

**EFFECTS OF TEACHER CHARACTERISTICS ON PROJECT ABC  
OUTCOMES IN NIGER**

Master of Arts in Law and Diplomacy Thesis

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# Effects of Teacher Characteristics on Project ABC Outcomes in Niger

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**Abstract:** This paper provides the results of an impact evaluation measuring the effect of observable teacher characteristics (gender, age, local status and years of schooling) on Project ABC outcomes. Project ABC is a randomized mobile phone adult education program which taught participants basic mobile phone skills along with traditional literacy and math classes in two regions of Niger. Female teachers were associated with lower test scores overall, although this is highly correlated with the fact that female teachers mostly taught female students who had lower scores than males, on average. For teacher age, we see that younger teachers are better at teaching technology (target age for teachers is 28 to 33 years old) in ABC literacy classes, whereas older teachers (target age is 37 to 45 years old) are better at teaching ABC math which uses more traditional methods. Local teachers (teachers from the village where they were teaching) have a positive effect on ABC scores in Dosso, but a negative effect in Dosso overall and in Zinder. Teachers should have at least 7 years of schooling in order to have the greatest impact on student test scores.

## 1 Introduction

Niger has one of the lowest literacy rates in the world – only 30 percent of the population over 15 years old could read or write in 2008 (U.S. Department of State 2010). In order to address this problem, Project ABC (*Alphabetisation de Base par Cellulaire*) was designed and implemented by Catholic Relief Services (CRS), Tufts

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University, the Ministry of Non-Formal Education in Niger and the University of Oxford. Project ABC is mobile phone based literacy and numeracy program for adults in Niger which was implemented in 110 villages and involved over 5,500 adult participants. On top of having traditional literacy and math classes, the villages randomly selected for ABC had the opportunity to learn simple mobile phone technology in their lessons. This paper builds off of the work led by Jenny C. Aker (Aker, Ksoll, Lybbert 2011) which provides an impact evaluation of Project ABC.

Recent literature highlights the importance of teachers as a key input for improving education and student outcomes. A UNESCO report states “...the impact of the teacher and teaching, has been identified in numerous studies as *the* crucial variable for improving learning outcomes” (Anderson 2004). Teacher quality and training has become a key area for researchers, implementers and evaluators and policy makers to focus on. This paper seeks to address a gap in the analysis and evaluation of the effects of non-formal or adult education teachers on educational outcomes.

Teacher effectiveness is most commonly measured by student achievement or test scores and the same metric is applied in this paper. There are a range of teacher characteristics which have been identified that increase teacher effectiveness including commitment, confidence, trustworthiness, respect, analytical thinking, conceptual thinking, a drive to improve, information seeking, initiative, flexibility, accountability and a passion for learning (Anderson 2004). Unfortunately, these are characteristics that are not able to be quantitatively measured and do not lend themselves easily to impact evaluation. Some papers have used teacher attendance rates to measure their effect on student learning (Das, Dercon, Habyarimana, Krishnan 2007) or as a proxy for teacher

motivation (Aker, Ksoll, Lybbert 2011). This paper uses the observable characteristics of teacher gender, age, years of schooling and local status and measures their impact on Project ABC outcomes.

### **3 Project ABC**

Catholic Relief Services (CRS) implemented Project ABC in two regions of Niger— Dosso and Zinder. Of the 140 villages where CRS was working at the time, 117 villages qualified for the program and 110 were selected.<sup>2</sup> The randomization first classified villages by region and administrative districts, then treatment and control villages were randomly selected by a computer number generator. Half of the villages (55) were chosen to participate in the first round of classes in 2009, and half of those villages (26) were randomly assigned participation in the ABC program. The same process was carried out for the phased-in 2010 group. The intervention included eight months of literacy and math classes (February to June) for two years with breaks from July to January to accommodate agricultural planting and harvesting seasons. All classes were taught in one of two local languages—Zarma or Hausa.<sup>3</sup>

In February 2009, CRS began to implement the program in 55 villages in Dosso and Zinder. Each village had 50 adult students split into 2 classes (25 male and 25 female) for cultural reasons. Qualified students were selected by a public lottery held in each village. Qualification criteria included: 1) membership in a formal or informal producers' association in the village and 2) the inability to read or write in any language. Eligible applicants comprised of over half the adult village population, on average.

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<sup>2</sup> Villages without mobile phone coverage and villages with existing adult literacy programs were deemed ineligible and were not included in the randomized selection.

<sup>3</sup> The exceptions to this are the Kanuri participants (4 percent of students) who did not learn in their native language (Kanuri), but in Hausa. Note, there are almost 10 local languages spoken in Niger, but Hausa, Zarma and Kanuri are the primary regional languages for Dosso and Zinder.

In order to recruit teachers, the Ministry of Non-Formal Education in Niger visited each village selected for the program (ABC or not) and tried to find candidates that had several years of formal education. If there were no such candidates, the Ministry looked in nearby villages, cities or towns. Eventually several teachers were identified for each village and these candidates went through two to three weeks of teacher training to learn the adult literacy teaching methodology and course curriculum. At the end of the training, the teacher had to pass a test in order to be hired. Teachers were compensated with food and cash. Teacher recruitment took place both in 2009 and 2010, so the composition of teachers was slightly different each year.

Both ABC and non-ABC villages had the same literacy and numeracy curriculum, but simple mobile phone skills modules<sup>4</sup> were integrated into ABC villages three months after classes started. Students in the ABC classes did not have any additional time in class, so the module was adapted to fit inside normal class hours. Mobile phones were also distributed to groups of five students in ABC villages.

