

## Figures and Tables

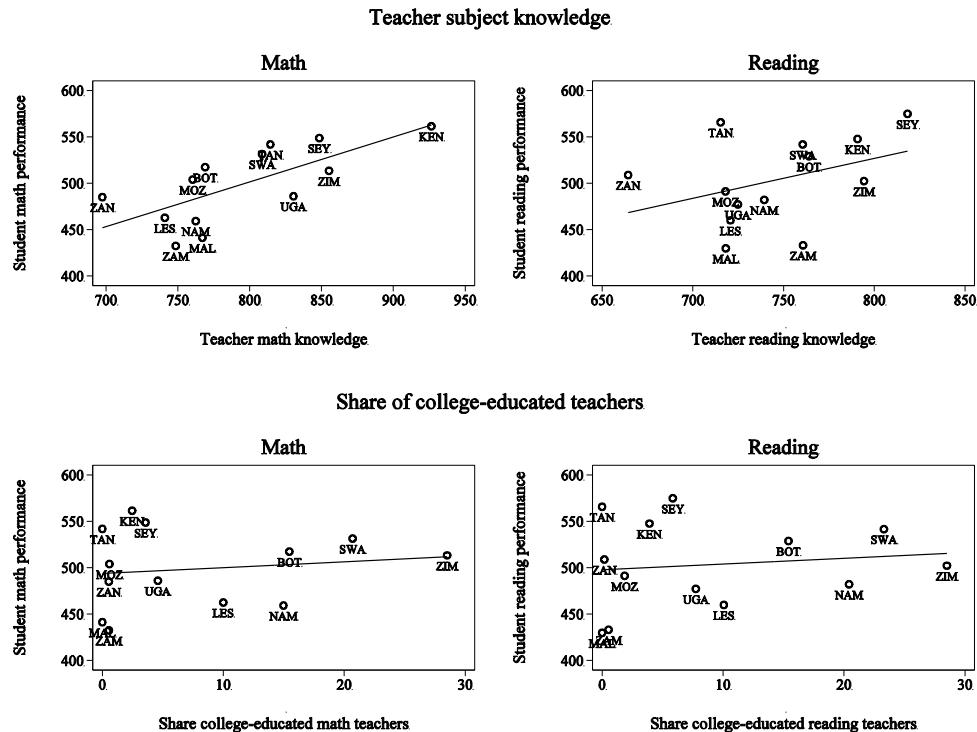


Figure 1

Potential Determinants of Cross-Country Differences in Student Performance

Source: SACMEQ.

Note: Solid lines fit a linear relationship between student performance and teacher subject knowledge in the top panel and between student performance and the share of college-educated teachers in the bottom panel. Share of college-educated teachers is the share of sixth-grade teachers with a college degree (based on SACMEQ data). Country abbreviations: BOT = Botswana, KEN = Kenya, LES = Lesotho, MAL = Malawi, MOZ = Mozambique, NAM = Namibia, SEY = Seychelles, SWA = Swaziland, TAN = Tanzania, UGA = Uganda, ZAM = Zambia, ZAN = Zanzibar, ZIM = Zimbabwe.

