolds over a discrete and finite period, $t = 0, 1, \dots, T$, where $t = 0$ is the initial period (e.g., birth in Cunha et al. (2010)) and $t = T$ is the final period of childhood (e.g., age 16 in Cunha et al. (2010)). There is a population of children and each child is indexed by i. At each period, each child is characterized by a stock of skills $\theta_{i,t}$, with $\theta_{i,t} > 0$ for all i and t. These skills include both cognitive and non-cognitive abilities, and may include other attributes such as health or personality traits. For each child, the current stock of skills influences the development of skills in the next period, according to the following technology:

$$\theta_{i,t+1} = f_t\left(\theta_{i,t}, H_{i,t}, S_{i,t}\right) \qquad (1)$$

where $H_{i,t}$ represents a vector of investment from home or family's observable characteristics that are relevant to shaping the child's development. Similarly, $S_{i,t}$ stands for the child i's school investments. Equation (1) can be viewed as a dynamic state space model, with $\theta_{i,t}$ serving as the state variable for each child i. It is important to note that the production function, $f_t(.)$, is indexed by t to account for potential variations in technology over the course of child development. In line with Cunha et al. (2010), the production function (1) can be expressed in a recursive form. By substituting for $\theta_{i,t}, \theta_{i,t-1}, \dots, \theta_{i,1}$ successively in (1), the stock of skills at period $t + 1$ can be rewritten as a function of all past investments:

$$\theta_{i,t+1} = g_t\left(\theta_{i,0}, I_{i,0}, \dots, I_{i,t}\right) \qquad (2)$$

where $I_{i,\tau}$ $(\tau = 0, \dots, t)$ stands for both home and school investments in child development, and $\theta_{i,0}$ is the vector of child i's initial skills, typically at birth. Home investment represents all child development activities outside of school, and results from interactions with parents (Cunha et al., 2010; Levitt, 2003; Olds, 2002; Suomi, 1999), while investment from school can be from any interaction during the school day, including teachers and another school staff. In the child development literature (e.g., Heckman and Masterov, 2007), equation (1) is labelled "child development technology." In the education literature (e.g., Krueger, 1999; Rivkin et al., 2005), the model (1) is labelled "education production function." In the former case, the skills include cognitive and non-cognitive skills measured in survey data, and the investments from parents are the focus of the analysis. In the latter case, skills are typically reading and mathematics scores measured using standardized tests administered in schools, and the productivity of school inputs is the focus.
Our paper fits within both of these frameworks, with a central focus on analyzing how differences in family and school characteristics influence child development. We aim to explore the intricate interplay between these factors and their impact on the cognitive skills of grade 2 students in Benin.

4. Data

Our analysis is grounded in data derived from the 2014 primary school survey conducted by the Program for the Analysis of Education Systems of CONFEMEN (PASEC). This survey, carried out in French-speaking countries across Africa, including Benin, Burkina Faso, Burundi, Cameroon, Congo, Côte d'Ivoire, Niger, Senegal, Chad, and Togo, aimed to evaluate learning achievement and the quality of primary education.

The survey consisted of collecting data from a sample of pupils' representative of the school population in each country, in the language of instruction and mathematics, at the beginning (i.e., among the 2nd-year primary school students) and the end of the primary cycle (among primary school students in Grade 6). The schools were chosen from the List of Francophone schools available at the National Ministries of Education (in French, "carte scolaire").Notably, Coranic schools were not included since they follow a different curriculum and teaching generally takes place in Arabic. However, other private schools were included if they were duly registered by the national education authorities.

In Benin, the survey selected approximately 180 schools for evaluating the skills of Grade 6 students, while 80 schools were chosen for assessing the performance of 2nd-year pupils. Within the selected schools, one class from the 2nd grade and one from the 6th grade were randomly designated. Subsequently, around 10 pupils were randomly selected from each class, and data on their reading and math skills were collected. These data were based on standardized tests comprising test items tailored to the typical curriculum of Francophone African primary education and were administered in the French language.