Tests were designed by Catholic Relief Services in collaboration with Niger's Ministry of Non-Formal Education and were the same for students learning in Hausa and Zarma. Students were periodically given both a literacy and math test to measure their progress. Each test was graded on a scale of zero to six. A score of zero on a literacy test indicated that the person was completely illiterate (unable to read or write) and a score of six signaled that the student had mastered basic reading and writing skills (measured by the ability to write two complete sentences with complex word patterns). For math, a score of zero also indicated no knowledge of basic math and a score of six meant the

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<sup>4</sup> The modules consisted of learning how to turn the phone on and off, recognize numbers and letters on the screen and keypad, make a call and send a SMS.

individual could solve math problems involving addition, subtraction, multiplication and division.

According to an impact evaluation of Project ABC, the ABC treatment proved to be an effective way for students to learn and retain literacy and numeracy skills. All students (ABC and non-ABC) demonstrated substantial improvements in literacy and math tests from the baseline scores. However, students in ABC villages outperformed those not in ABC classes by test scores that were 10-20 percent higher. There is evidence of persistent impacts of the program for ABC students who were able to continue using mobile phones outside of the classroom. Overall, mobile phones can be an effective and sustainable educational tool for rural populations (Aker, Ksoll, Lybbert 2011).

#### **4 Data and Summary of Findings**

The data used in this paper were taken from an existing data set from Aker, Ksoll and Lybbert (2010) which was combined with an exhaustive dataset of teacher information for Project ABC teachers from the Ministry of Non-Formal Education. In this paper, I measure the effect of specific teacher characteristics (gender, age, level of education and local status) on participant test scores and aim to make recommendations for what characteristics constitute the best teacher for this program.

In terms of teacher gender, students of female teachers had lower scores on average, except for when they taught female students, literacy in Dosso, ABC literacy classes in Zinder or Hausa students for math. The outcomes for ABC math and Dosso ABC math are lower for students with female teachers at a statistically significant level. It seems that assigning female classes to female teachers and male teachers to male classes improves scores.

For a teacher's local status (they are from the village in which they are teaching), local teachers had a positive effect on ABC scores in Dosso which makes sense because Dosso teachers were 97 percent local.

In regards to teacher age, we see that younger teachers are better at teaching ABC literacy classes, probably because they are more familiar with technology. The target age for teachers is 28 years (or lower) in Dosso, 30 years (or lower) for Dosso females and 33 years (or lower) in Zinder. For math, students of older teachers have better results, probably because it is taught using traditional methods and does not require the use of technology. The target age for Dosso math teachers is 37 years (or younger), 38 years (or lower) for Dosso female students and 45 years (or higher) for Zinder math. It is unlikely that CRS will be able to accommodate two teachers per village, but focused teacher trainings can hopefully make up for the what each age group of teachers lacks.

When considering a teacher's level of schooling, students perform better with teachers who have over 7 years of education. This is below the threshold for the average level of education for teachers (8.4 years) which is promising.

#### **4.1 Comparison of Observable Teacher Characteristics**

Tables 1 to 3 compare socio-demographic characteristics of teachers including age, level of education, sex, local status and region where they taught. I split teachers up by the intervention year in which they taught (2009 or 2010), then calculated the distribution of means through regressions by clustering the standard errors. I compared the results according to ABC versus non-ABC, Dosso versus Zinder and also male versus female classes. Since the teacher selection was non-random, it would not be surprising to see some differences.

**Table 1. Comparison of teacher characteristics– ABC vs. non-ABC**

2009	ABC	Non-ABC	Difference
Level	8.91 (.35)	8.31 (.30)	.60 (.35)*
Age	32.45 (1.56)	32.53 (1.23)	-.08 (1.56)
Gender	.32 (.09)	.25 (.06)	.06 (.09)
Local	.67 (.09)	.74 (.06)	-.07 (.67)
Region	.58 (.10)	.56 (.07)	.02 (.10)
2010	ABC	Non-ABC	Difference
Level	8.32 (.27)	8.28 (.19)	.04 (.27)
Age	32.75 (1.18)	33.28 (.80)	-.53 (1.18)
Gender	.40 (.06)	.35 (.04)	.05 (.06)
Local	.70 (.06)	.74 (.04)	-.04 (.06)
Region	.58 (.07)	.57 (.05)	.01 (.07)

Across ABC and non-ABC teachers, there are no significant differences for teacher characteristics except for the level of education in 2009 (ABC teachers had 0.60 more years of

education, on average) which is statistically significant at the 10 percent level. The difference was corrected for in 2010. To the extent that teachers with more education more positively affect student test scores, this could potentially bias the results.

**Table 2. Comparison of teacher characteristics– Dosso vs. Zinder**

2009	Dosso	Zinder	Difference
Level	8.18 (.36)	9.08 (.23)	-.89 (.36)**
Age	32.26 (1.59)	32.78 (1.14)	-.52 (1.59)
Gender	.27 (.09)	.31 (.07)	-.04 (.09)
Local	.97 (.08)	.38 (.07)	.59 (.08)***
2010	Dosso	Zinder	Difference
Level	7.99 (.26)	8.71 (.20)	-.72 (.26)**
Age	33.27 (1.20)	32.66 (.91)	.61 (1.20)
Gender	.29 (.07)	.48 (.05)	-.19 (.07)***
Local	.96 (.05)	.40 (.05)	.56 (.05)***

A comparison of teacher characteristics for Dosso versus Zinder shows that Zinder teachers had a significantly higher level of education (9-10 months more on average) at the 5 percent level. Also, Zinder had

fewer local teachers (39 percent), where Dosso had almost a complete majority (97 percent). The data is consistent with reality because implementers had a difficult time finding adults with previous education in Zinder, so priority was placed on a higher level of education over local status. Also, Zinder had a significantly higher number of female teachers than Dosso in 2010. To the extent that more educated, local or male teachers get better results from their students, this could also affect the results when comparing Dosso and Zinder.