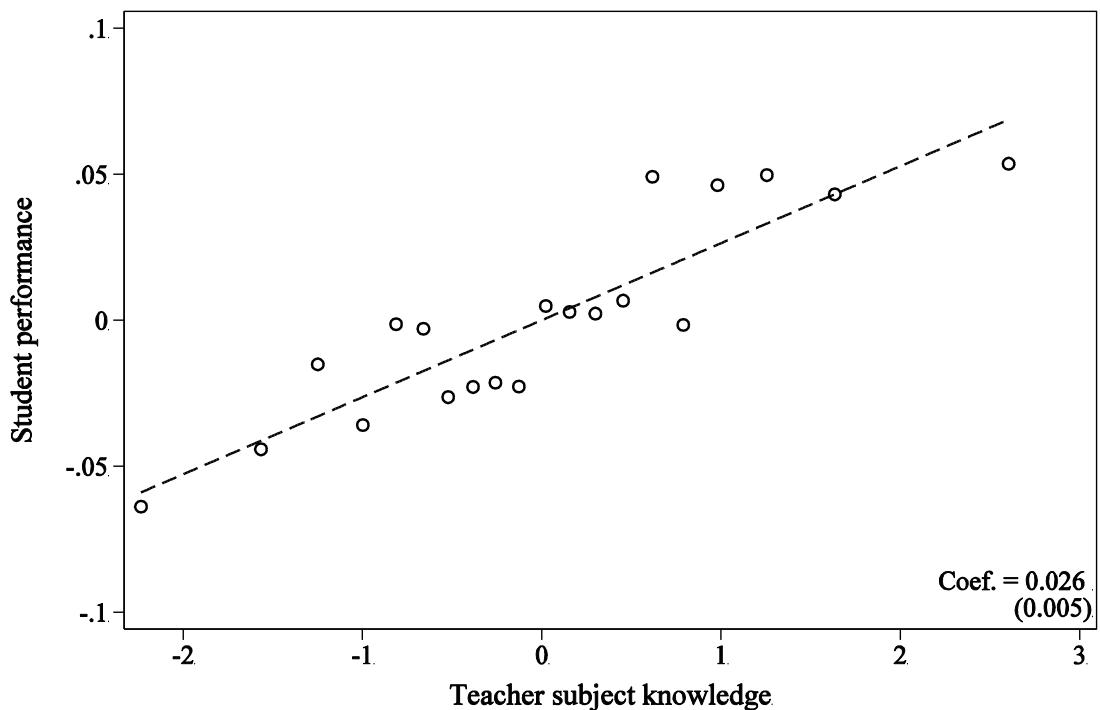


Figure 2

Effect of Teacher Subject Knowledge on Student Performance

Source: SACMEQ.

Note: The figure displays a binned scatterplot corresponding to the student fixed effects model in Column 3 of Table 2; see notes to Tables 1 and 2 for a list of the control variables. To construct the figure, we first regressed the test score difference between math and reading of students and teachers separately on all control variables (also differences between math and reading). We then divided the teacher test score residuals into 20 ranked equal-sized groups and plotted the mean of the student test score residuals against the mean of the teacher test score residuals in each bin. The best-fit line, the coefficient, and the standard error (clustered at the school level) are calculated from regressions on the micro data.

Table 1  
Ordinary Least Squares Model

|                                     | Panel A: student math performance    |                     |                     |                     |                     |
|-------------------------------------|--------------------------------------|---------------------|---------------------|---------------------|---------------------|
|                                     | (1)                                  | (2)                 | (3)                 | (4)                 | (5)                 |
| Teacher math knowledge              | 0.121***<br>(0.012)                  | 0.096***<br>(0.010) | 0.095***<br>(0.010) | 0.075***<br>(0.009) | 0.072***<br>(0.010) |
| Adj. R2                             | 0.22                                 | 0.30                | 0.30                | 0.32                | 0.32                |
| Observations (students)             | 74,708                               | 74,708              | 74,708              | 74,708              | 74,708              |
| Clusters (schools)                  | 3,939                                | 3,939               | 3,939               | 3,939               | 3,939               |
|                                     | Panel B: student reading performance |                     |                     |                     |                     |
|                                     | (1)                                  | (2)                 | (3)                 | (4)                 | (5)                 |
| Teacher reading knowledge           | 0.117***<br>(0.012)                  | 0.085***<br>(0.009) | 0.084***<br>(0.009) | 0.062***<br>(0.009) | 0.057***<br>(0.009) |
| Adj. R-squared                      | 0.22                                 | 0.35                | 0.36                | 0.39                | 0.39                |
| Observations (students)             | 74,708                               | 74,708              | 74,708              | 74,708              | 74,708              |
| Clusters (schools)                  | 3,939                                | 3,939               | 3,939               | 3,939               | 3,939               |
|                                     | Control variables in Panels A + B    |                     |                     |                     |                     |
| Country fixed effects               | X                                    | X                   | X                   | X                   | X                   |
| Socio-economic characteristics (16) |                                      | X                   | X                   | X                   | X                   |
| Classroom characteristics (4)       |                                      |                     | X                   | X                   | X                   |
| School characteristics (5)          |                                      |                     |                     | X                   | X                   |
| Teacher characteristics (6)         |                                      |                     |                     |                     | X                   |

Source: SACMEQ.

Note: Least squares regressions. Dependent variable: student performance in math (Panel A) and in reading (Panel B). Student and teacher test scores are z-standardized at the individual level across countries and waves. Socio-economic controls include three student characteristics (age, gender, repeated grade) and 13 family background measures (mother's education, father's education, number of books at home, and ten family resources). Classroom controls contain four classroom resources (availability of subject-specific textbooks, number of books in class, access to teaching guide, class size), and school controls include five measures of school resources and location (school facilities index (see Table 4), private school indicator, frequency of teacher absence at school, number of students in school, rural school indicator). Teacher controls include six teacher characteristics (gender, education, work experience, duration of subject-specific training, weekly teaching time, frequency of meeting parents). All regressions include imputation dummies and a dummy indicating the SACMEQ wave. Robust standard errors, adjusted for clustering at the school level, are reported in parentheses. Significance levels: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Table 2  
Student Fixed Effects Model

| Dependent variable: student performance |                     |                     |                     |
|---|---------------------|---------------------|---------------------|
|   | (1)                 | (2)                 | (3)                 |
| Teacher subject knowledge               | 0.025***<br>(0.005) | 0.025***<br>(0.005) | 0.026***<br>(0.005) |
| Student fixed effects                   | X                   | X                   | X                   |
| Classroom characteristics (3)           |                     | X                   | X                   |
| Teacher characteristics (6)             |                     |                     | X                   |
| Observations                            | 149,416             | 149,416             | 149,416             |

Source: SACMEQ.