The Mathematics test contains a wide variety of items ranging from numeracy over problem solving (i.e., application to situations of daily life) to simple geometry. The French test covers general understanding and orthography as well as grammar skills. Tests were administered in a classroom setting, item by item, following detailed instructions on the presentation of each question and the allocated time for responding.
In 2014, PASEC administered a single test to the pupils sampled at the end of the school year, in April and May in all the countries concerned. Crucially for our analysis, the PASEC survey compiled extensive information on the pupil's family background, schools, classrooms, teachers and principals. For instance,

survey staff was requested to fill in all questionnaires on the basis of individual interviews with each of the sampled pupils, their teachers and their principals, in order to provide explanations where necessary and to avoid unnecessary nonresponse.

The PASEC pupils' data also include comprehensive information on the pupils themselves, including their age, gender, and the extent of homework support they receive. Additionally, details about their families are provided, including whether their parents have been reading knowledge and the family's possession of assets directly pertinent to education, such as printed and other media, books, dictionaries, and blackboards. Teachers' and directors' questionnaires contain detailed information on personal characteristics (age and gender), teaching quality (job experience, educational attainment, professional training, language skills, and indicators of personal job satisfaction and general attitudes). Moreover, the PASEC data also contain rich information on school and classroom infrastructure, the location and structure of schools, the interaction of the different stakeholders within the school environment and various pedagogical tools and approaches.

For the purposes of this paper, we have focused on pupils with minimal missing data, resulting in a sample of 557 pupils who were enrolled in the 2nd grade during the 2014 academic year. Our selection of pupils in the second year of primary school is underpinned by two central considerations:

i. At this age, thinking and problem-solving skills are taking off. Children tend to engage in more mature thinking and problem-solving, exhibiting a greater propensity for inquisitiveness and interest in specific activities. They begin to explore reasons behind events, seek additional information through questioning, understand cause and effect, establish deeper connections, and display an extended attention span.
ii. Language development typically continues at a steady pace at this stage, marked by expanding vocabulary and a growing willingness to experiment with new words they have read but not yet heard.

4.1. Summary Statistics

Table 1 provides comprehensive descriptive statistics for our sample, consisting of 557 second-year primary school students. The sample displays a balanced gender distribution, with an average age of approximately 6.7 years. Following recent various awareness programs advocating for parents to enroll their children in kindergarten, 41% of the students in our sample attended kindergarten. Although the majority of these students have access to reading and mathematics books in their classrooms (93% and 92%, respectively), only half of them have such books available at home for their education. Nevertheless, more than half of the students engage in reading at home, despite only 21% of their mothers and 37% of their fathers possessing reading abilities.

Additionally, within the students' family circles, on average, at least one person possesses reading skills. Exploring the characteristics of students' classrooms and schools, we find that the average class size is approximately 55 pupils. Their teachers, on average, have more than four years of teaching experience at the primary school level. Furthermore, around 40% of the teachers are female, 20% hold a university degree, and 51% have a high school diploma. Notably, the teachers demonstrate a high level of commitment, with an average of only 2.86 days of absenteeism during the 2014 academic year. In terms of school attributes, about 79% of the schools in the sample are public institutions, with 43% located in urban areas. Moreover,

26% of these schools offer tutoring programs to their students. The equipment index[3] for the 2nd-grade class varies from 15.19 to 79.54, with an average of 56.30 in our sample.

4.2. Emerging Data Patterns

To provide context for our in-depth empirical analysis, we begin by summarizing key data patterns, as depicted in Table 2. **Panel A** presents test scores of both girls and boys in mathematics and reading. While girls outperform boys in both subjects, with a marginal difference of 0.1 points in math and a more pronounced 2.69-point difference in reading, these disparities are not statistically significant.