**Table 3. Comparison of teacher characteristics– male vs. female classes**

2009	Male class	Female class	Difference
Level	8.68 (.26)	8.50 (.37)	.18 (.37)
Age	33.85 (1.01)	31.13 (1.57)	2.72 (1.57)*
Gender	.09 (.04)	.48 (.08)	-.39 (.08)***
Local	.72 (.06)	.70 (.09)	.02 (.09)
2010	Male class	Female class	Difference
Level	8.17 (.21)	8.43 (.26)	-.26 (.26)
Age	35.19 (.75)	30.80 (1.14)	4.39 (1.14)***
Gender	.04 (.02)	.71 (.05)	-.67 (.05)***
Local	.78 (.04)	.54 (.06)	.12 (.06)**

When looking at the difference in teacher characteristics between male and

female classes, there were statistically significant differences for age and gender. On average, teachers of male classes were about 3.6 years older than those who taught female classes. Also, over half of female students had female teachers, where less than 10 percent of males had female teachers. The results are not surprising since the program purposely tried to match female teachers to female classes and male teachers to male classes for cultural reasons.

In 2010, there was also a statistically significant difference between the number of local teachers. Male classes had more local teachers which is not surprising because men normally have higher levels of education than women and it would make sense that more eligible males with education could be found locally. To the extent that age, gender or local status affects test scores, this could also potentially affect the results when comparing outcomes between male and female classes.

#### **4.2 Comparison of Female Average Test Scores**

Tables 4 and 5 show the results from a difference in means test for female student scores between ABC and non-ABC villages by region and ethnicity at the baseline (January 2009), after 5 months (June 2009) and at 17 months (June 2010).<sup>5</sup> As compared to baseline test scores where all women scored near zero and were ‘completely illiterate’ on average, all test scores show significant improvement by June 2010 to a minimum level of simple letter recognition, the ability to write a few letters and basic math skills.

For the pooled sample and Dosso, a comparison of baseline test scores provides evidence that the treatment and control groups were comparable and the randomization

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<sup>5</sup> The Aker, Ksoll, Lybbert paper shows that the randomization of the participants was mostly successful in creating comparable groups. The only caveat is non-ABC participants owned more assets which was statistically significant. The authors also performed a difference in means test for test results at the baseline and show that there were no significant differences between ABC and non-ABC scores in the pooled sample, Dosso or Zinder.

worked (Table 4). In Zinder, we see that the non-ABC group tested higher than the ABC group in the baseline which could bias the results, especially because we see that non-ABC women in Zinder finished classes with higher scores than those in Zinder with ABC and makes it harder to detect an effect. However, given this scenario, the results would be underestimated which would work in my favor.

For the final round (June 2010), the pooled sample shows that women in ABC classes performed better than those without ABC by 0.19 points for literacy and 0.18 points for math. This is statistically significant at the 1 percent level.

**Table 4. Difference in mean test scores for females, by region**

<b>Panel A: Pooled Sample</b>	ABC mean	Non-ABC mean	Difference
Jan 2009 literacy test score	0.03 (.19)	0.04 (.33)	-0.01 (.01)
Jan 2009 math test score	0.03 (.21)	0.05 (.34)	-0.01 (.01)
June 2009 literacy test score	1.71 (1.62)	1.32 (1.56)	0.39 (.09)***
June 2009 math test score	2.29 (1.45)	1.86 (1.41)	0.43 (.08)***
June 2010 literacy test score	1.59 (1.55)	1.40 (1.34)	0.19 (.06)***
June 2010 math test score	2.38 (1.46)	2.20 (1.32)	0.18 (.06)***
<b>Panel B: Dosso Region</b>	ABC mean	Non-ABC mean	Difference
Jan 2009 literacy test score	0.04 (.22)	0.03 (.34)	0.00 (.02)
Jan 2009 math test score	0.05 (.24)	0.04 (.35)	0.01 (.02)
June 2009 literacy test score	1.24 (1.48)	0.77 (1.24)	0.47 (.10)***
June 2009 math test score	2.21 (1.46)	1.64 (1.25)	0.56 (.10)***
June 2010 literacy test score	1.72 (1.53)	1.34 (1.32)	0.38 (.07)***
June 2010 math test score	2.52 (1.60)	2.13 (1.35)	0.39 (.07)***
<b>Panel C: Zinder Region</b>	ABC mean	Non-ABC mean	Difference
Jan 2009 literacy test score	0.02 (.15)	0.06 (.33)	-0.04 (.02)*
Jan 2009 math test score	0.02 (.15)	0.06 (.33)	-0.04 (.02)*
June 2009 literacy test score	2.26 (1.60)	1.98 (1.66)	0.28 (.14)**
June 2009 math test score	2.39 (1.50)	2.12 (1.54)	0.27 (.13)**
June 2010 literacy test score	1.43 (1.56)	1.51 (1.37)	-0.08 (.09)
June 2010 math test score	2.19 (1.22)	2.31 (1.27)	-0.12 (.08)*

For women in Dosso, final round test scores were also higher for ABC students by 0.38 points on average for literacy and 0.39 points for math (significant at the 1 percent level).