Note: Fixed effects estimations. Dependent variable: student performance in math and reading. Student and teacher test scores are z-standardized at the individual level across countries and waves. Compared to Table 1, among classroom characteristics, class size is excluded because it does not vary across subjects for the same student. All regressions include imputation dummies. Robust standard errors, adjusted for clustering at the school level, are reported in parentheses. Significance levels: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Table 3  
Robustness (Student Fixed Effects Model)

| Dependent variable: student performance      |                     |                       |                               |                     |                     |                      |                   |
|--|---------------------|-----------------------|-------------------------------|---------------------|---------------------|----------------------|-------------------|
|  | Rural schools       | One-classroom schools | Rural & one-classroom schools | School level        | Same-teacher sample | Subject interactions |                   |
|  | (1)                 | (2)                   | (3)                           | (4)                 | (5)                 | (6)                  | (7)               |
| Teacher subject knowledge                    | 0.021***<br>(0.006) | 0.022***<br>(0.008)   | 0.026***<br>(0.009)           |                     | 0.025***<br>(0.010) | 0.017***<br>(0.005)  | 0.008*<br>(0.004) |
| Teacher subject knowledge (school level)     |                     |                       |                               | 0.030***<br>(0.005) |                     |                      |                   |
| Student fixed effects                        | X                   | X                     | X                             | X                   | X                   | X                    | X                 |
| Classroom characteristics (3)                | X                   | X                     | X                             | X                   | X                   | X                    | X                 |
| Teacher characteristics (6)                  | X                   | X                     | X                             | X                   | n.a.                | X                    | X                 |
| Subject X socio-economic characteristics (6) |                     |                       |                               |                     |                     | X                    | X                 |
| Subject X school characteristics (5)         |                     |                       |                               |                     |                     | X                    | X                 |
| Subject X country fixed effects              |                     |                       |                               |                     |                     |                      | X                 |
| Observations                                 | 92,968              | 63,204                | 51,948                        | 149,416             | 46,888              | 149,416              | 149,416           |

Source: SACMEQ.

Note: Fixed effects estimations. Dependent variable: student performance in math and reading. Student and teacher test scores are z-standardized at the individual level across countries and waves. In Column 1, the sample includes only schools in rural areas. In Column 2, all schools with more than one sixth-grade classroom are excluded. In Column 3, the sample includes only schools in rural areas with just one sixth-grade classroom. In Column 4, teacher test scores and all teacher characteristics are collapsed at the school level. In Column 5, the sample includes only students who are taught both math and reading by the same teacher; teacher characteristics are excluded as they do not vary within the same teacher. In Column 6, the subject indicator is interacted with students' socioeconomic characteristics (but not with family resources) and school characteristics (see Table 1); in Column 7, the subject indicator is additionally interacted with the country fixed effects. Classroom and teacher characteristics are the same as in Table 2. All regressions include subject fixed effects and imputation dummies. Robust standard errors, adjusted for clustering at the school level, are reported in parentheses. Significance levels: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Table 4  
Heterogeneity (Student Fixed Effects Model)

| Dependent variable: student performance |   |                     |                         |                     |                        |
|---|---|---------------------|-------------------------|---------------------|------------------------|
|   | Country's level of economic development |                     | Student-level resources |                     | School-level resources |
|   | (1)                                     | (2)                 | (3)                     | (4)                 | (5)                    |
| Teacher subject knowledge               | 0.009<br>(0.008)                        | 0.011<br>(0.008)    | 0.017**<br>(0.007)      | 0.025***<br>(0.005) | 0.027***<br>(0.005)    |
| × high GDP per capita                   | 0.038***<br>(0.010)                     |                     |                         |                     |                        |
| × high Human Development Index          |   | 0.030***<br>(0.010) |                         |                     |                        |
| × textbook availability                 |   |                     | 0.017**<br>(0.007)      |                     |                        |
| × school facilities (index)             |   |                     |                         | 0.011**<br>(0.005)  |                        |
| × average class size                    |   |                     |                         |                     | 0.001<br>(0.006)       |
| Textbook availability                   |   |                     | 0.006<br>(0.010)        |                     |                        |
| Student fixed effects                   | X                                       | X                   | X                       | X                   | X                      |
| Classroom characteristics (3)           | X                                       | X                   | X                       | X                   | X                      |
| Teacher characteristics (6)             | X                                       | X                   | X                       | X                   | X                      |
| Observations                            | 143,978                                 | 149,416             | 149,416                 | 149,416             | 146,310                |

Source: SACMEQ.