Table 1: Summary Statistics

	Mean	Std. Dev.	Min	Max
Panel A: Students' Characteristics				
Female	0.51		0	1
Age	6.73	1.10	4	10
Attended kindergarten	0.41		0	1
Has books at home	0.50		0	1
Has reading books in class	0.93		0	1
Has math book in class	0.92		0	1
Can bring reading book at home	0.11		0	1
Can bring math book at home	0.10		0	1
Read at home	0.55		0	1
Panel B: Teachers' Characteristics				
Female	0.39		0	1
Age	28.88	6.52	21	59
Has high school degree	0.51		0	1
Has university degree	0.20		0	1
Year of experience	4.32	3.81	0	35
number days of absenteeism	2.86	5.19	0	28
Panel C: Schools' Characteristics				
Public school	0.79		0	1
Number of teachers	5.64	1.22	2	37
Class size	54.59	21.94	8	173
Tutoring to students	0.26		0	1
Class equipment index	56.30	7.80	15.19	79.54

[3] The Programme d'Analyse des Systèmes Educatifs de la CONFEMEN (PASEC) uses the item response analysis (IRT) method based on various questions related to classroom equipment and school infrastructure to compute the equipment index. The index ranges from 0 to 100 with higher values indicating better school infrastructure and classroom equipment.

Urban	0.43		0	1
Panel D: Parents' Characteristics				
Mother knows reading	0.21		0	1
Father knows reading	0.37		0	1
No. People who know reading	1.41	0.97	0	5
Observation		**557**		

Note: The sample size for Panel B and C is 80.
Source: Table prepared by the authors, using information from PASEC survey.

Moving to the rows in Table 2 that encapsulate explanatory variables used in our analysis, **Panel B** depicts how pupil performance in math and reading varies when they are instructed by female or male teachers. Notably, pupils taught by female teachers score substantially higher, with an average difference of 35.79 points in math and 45.94 points in reading compared to those taught by their male counterparts. This observation suggests the possibility that female teachers may exert greater effort in teaching or that differences in the quality of teaching practices between female and male teachers are at play. These factors will be examined in more detail in the subsequent sections, aiming to elucidate the factors contributing to the observed variations in skills between girls and boys.

Panel C explores the average score of pupils in math and reading, distinguishing between private and public schools. The results reveal that pupils from private schools consistently score significantly higher in both math and reading compared to their peers in public schools, with a considerable difference of 69.86 and 67.4 points, respectively. This contrast underscores the potential influence of school types on students' academic performance. We proceed to present our empirical analysis in the forthcoming section, aiming to provide a comprehensive understanding of the underlying factors contributing to these data patterns.

Table 2: Difference in mean test scores

	Panel A: Child		
	Boy	Girl	Diff in mean
	(1)	(2)	(3)
Math test score	463.97	464.07	-0.10
Reading test score	456.1	458.79	-2.69
No. Children	284	273	

	Panel B: Teacher		
	Male	Female	Diff in mean
	(4)	(5)	(6)
Math test score	450.08	485.87	-35.79***
Reading test score	439.57	485.51	-45.94***
No. Children	217	340	

Panel C: School

	Private	Public	Diff in mean
	(7)	(8)	(9)
Math test score	518.96	449.1	69.86***
Reading test score	510.47	443.07	67.4***
No. Children	438	119	

Note: Panel A displays average test scores in math and reading among students. Panel B investigates the difference in the average score when female or male teachers teach pupils. Panel C addresses pupils' performances by the type of their schools (public vs. private). Reported in columns (3), (6) and (9) are the difference in mean test scores. *** p <0.01

5. Empirical Model

In this section, we outline our approach for estimating the effects of teachers and schools on the cognitive skills of primary school pupils. Due to the absence of longitudinal data, we opt for a static version of the model (2). Indeed, even if several papers that focus on child development process consider a dynamic model of skill development, some studies, such as Boo and Creamer (2019), Schady et al. (2014), and Dearden et al. (2011), resort to static models due to data limitations. Thus, we consider a linear production function, as indicated in equation (2), to deal with the identification problem raised in Agostinelli and Wiswall (2016). We estimate the following model:

$$Log(\theta_{ij}) = \boldsymbol{T}_j\boldsymbol{\psi} + \boldsymbol{S}_j\boldsymbol{\lambda} + \boldsymbol{X}_i\boldsymbol{\beta} + \eta_{ij} \qquad (3)$$

where θ_{ij} represents the test score of students i from school j. The vectors $\boldsymbol{T}, \boldsymbol{S}$, and $\boldsymbol{X}$ encompass teachers, schools and children's characteristics, respectively**.** Our estimation strategy relies on ordinary least square regressions for equation (3). Given that we have relatively small student groups at the school level, there is a potential for downward-biased standard errors (Cameron et al., 2008). To address this concern, we follow the methodology suggested by Cameron et al. (2008) and Roodman et al. (2019), employing bootstrapped p-values with clustering based on schools. This approach helps mitigate the impact of small group sizes on our estimation results.