In Zinder, we see that non-ABC students tested at a higher level than ABC students at the baseline, lower after the first year of classes and finished stronger by 0.08 points for literacy (not significant) and 0.12 points in math (significant at the 10 percent level) in June 2010. Overall, Dosso women had the best ABC scores (1.72 points for literacy and 2.52 points for math) and Zinder women had the best non-ABC scores (1.51 for literacy, 2.31 for math).

**Table 5. Difference in mean test scores for females, by ethnicity**

<b>Panel A: Hausa</b>	ABC mean	Non-ABC mean	Difference
Jan 2009 literacy test score	0.01 (.14)	0.04 (.34)	-0.03 (.02)*
Jan 2009 math test score	0.02 (.15)	0.05 (.34)	-0.03 (.02)*
June 2009 literacy test score	1.76 (1.67)	1.26 (1.56)	0.50 (.10)***
June 2009 math test score	2.28 (1.46)	1.81 (1.38)	0.47 (.09)***
June 2010 literacy test score	1.30 (1.62)	1.22 (1.48)	0.09 (.07)
June 2010 math test score	2.20 (1.34)	2.19 (1.35)	0.01 (.06)
<b>Panel B: Zarma</b>	ABC mean	Non-ABC mean	Difference
Jan 2009 literacy test score	0.08 (.31)	0.01 (.11)	0.06 (.04)*
Jan 2009 math test score	0.08 (.33)	0.03 (.16)	0.06 (.04)
June 2009 literacy test score	1.57 (1.53)	1.27 (1.42)	0.30 (.23)
June 2009 math test score	2.40 (1.57)	1.83 (1.53)	0.56 (.23)**
June 2010 literacy test score	1.73 (.13)	0.86 (1.11)	0.88 (.16)***
June 2010 math test score	3.31 (1.94)	2.19 (1.47)	1.12 (.19)***
<b>Panel C: Kanuri</b>	ABC mean	Non-ABC mean	Difference
Jan 2009 literacy test score	0.00 (.00)	0.12 (.60)	-0.12 (.08)
Jan 2009 math test score	0.00 (.00)	0.12 (.60)	-0.12 (.08)
June 2009 literacy test score	1.65 (1.43)	2.83 (1.20)	-1.19 (.34)***
June 2009 math test score	2.11 (1.40)	3.17 (1.34)	-1.06 (.34)***
June 2010 literacy test score	1.36 (1.82)	1.10 (1.16)	0.26 (.33)
June 2010 math test score	2.11 (1.19)	1.70 (.88)	0.41 (.22)*

When disaggregated by ethnicity, Hausa women (84 percent of the female sample) performed better in ABC than non-ABC classes in the first year, but the effect was marginal in the final round (0.09 points better for literacy, 0.01

points for math) and not statistically significant.

Zarma women (13 percent) performed much better with ABC classes— 0.88 points higher for literacy and 1.12 points higher for math tests which is statistically significant at the 1 percent level. For Kanuri women (3 percent), scores were better for ABC students (0.26 points higher for literacy, 0.41 points higher for math) but only math is significant at the 10 percent level. For these women, we see a negative effect during the first 4 months of ABC classes (baseline to June 2009) where scores are over 1 point worse than non-ABC scores. ABC and learning through technology is having a negative effect and perhaps shows that by not learning in your native language, it is harder to catch up. It is also harder for students to reinforce what they have learned over time via text messages in Hausa, when their friends speak Kanuri. This is interesting in terms of external validity.

Overall, Zarma women performed the best in ABC classes (1.73 points for literacy, 3.31 for math) and for non-ABC, Hausa did the best in literacy (1.22 points) and Hausa and Zarma women got an equal average for math (2.19 points).

In terms of randomization, non-ABC Hausa students tested at a higher level for literacy and math scores in the baseline, but by the final round, ABC students had passed them which perhaps attests to the success of the ABC program. At the baseline, Zarma ABC scores were higher and the ABC scores finished higher which could show bias in the results. Kanuri women had no significant difference in baseline scores between ABC and non-ABC.

## 5 Empirical Strategy and Results

I focus on the impact of observable teacher characteristics on literacy and math test scores. The main estimation equation is:

$$(1) \quad \text{Score}_i = \alpha + \beta_1 (T) + \beta_2 (I) + \beta_3 (T * I) + X\gamma_i + \varepsilon_i$$

where *score* is the literacy or math test score attained by an individual student in the final round (June 2010). *T* is the teacher characteristic of interest – age, local, level of education or sex. *I* is the individual characteristic of the student of interest – ethnicity, region, ABC, sex or age. *T\*I* is the interaction between the teacher characteristic and the individual characteristic of interest. *X* represents the combination of control covariates including participant gender, ethnicity, age, region and ABC and  $\varepsilon$  is the error term which captures unobserved teacher or student characteristics such as motivation or ability. I clustered the error term at the class level.

## 5.1 Average Effects of Teacher Gender

Table 6 summarizes the main findings from this section which uses the methodology in Equation 1 to assess the impact of teacher gender on final outcomes. We learn that on average, the pooled sample and students in ABC classes with female teachers tested at a lower level. This trend also applies for Hausa literacy and Dosso math outcomes. Except for students in ABC math classes with a female teacher (0.57 points worse on average than classes taught by a male teacher, significant at the 5 percent level), no other results are statistically significant. The negative trend for student outcomes with female teachers may be correlated with the fact that female teachers teach mostly female students who tested lower on average than male students (Aker, Ksoll, Lybbert 2011). Female students could perform worse than men on average for a number of reasons including the fact that they are often caring for their infants and children during class, have no time to study due to domestic work, they started at a lower knowledge level, have lower inherent ability, are facing cultural factors, and the list goes on.

On the other hand, the results show that for female students, Hausa math students and those in Dosso literacy classes, they perform better on average with female teachers (not statistically significant). These findings suggest that ensuring students have a teacher of the same gender will yield better outcomes on average.

**Table 6. Average program effects of teacher gender on test scores**

LITERACY	(1)	(2)	(3)	(4)	(5)	MATH	(1)	(2)	(3)	(4)	(5)
Sexteacher	-.297 (.197)	-.791 (.638)	-.141 (.215)	-.343 (.345)	-.068 (.323)	Sexteacher	-.263 (.211)	-.416 (.367)	.019 (.245)	-.015 (.264)	-.683 (.495)
Sexteacher*sex		.566 (.664)				Sexteacher*sex		.175 (.433)			
Sexteacher*abc			-.313 (.307)			Sexteacher*abc			-.568** (.284)		
Sexteacher*dosso				.063 (.360)		Sexteacher*dosso				-.335 (.278)	
Sexteacher*hausa (Dosso only)					-.250 (.347)	Sexteacher*hausa (Dosso only)					.450 (.508)
ABC	.221 (.150)	.224 (.151)	.332* (.192)	.222 (.249)	.340* (.175)	ABC	.248* (.144)	.248* (.143)	.448** (.184)	.243* (.142)	.266 (.182)
Region	.297* (.180)	.309* (.178)	.292* (.178)	.270 (.231)		Region	.354** (.138)	.358*** (.138)	.345** (.136)	.501** (.179)	
Sex	-1.033*** (.196)		-1.028*** (.194)	-1.028*** (.196)	-1.031*** (.218)	Sex	-.604*** (.206)		-.595*** (.202)	-.631*** (.207)	-.661** (.232)
Hausa	.504*** (.148)	.510*** (.150)	.521*** (.147)	.502*** (.150)	.529** (.216)	Hausa	-.198 (.190)	-.196 (.191)	-.167 (.187)	-.188 (.190)	-.494** (.252)
Age	-.036*** (.003)	-.036*** (.003)	-.036*** (.003)	-.036*** (.003)	-.035*** (.003)	Age	-.026*** (.003)	-.026*** (.003)	-.026*** (.003)	-.026*** (.003)	-.027*** (.004)
Num of obs.	3852	3852	3852	3852	2760	Num of obs.	3856	3856	3856	3856	2761
R <sup>2</sup>	0.149	0.151	0.151	0.149	0.158	R <sup>2</sup>	0.119	0.119	0.127	0.121	0.137

In terms of the covariate controls, the results show a positive impact on scores for ABC or Dosso students (mostly statistically significant). For participant gender, we see that women perform worse than men by an average of 0.83 points overall (statistically significant at the 1 or 5 percent level). Older people perform worse on math and literacy tests (all significant at the 1 percent level) and being Hausa has a positive effect on literacy scores by over half a point (statistically significant at the 1 or 5 percent level), but has a negative effect on math scores which is not statistically significant.

Because there are significant differences between teacher characteristics in Dosso and Zinder, I will run the data separately for each region in order to compare the effect of teacher gender on each region for math and literacy outcomes.

**Table 7. Average program effects of teacher gender on test scores, by region**

DOSSO MATH			ZINDER MATH			DOSSO LITERACY			ZINDER LITERACY		
	(1)	(2)		(1)	(2)		(1)	(2)		(1)	(2)
Sexteacher	-.312 (.247)	.054 (.298)	Sexteacher	-.015 (.161)	.069 (.209)	Sexteacher	-.274 (.220)	-.076 (.243)	Sexteacher	-.300 (.342)	-.375 (.441)
Sexteacher*abc		-.801** (.368)	Sexteacher*abc		-.134 (.342)	Sexteacher*abc		-.430 (.348)	Sexteacher*abc		.119 (.581)
ABC	.281 (.181)	.526** (.224)	ABC	.029 (.169)	.092 (.229)	ABC	.331** (.174)	.463** (.221)	ABC	-.089 (.294)	-1.054** (.383)
Sex	-.660*** (.232)	-.650*** (.227)	Sex	-.591*** (.170)	-.598*** (.168)	Sex	-1.031*** (.217)	-1.025*** (.215)	Sex	-1.059*** (.367)	-1.054** (.383)
Hausa	-.387* (.219)	-.342 (.214)	Hausa	.718*** (.136)	.722*** (.137)	Hausa	.470** (.176)	.494** (.175)	Hausa	.739*** (.212)	.735*** (.210)
Age	-.027*** (.004)	-.027*** (.004)	Age	-.025*** (.004)	-.025*** (.004)	Age	-.035*** (.003)	-.036*** (.003)	Age	-.037*** (.007)	-.037*** (.007)
Num of obs.	2761	2761	Num of obs.	1095	1095	Num of obs.	2760	2760	Num of obs.	1092	1092
R <sup>2</sup>	0.135	0.148	R <sup>2</sup>	0.102	0.103	R <sup>2</sup>	0.158	0.160	R <sup>2</sup>	0.137	0.137

Here, we find again that students with a female teacher had test scores that were lower on average, except for when paired with the interaction term for teacher gender and ABC math (Table 7). This is statistically significant at the 5 percent level for ABC math classes in Dosso and is consistent with previous findings. Also, we see that for students in Zinder ABC literacy classes with a female teacher, the test scores are higher on average (not significant). The controls show again that females and older students get lower test scores, on average.