6. Empirical Findings

In this section, we delve into our empirical findings, offering insights into the key determinants of pupils' skills in mathematics and reading.

6.1. Baseline results

Table 3 presents an overview of the explanatory power of school, home, classroom and teacher effects in elucidating pupils' skills in mathematics and reading. Standard errors of regression coefficients, clustered by school, are indicated in parentheses, while bootstrapped p-values clustered by school enclosed in braces. Results are qualitatively the same. For brevity, we present this exercise for Table 3 only but results are consistent with all main tables.

In addition, we provide the adjusted R-squared values derived from a series of regressions with different dependent variables (math test score and reading test score) and varying combinations of children, school, classrooms, and teacher characteristics. The initial column for each dependent variable considers only pupil

characteristics and family background. The subsequent column introduces school and classroom characteristics, and the final column adds teacher characteristics.

Our findings reveal several noteworthy features. First, we observe that female teachers are more likely to enhance pupils' skills in both math and reading. Contrarily, students in public schools are less likely to attain higher scores in these subjects compared to their counterparts in private schools. Second, the inclusion of teacher characteristics in the analysis significantly enhances the explanatory power for math and reading test scores. Specifically, the addition of teacher characteristics increases the explanatory power by 5.3 percentage points for math test scores and 5.6 percentage points for reading test scores. Third, we uncover that female students benefit more from female teachers in both reading and math test scores. Finally, we document that, students' gender does not significantly predict their test scores.

6.2. Teacher Efforts

We further explore the mechanisms underlying the positive effect of female teachers in the following section by investigating whether female teachers are more likely to devote more efforts to teaching than their male colleagues. Since teacher efforts are not directly measured in the PASEC data, we rely on a set of variables listed in the Table A1 in the Appendix to perform the factor analysis of mixed data (FAMD). We therefore use the loading factors from the first component of the FAMD to compute the teacher efforts as a linear combination of the corresponding loading factors. Specifically, we compute teacher effort as follows:

Table 3: Determinants of Pupils' Skills in Math and Reading

Variables	(1)	(2)	(3)	(4)
	Panel A: Math Test Score			
Pupil is female	-0.001	0.007	0.005	
	(0.017)	(0.015)	(0.015)	
	{0.970}	{0.754}	{0.790}	
School is public		-0.099**	-0.123***	-0.115***
		(0.041)	(0.038)	(0.039)
		{0.069}	{0.010}	{0.009}
Teacher is female			0.084***	
			(0.028)	
			{0.015}	
Female teacher x Female pupil				0.054**
				(0.026)
				{0.077}
Adjusted R-squared	0.120	0.183	0.236	0.221
Observations	557	557	557	557
	Panel B: Reading Test Score			
Pupil is female	0.001	0.002	0.002	
	(0.012)	(0.010)	(0.009)	
	{0.974}	{0.958}	{0.998}	
School is public		-0.113***	-0.131***	-0.126***
		(0.033)	(0.036)	(0.036)
		{0.004}	{0.001}	{0.001}

Teacher is female			0.053**	
			(0.021)	
			{0.038}	
Female teacher x Female pupil				0.041***
				(0.014)
				{0.003}
Adjusted R-squared	0.183	0.305	0.361	0.353
Observations	557	557	557	557
Pupil and family covariates	yes	Yes	yes	yes
Teacher covariates	no	no	yes	yes
School and classroom characteristics	no	Yes	yes	yes