## 5.2 Local Status

This section looks at the effect of a teacher's local status for Dosso compared to Zinder. Dosso had 97 percent local teachers compared to only 39 percent in Zinder so it is important to analyze them separately to get clearer results (Table 8 provides a summary). Local teachers did not have a significant effect on test scores except in Dosso. In Dosso, having a local teacher had a positive impact on test scores in ABC villages (ABC math is significant at the 10 percent level), but a negative effect on overall scores (0.23 points for math and 0.26 points lower on average for literacy). For Zinder on

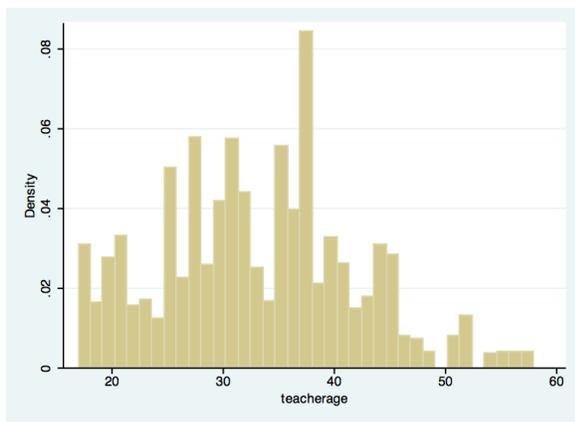
average, students with a local teacher had lower test scores, although the results are not statistically significant.

**Table 8. Average program effects of teacher’s local status on test scores, by region**

DOSSO MATH			ZINDER MATH			DOSSO LITERACY			ZINDER LITERACY		
	(1)	(2)		(1)	(2)		(1)	(2)		(1)	(2)
Local	-.027 (.238)	-.430*** (.135)	Local	-.042 (.204)	.067 (.210)	Local	-.212 (.311)	-.314** (.134)	Local	-.167 (.345)	-.090 (.431)
Local*abc		.616* (.358)	Local*abc		-.182 (.328)	Local*abc		.156 (.505)	Local*abc		-.131 (.542)
ABC	.295 (.184)	-.296 (.292)	ABC	.025 (.166)	.110 (.242)	ABC	.339** (.175)	.190 (.469)	ABC	-.118 (.296)	-.057 (.470)
Sex	-.842*** (.184)	-.840*** (.183)	Sex	-.615*** (.194)	-.625*** (.193)	Sex	-1.193*** (.174)	-1.192*** (.174)	Sex	-1.363*** (.320)	-1.371*** (.307)
Hausa	-.430** (.223)	-.450** (.227)	Hausa	.740*** (.187)	.716*** (.173)	Hausa	.437*** (.179)	.432** (.183)	Hausa	.839*** (.328)	.822** (.334)
Age	-.027*** (.004)	-.026*** (.004)	Age	-.025*** (.004)	-.025*** (.004)	Age	-.035*** (.003)	-.035*** (.003)	Age	-.037*** (.007)	-.037*** (.007)
Num of obs.	2781	2781	Num of obs.	1095	1095	Num of obs.	2780	2780	Num of obs.	1092	1092
R <sup>2</sup>	0.131	0.132	R <sup>2</sup>	0.102	0.103	R <sup>2</sup>	0.156	0.156	R <sup>2</sup>	0.137	0.137

### 5.3 Teacher Age

**Figure 1. Histogram of teacher age**



As demonstrated in Figure 1, the average teacher was 33 years old and the teacher age range was from 17 to 58 years old.

When looking at the effect of teacher age on student test scores (Table 9), I find that in Dosso, the coefficient on both interaction

terms are significant at the 5 percent level and indicate diminishing returns (the teacher’s age has an increasingly positive effect on test scores until a certain point when diminishing returns sets in). For ABC literacy classes, the calculated “sweet spot” is 28 years and for ABC math classes, it is 37 years in Dosso. In Zinder, the “sweet spot” age for literacy is 33 years old and for ABC math shows an inverse relationship to

diminishing returns with a calculated age of 45 years old. Neither of the findings are statistically significant for Zinder.

**Table 9. Average program effects of teacher age on test scores, by region**

DOSSO LITERACY	(3)	ZINDER LITERACY	(3)	DOSSO MATH	(3)	ZINDER MATH	(3)
Teachage*abc	.221** (.100)	Teachage*abc	.131 (.161)	Teachage*abc	.222** (.106)	Teachage*abc	-.089 (.138)
Teachage^2*abc	-.004** (.001)	Teachage^2*abc	-.002 (.002)	Teachage^2*abc	-.003** (.001)	Teachage^2*abc	.001 (.002)
ABC	-2.854* (1.644)	ABC	-2.053 (2.473)	ABC	-3.518** (1.789)	ABC	1.256 (2.237)
Sex	-1.151*** (.179)	Sex	-1.029** (.434)	Sex	-.786*** (.189)	Sex	-.494** (.248)
Hausa	.326* (.191)	Hausa	.511** (.241)	Hausa	-.488** (.226)	Hausa	.694*** (.160)
Age	-.036*** (.003)	Age	-.035*** (.007)	Age	-.028*** (.004)	Age	-.026*** (.004)
Num of obs.	2740	Num of obs.	1052	Num of obs.	2741	Num of obs.	1055
R^2	0.164	R^2	0.138	R^2	0.141	R^2	0.104

Since the results for Dosso were significant, I restricted the sample to Dosso only and looked at female test scores (Table 10), the results are statistically significant for females at the 5 and 10 percent level. Here the target age for ABC literacy teachers is 30 years old and for ABC math teachers it is 38 years old. The results for Zinder women show an inverse relationship to Dosso’s diminishing returns results, but they are mostly not significant.

**Table 10. Average program effects of teacher age on regional test scores for females**

DOSSO LITERACY		DOSSO MATH	
Teachage*abc	.239* (.128)	Teachage*abc	.301** (.154)
Teachage^2*abc	-.004* (.002)	Teachage^2*abc	-.004* (.002)
ABC	-3.506* (1.941)	ABC	-4.995** (2.421)
Hausa	.058 (.279)	Hausa	-.558 (.367)
Age	-.031*** (.005)	Age	-.026*** (.006)
Num of obs.	1404	Num of obs.	1404
R^2	0.098	R^2	0.112

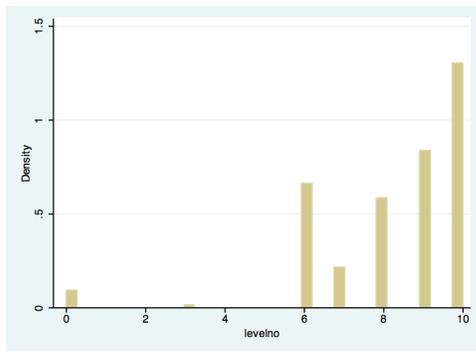
The results from this section suggest that for ABC literacy classes, younger teachers are better, presumably since they have had more exposure to and familiarity with

technology (especially mobile phones). According to Table 3, the average teacher was 33 years old in both Dosso and Zinder which is just above the ideal ABC literacy class age and below the ideal ABC math class age. Although it is not feasible for CRS to organize two teachers for each village, more focused training in math for younger teachers (33 years and younger) and extra training on the mobile phones for older teachers (above 34 years old) could potentially close this gap.

#### 5.4 Years of Schooling

As demonstrated Figure 2, the average teacher had 8.4 years of schooling and the range is from 0 to 12 years.

**Figure 2. Histogram of teacher’s years of schooling**



In Table 12, I compare the effect of the teacher’s education level on ABC scores for female and male classes and attempt to calculate the ideal level of education for teachers. The only statistically significant result is for men’s math scores at the 1 and 5 percent level. Here we see the opposite of diminishing returns, so math scores get worse as the teacher’s age increases, but at a certain level of education, ABC math scores improve. The ideal level of schooling is 7.5 years or higher which suggests that teachers need this level of education or higher in order to improve male scores in ABC math classes.

Although not statistically significant, ABC literacy classes targeted teacher level of education for females and males respectively is 7.1 and 7.0 years. Female ABC math teachers should have 11.2 years of education which seems a bit odd. The good news is

the average ABC teacher has 8.6 years of education which is well above the target age except for female ABC math classes.

**Table 12. Average program effects of teacher’s level of education on test scores**

FEMALE LITERACY	(2)	MALE LITERACY	(2)	FEMALE MATH	(2)	MALE MATH	(2)
Level*abc	.071 (.219)	Level*abc	-.393 (.509)	Level*abc	.337 (.220)	Level*abc	<b>-899***</b> (.307)
Level^2*abc	.005 (.022)	Level^2*abc	.028 (.037)	Level^2*abc	-.015 (.021)	Level^2*abc	<b>.060**</b> (.025)
Age	<b>-.028***</b> (.004)	Age	<b>-.044***</b> (.005)	Age	<b>-.022***</b> (.004)	Age	<b>-.029***</b> (.004)
ABC	-.736 (.522)	ABC	1.531 (1.739)	ABC	<b>-1.419**</b> (.564)	ABC	<b>3.410***</b> (.916)
Region	.374 (.251)	Region	<b>.485**</b> (.241)	Region	.311 (.216)	Region	<b>.566**</b> (.207)
Hausa	.201 (.226)	Hausa	<b>.707***</b> (.198)	Hausa	-.288 (.320)	Hausa	-.188 (.232)
Num of obs.	1975	Num of obs.	1836	Num of obs.	1978	Num of obs.	1837
R^2	0.073	R^2	0.097	R^2	0.069	R^2	0.097

## 6 Possible bias

There are a variety of unobservable teacher and student characteristics that could be biasing results. These include motivation, ability and effort of both on the part of the students and the teachers. From the equality of means in Tables 1 to 3 for teacher characteristics and the non-random nature of the teacher selection, we see that teacher characteristics were not equally distributed by region or male versus female classes which could also bias the results.

### 6.1 Motivation and Effort

The ABC mobile phone module could have been a serious motivation to teachers and students in those classes. Students received access to mobile phones, many for the first time. Having access to a mobile phone outside of class allowed those students to practice sending text messages to their friends and family on a regular basis. Perhaps teachers and students not randomly selected for ABC were discouraged or disappointed, so their motivation and performance was worse. Aker et al addressed some of these

issues in their paper (Aker, Ksoll, Lybbert 2011). In order to assess teacher motivation, they used the number of classes taught by the teacher as an attendance proxy and the results suggested that teachers in ABC villages were not teaching more classes on average. This is an imperfect proxy, but adds measureable substance to the results.

The paper also looked at student attendance in ABC and non-ABC villages to see if there was a greater percentage of students attending ABC classes. They did not find a statistically significant difference in student attendance between ABC and non-ABC classes. Lastly, they looked at mobile phone usage outside of the classroom using household-level data from January 2010. The ABC program did not seem to affect mobile phone ownership, access to a mobile phone, or frequency of usage. “Beeping” and calling did not increase to a significant degree. However, ABC students did increase their number of texts and calls and stayed in better contact with friends and family.

## **6.2 Ability**

Teacher and student natural ability is something which could greatly contribute to test results, but is also unobservable and difficult to measure quantitatively.

## **6.3 Non-random Teacher Selection**

We know that teacher selection was non-random and Tables 1 to 3 showed that there were some statistically significant differences in teacher characteristics between male and female classes and by region. If better quality teachers were present in one group over another, we would expect to see some bias and it would be more difficult to interpret the results.