Note: All regressions include pupil characteristics and family background. Each column reports coefficients from OLS regressions, with standard errors clustered by school in parentheses. The dependent variable is the logarithm of math test score for Panel A, and the logarithm of reading test score for Panel B. Column (2) adds school characteristics and column (3) includes teacher characteristics. Column (4) documents the effect of interactions between female teacher and girl pupil. Adjusted R-squared and number of observations are reported in each column. Pupil covariates include age, attended kindergarten, has books at home, has reading books and math books in class. Family covariates include whether the mother or father knows reading, and the number of people who know reading in the pupil's home. Teacher characteristics include age, tenure, education level and number of days of absenteeism. Finally, we include the number of teachers, the class size, tutoring dummy, teachers' grade, class equipment index, and urban dummy in the school and classroom characteristics. P-values are in the bracket: *** p<0.1, ** p<0.05, * p<0.1. We also present in brace, bootstrapped p-values clustering at school.

$$Teacher\ Effort = \sum_{k=1}^{K} \phi_k W_k \qquad (4)$$

where the parameters ϕ_k represents the loading factor associated with the variable k, while W comprises the variables used to run the FAMD. The specific variables employed in this calculation are detailed in Table A1, along with their corresponding loading factors.

Subsequently, we normalize the teacher efforts to have values ranging between 0 and 1, where higher values indicate greater teaching effort and lower values signify less teacher involvement. Figure 1 provides an overview of the distribution of teacher efforts, differentiating between male and female teachers and school types. Notably, female teachers consistently exhibited a higher level of effort in teaching compared to their male counterparts. Specifically, the teacher effort index ranged from 0.35 to 1, with a median of 0.65 for female teachers, while male teachers demonstrated an index ranging from 0.2 to 0.95, with a median of 0.55. Furthermore, a substantial proportion of female teachers (approximately 60%) displayed a teaching effort index surpassing 0.6, whereas this proportion was roughly 40% among male teachers. To assess the significance of differences in effort distributions between male and female teachers, we conducted a Kolmogorov-Smirnov test, resulting in a statistics value of 0.2443 and an associated p-value of 0.000. These results underscore a notable and statistically significant distinction between male and female effort distributions, further reinforcing our observations. Additionally, our analysis revealed that teachers in private schools tend to invest more effort in teaching than their counterparts in public schools.