Between ABC and non-ABC classes, teacher characteristics were pretty equal except for the teacher level in 2009 was higher for ABC classes. We see that women’s

ABC scores in Tables 4 and 5 for June 2009 tests were higher for every group except Kanuri women who were not learning in their native language. The ABC teachers' slightly higher average level of education could be influencing these results.

When comparing teacher characteristics between Dosso and Zinder, Zinder had more educated and fewer local teachers. From the regression results, we learned that local status had a negative effect on ABC scores (though not significant) but could be attributed to local teachers only making up 39 percent of the sample. They also had more women teachers in 2010 which we know usually have lower math scores and a positive effect on literacy scores in Zinder. Zinder women had better scores on average than Dosso women for ABC and non-ABC classes in June 2009 and also for non-ABC classes in June 2010. Dosso women only performed better in ABC classes in June 2010.

Also, for male and female classes, males had older teachers by 3.6 years and had almost all male teachers. In 2010, male classes had significantly more local teachers. If older male teachers positively contribute to scores (we have evidence of this at least in math), then this could bias the male results. The same can be said for local teachers.

#### **6.4 Problems with Randomization**

When looking at the baseline scores in Tables 4 and 5, we see that not all groups initially tested at the same level which means there was bias and incomparability from the start. Zinder ABC women started off at a lower level than non-ABC women, Hausa ABC women also started off at a statistically significant lower level and Zarma ABC women tested significantly higher. By starting off at different points, it is harder to detect the effect of the ABC program or teacher quality.

It is important to note that participants were randomly selected from their individual villages which were randomly selected from a regional strata which could account for the ‘unsuccessful’ outcome of the randomization.

## **7 Conclusions and Recommendations**

Overall, we see that test scores greatly improved from a baseline of ‘completely illiterate’ (0.00 to 0.12 points) to average scores which demonstrate a basic command of math skills and the ability to write letters (0.86 to 3.31 points). We see that ABC classes had higher scores than non-ABC classes for all groups of women except in Zinder where there was some existing bias from the start of the program.

We also see that Kanuri women who were not learning in their local language really struggled during the first four months of the program. Their ABC scores were over a point less than scores for non-ABC villages. This perhaps indicates that students who are not learning in their local language have a more difficult time catching up. They also would have a harder time retaining the skills in Hausa when all of their friends speak Kanuri. Since ABC scores were worse, we see that technology was not helping these women learn better where it definitely did for Hausa and Zarma women who were learning in their local language. It seems that those groups not learning in local language should stick with traditional methods of teaching literacy and math or have ABC classes in their local language.

In regards to teacher gender, students with female teachers tend to get lower scores, on average. However, this outcome is probably highly correlated with the fact that female teachers mostly teach female students who get lower test scores on average than men (Aker, Ksoll, Lybbert 2011). As an extra robustness check, in every single

regression, the coefficient on the participants' gender (Sex) shows that being female reduces test scores on average and this is always significant at the 1 or 5 percent level. Therefore, these two things are highly correlated and again, female teachers may or may not have anything to do with it.

Students of female teachers that were either female, Hausa math students, in Dosso literacy classes or ABC literacy classes in Zinder had higher scores than those students on male teachers, on average. This suggests that pairing female teachers with female students and male teachers with male students is the right approach.

In regards to teacher age for ABC classes, the ideal age for a literacy teacher in Dosso is 28 years old and 37 years old for math (significant at the 5 percent level). Furthermore, the ideal age for a literacy teacher for Dosso females is 30 years old and 38 years old for math. In Zinder, the ideal age is 33 years old for literacy and 45 years old for math. Considering that the trend for a younger teacher for ABC literacy classes and older teachers for ABC math classes is consistent, we can conclude that the younger teachers are better at teaching ABC literacy classes which make use of mobile phones, because the younger generation has presumably been more exposed to technology and is more comfortable with it. The older target age for ABC math teachers suggests that, unlike literacy, math requires full command of the subject in order to teach it. Also, teaching ABC math does not require any transfer of technology and is taught in the traditional way.

The results also showed that local teachers (from the village where they taught) have a positive effect on ABC scores in Dosso, but a negative effect on overall scores in both regions. In Dosso, 97 percent of teachers were local, but in Zinder, only 39 percent

of teachers were local. When looking for teachers, the Ministry of Non-Formal Education put greater emphasis on a teacher's level of education as opposed to their local status. Here we have learned that the opposite approach is better – local teachers can get better results, at least for ABC Dosso classes.

Lastly, in regards to the teacher's level of education, teachers are recommended to have over 7 years of education in order to improve ABC student scores. This signals that the individual has completed primary school and at least a one to two years of secondary school. The target level of education for teachers is 7.1 years for ABC female literacy classes, 11.2 years for ABC female math classes, 7.0 years for ABC male literacy classes, and 7.5 years for ABC male math classes (significant at the 1 and 5 percent levels). Although it is difficult to find qualified teachers in Niger given its struggle with extremely low literacy rates, any teacher under the threshold of having their primary school certificate should ideally be dismissed.

In terms of the recommendations for the “sweet spot” or target age and level of education for a teacher to have, it is difficult to implement since each village has only one teacher and it would be a logistical and financial nightmare to try and coordinate multiple teachers for each village. However, I recommend that at the very minimum, all teachers fall within the age range of 25 to 45 years of age and have at least 7 years of formal education. Younger teachers should get more emphasis on teaching math methodology during training and the older teachers need more emphasis on teaching mobile phone technology and best practices that the younger students have learned.

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