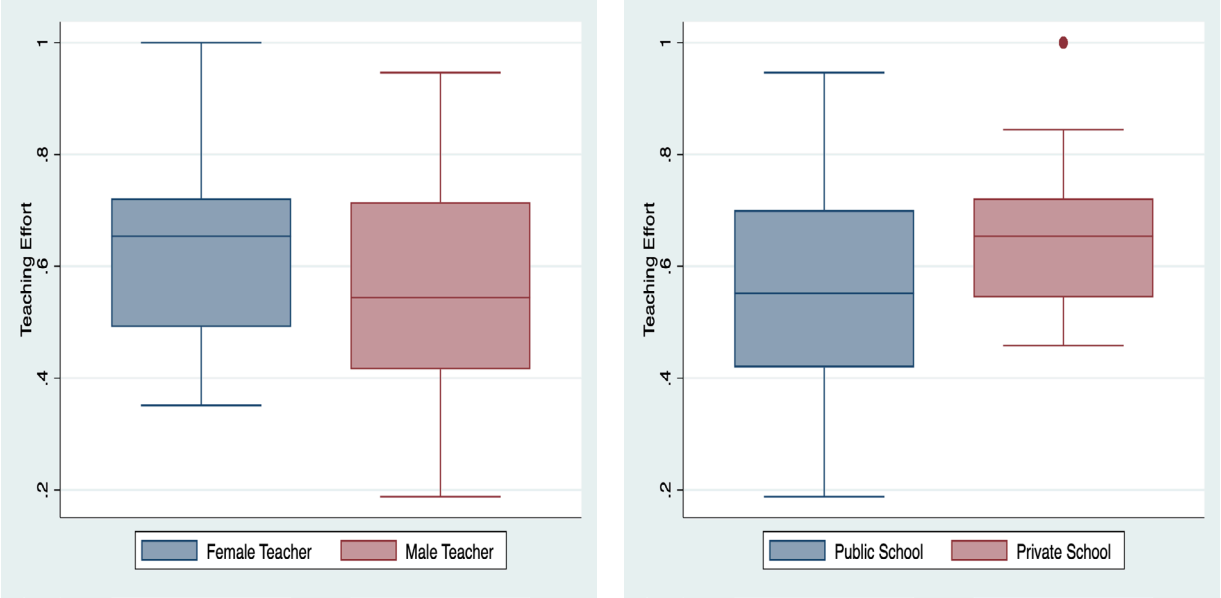

Figure 1: Distribution of Teacher Efforts

Our investigation also explores how the relationship between female teachers and students' test scores varies according to the level of test scores. To elucidate this, we present quantile regression results in Table 4, reporting the 0.2, 0.5 and 0.8 quintiles. The results demonstrate similarities in reading test scores and significant disparities among the selected quintiles for math test scores. Particularly, students with higher math scores exhibit a markedly positive effect of female teachers compared to those with lower math scores, suggesting the potential significance of female teachers in improving student outcomes in mathematics.

Table 4: Effect of female teachers on test scores (Quantile regression)

	Reading test score			**Math test score**		
	Quantile			Quantile		
	0.2	0.5	0.8	0.2	0.5	0.8
Female teacher	0.062***	0.039***	0.062***	0.086***	0.079***	0.097***
	(0.011)	(0.014)	(0.013)	(0.023)	(0.019)	(0.030)
Observation		557			557	

Note: Regressions include pupil characteristics, family background, school characteristics, and teacher characteristics. Standard errors are in parentheses: *** p<0.1, ** p<0.05, * p<0.1.

6.3. Teaching Practices

In the preceding sections, we have observed the positive and statistically significant influence of female teachers on students' cognitive skills. We have also established that female teachers exhibit a higher propensity for exerting effort in teaching compared to their male counterparts. To further explore the factors contributing to these effects, we shift our focus to teaching practices, specifically examining the pedagogical methods employed by teachers in the classroom. Previous research on teaching practices, particularly in relation to student cognitive skills, has yielded inconclusive findings. To investigate the extent to which specific teaching practices impact students' performance in math and reading, we estimate the following model:

$$TP_i = \alpha \times FemaleTeacher_i + \boldsymbol{Z}_i\boldsymbol{\delta} + \zeta_i \quad (5)$$

where TP_i stands for each of the teaching practices listed in Table 5. We rely on the ordinary least square regression when estimating equation (5).

Table 5 presents detailed results of female teachers on teaching practices. The estimates are derived from separate regressions, with each teaching practice treated as an individual outcome. Results clearly show that certain teaching practices are associated with female teachers, but can have different effects on pupils' cognitive skills. The estimates indicate that measures associated with "traditional teaching practices," such as French and math exercises, extra homework assignments, and maintaining an up-to-date attendance list, are positively and significantly correlated with female teachers. Furthermore, the estimates unveil the positive and significant effects of "modern teaching practices". These practices include organizing students into subgroups, engaging in fun activities with students, and maintaining a notebook for teaching preparation. These findings shed light on the diverse approaches employed by female teachers in fostering students' cognitive skills. Further analysis can delve into the specific strategies used by female teachers to implement these practices and their impact on student learning outcomes.

Table 5: Female Teacher effects on Teaching Practices – OLS Estimates

Variables	Estimates	Std. Err.
Number of days of teacher's absenteeism	-1.6116**	(0.735)
Number of weekly teaching hours	-0.3524	(0.234)
Number of French exercises	**4.3094*** **	**(0.794)**
Number of math exercises	0.5136	(0.849)
Attendance list up to date	**0.0361*** **	**(0.009)**
Has a notebook for teaching preparation	**0.0214*** **	**(0.007)**
Has a rolling note book	**0.0607*** **	**(0.019)**
Meeting with students' parents	0.0064	(0.029)
Regular assessments	-0.0727**	(0.034)
Organize students into subgroups	-0.0547	(0.039)
Extra homework	0.0905**	(0.036)
Number of math lectures per week	**0.4791*** **	**(0.134)**
Read stories, novels, etc. to students	-0.0952	(0.071)
Fun activities with students	**0.1509***	**(0.078)**
Number of reading lectures per week	**0.8937***	**(0.470)**
Use the most maternal language spoken by students	0.0837	(0.057)
School sample size	80	

Note: Table 5 presents the OLS estimation of being a female teacher on teaching practices. Regressors include pupil characteristics, family background, school characteristics, and teacher characteristics. Standard errors clustered at the school level are presented in parentheses. *** p<0.1, ** p<0.05, * p<0.1. Note:

5.4. Students sorting

The estimations of the female teacher effect in the preceding sections may be subject to bias stemming from the non-random sorting of students into schools or classrooms. For instance, students whose parents are high educated would be likely to sort in elite schools or schools of excellence. So, if the variables that drive this process of selection are not fully observed, potential correlations between school-specific factors and students' cognitive skills are major sources of bias. While we partially address this concern by controlling for teachers, schools, and students' observable characteristics, this section further explores the extent to which student sorting occurs within our sample, specifically based on (i) parents' literacy (either father or mother knows reading, the number of people who know reading in the family) and (ii) kindergarten attendance.

To assess student sorting, we generate predicted test scores for each student based on their parents' literacy levels. Subsequently, we estimate the association between these predicted outcomes and the presence of a female teacher, while controlling for student, teacher, and school characteristics. These control variables do not include parents' literacy. We perform similar exercise by replacing parents' literacy with whether the student has attended kindergarten. By doing so, one can control for the possible effect of baseline skills endowment since this is not directly measured in our data. Notably, these control variables do not include parents' literacy. A similar analysis is conducted by substituting parents' literacy with the student's history of kindergarten attendance. This allows us to account for any potential effect of early childhood education on baseline skills endowments, as this information is not directly measured in our dataset.

In the absence of student selection to teachers or schools, there should be no discernible correlation between predicted outcomes and teacher effects. The results are presented in Table 6, with Panel A illustrating the estimates when cognitive skills are predicted using parents' literacy. Here, we observe modest evidence of negative selection for female teachers and cognitive skills, with coefficients of -0.002 for both math and reading scores. This implies that the bias introduced by selection based on parents' literacy is approximately 0.2% for both cognitive skills. Moving to Panel B, we examine the results when cognitive skills are predicted using kindergarten attendance. Intuitively, the degree of bias can be related to early childhood education. The findings reveal no significant relationship between female teachers and predicted cognitive skills. Moreover, the estimated coefficients for both math and reading scores are close to zero.

Overall, our results suggest that there is a moderate level of bias in the estimations of the female teacher's impact on students' cognitive skills, potentially due to selection based on parents' literacy. However, it's important to note that other forms of selection driven by unobservable characteristics may also be at play. Notably, research by Chetty et al. (2014) using a quasi-experimental approach found minimal bias due to sorting on unobservable in models that control for lagged test scores. A similar conclusion can be expected in models that account for kindergarten attendance.

Table 6: Estimating pupil sorting using parents' education literacy and kindergarten attendance

	Panel A: Sorting w.r.t. parents' literacy	
	Predicted math score	Predicted reading score
Female teacher	-0.002	-0.002
	(0.008)	(0.008)
Controls	yes	yes

	Panel B: Sorting w.r.t. kindergarten attendance	
	Predicted math score	Predicted reading score
Female teacher	0.0003	0.0003
	(0.0011)	(0.0011)
Controls	yes	yes

Note: In Panel A, students' test scores are predicted using their parents' literacy as control variables. In panel B, we predict cognitive skills using whether pupils have attended kindergarten as the only control variable. Standard errors clustered at the school level are presented in parentheses. When investigating the correlation between female teacher and the predicted scores, we use the same controls (except parents' literacy and kindergarten attendance) as in the regressions presented in the previous sections. w.r.t. means "with respect to".

7. Discussion and Concluding Remarks

This study provides a comprehensive examination of the impact of teachers on pupils' cognitive skills, shedding light on crucial factors influencing student achievement in primary schools in Benin. The findings reveal several important insights that contribute to our understanding of the educational landscape in developing countries. Notably, our research emphasizes the pivotal role of female teachers in influencing students' cognitive skills positively. Female teachers exhibit a significant impact on pupil learning outcomes, particularly in mathematics and reading. Importantly, this effect is amplified among students with higher initial math scores, highlighting the potential for tailored teaching strategies based on students' existing abilities. To unravel the mechanisms underlying these outcomes, we uncover that female teachers are more likely to invest additional effort in their teaching compared to their male colleagues. This investment includes both traditional and modern teaching practices, pointing to the importance of pedagogical diversity in driving improvements in cognitive skills.

The positive effects of female teachers would stem from the creation of a supportive and empowering learning environment. Female teachers would often serve as relatable role models, breaking down gender stereotypes and inspiring confidence in their female students. In Benin, where traditional gender norms limit girls' educational aspirations, female teachers would act as mentors, encouraging girls to actively participate and excel in subjects traditionally perceived as challenging. Several studies also argue that female students tend to ask more questions, engage in discussions, and seek extra help in the presence of female teachers, leading eventually to improve understanding and mastery of math and reading concepts. Moreover, female teachers would often be more attuned to the unique challenges faced by their female students, offering targeted guidance and encouragement. This individualized support would help girls overcome barriers to learning, resulting in enhanced academic performance. The impact is not limited to subject knowledge; female students taught by female teachers often exhibit higher levels of self-esteem, motivation, and a belief in their own capabilities. Consequently, investing in female teachers in Benin would not only improve educational outcomes but also would foster gender equality, empowering the next generation of women leaders.

Looking forward, promising avenues for future research lie in exploring how these effects evolve as students progress through primary school and examining the ways different school interventions may amplify or diminish the impact of female teachers on cognitive skills. The findings outlined in this paper also emphasize the need for further research on the interplay between teachers, schools, and student development. Subsequent studies can explore the nuanced teaching practices that yield the most substantial

enhancements in cognitive skills. Furthermore, expanding the sample size to encompass a more extensive cross-section of primary school students and teachers is another avenue for future research. This expansion would facilitate the generation of more comprehensive and generalizable insights into the intricate dynamics of teacher-student interactions, providing a richer understanding of the educational landscape.

Our findings do not only contribute to the growing body of literature assessing the influence of teachers and schools on student outcomes in developing countries (Azam and Kingdon, 2015; Farrell and Oliveira, 1993; Glewwe and Kremer, 2006), particularly in the context of primary education in Benin but also have broader implications for education policy and practice. Recognizing the positive influence of female teachers, we recommend strategies to promote and support female educators in primary schools. Policymakers may consider initiatives that encourage the recruitment and retention of female teachers to bridge educational disparities and improve overall educational outcomes. Furthermore, this research underscores the significance of understanding the specific teaching practices that yield the most substantial improvements in cognitive skills. Exploring the intricacies of these practices can lead to more effective teacher training and classroom strategies.

In conclusion, this study highlights the complexity of the teacher-student dynamic and the multifaceted factors that influence student development. By gaining a deeper understanding of these elements, we can work towards an improved educational landscape in Benin and similar contexts, providing every child with the foundation for a brighter academic future and contributing to the progress of the nation.

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Appendix:

Table A1: Loading factors from the FAMD

Variables	Loading Factors
Number of days of teacher's absenteeism	0.656
School offers tutoring	0.007
Number of weekly teaching hours	0.547
Number of French exercises	0.748
Number of math exercises	0.637
Attendance list up to date	0.251
Has a notebook for teaching preparation	0.22
Has a rolling note book	0.005
Frequency of pedagogical meetings	0.0063
Meeting with students' parents	0.229
Students tracking form	0.096
Regular assessments	0.0022
Organize students into subgroups	0.048
Extra homeworks	0.0021
Number of math lectures per week	0.145
Read stories, novels, etc. to students	0.408
Fun activities with students	0.059
Number of reading lectures per week	0.698
Use the most maternal language spoken by students	0.251
Teach the entire planned program	0.027

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