Note: Fixed effects estimations. Dependent variable: student performance in math and reading. GDP per capita: gross domestic product divided by midyear population expressed in PPP-US-\$; data from the UNESCO Institute for Statistics. The following countries have a “high” (i.e., above-median) GDP per capita: Botswana, Kenya, Namibia, Seychelles, Swaziland; data for Zimbabwe are not available (therefore excluded in Column 1). Human Development Index: summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable, and having a decent standard of living; data are from the African Development Bank. The following countries have a “high” Human Development Index: Botswana, Kenya, Lesotho, Namibia, Seychelles, Swaziland. We assign the same values to country-level variables in Tanzania and Zanzibar because Zanzibar is a semi-autonomous part of Tanzania. Textbook availability: binary variable that equals 1 if a student shares his or her subject-specific textbook with exactly one other student or has own textbook; 0 otherwise. School facilities (index): counts the availability of all 31 school resources reported in SACMEQ: board, cafeteria, chairs, chalk, charts, classroom library, community hall, computer, drinking water, duplicator, electricity, fax, fence, first aid kit, garden, locker, overhead projector, photocopier, playground, radio, school library, separate office for school head, shelves, storeroom, tables, tape recorder, teacher room, telephone, TV, typewriter, and VCR. Average class size: average number of students per classroom in sixth grade; 3,106 student observations are missing because some principals did not report the number of sixth-grade students in their school. To facilitate interpretation of coefficient magnitudes, the resource variables in Columns 4 and 5 are z-standardized across countries and waves. The main effects of the school-level resources and country-level variables cannot be estimated because these variables do not vary across subjects. Classroom and teacher characteristics are the same as in Column 3 of Table 2. All regressions include subject fixed effects and imputation dummies. Robust standard errors, adjusted for clustering at the school level, are reported in parentheses. Significance levels: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

## Appendix

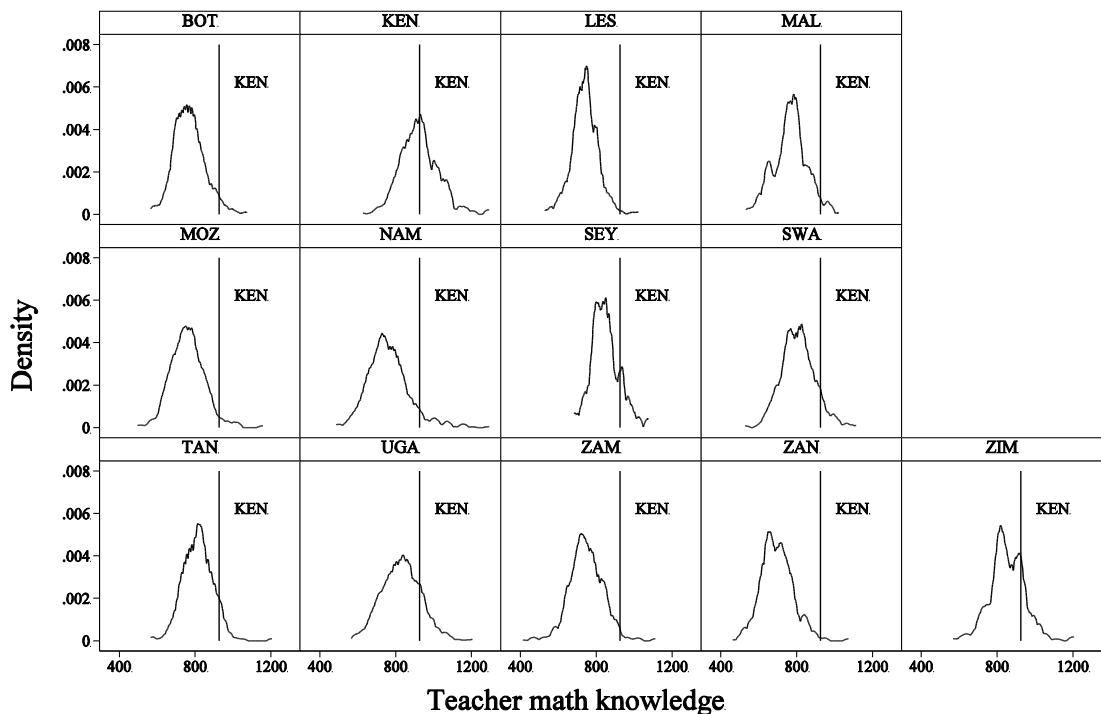
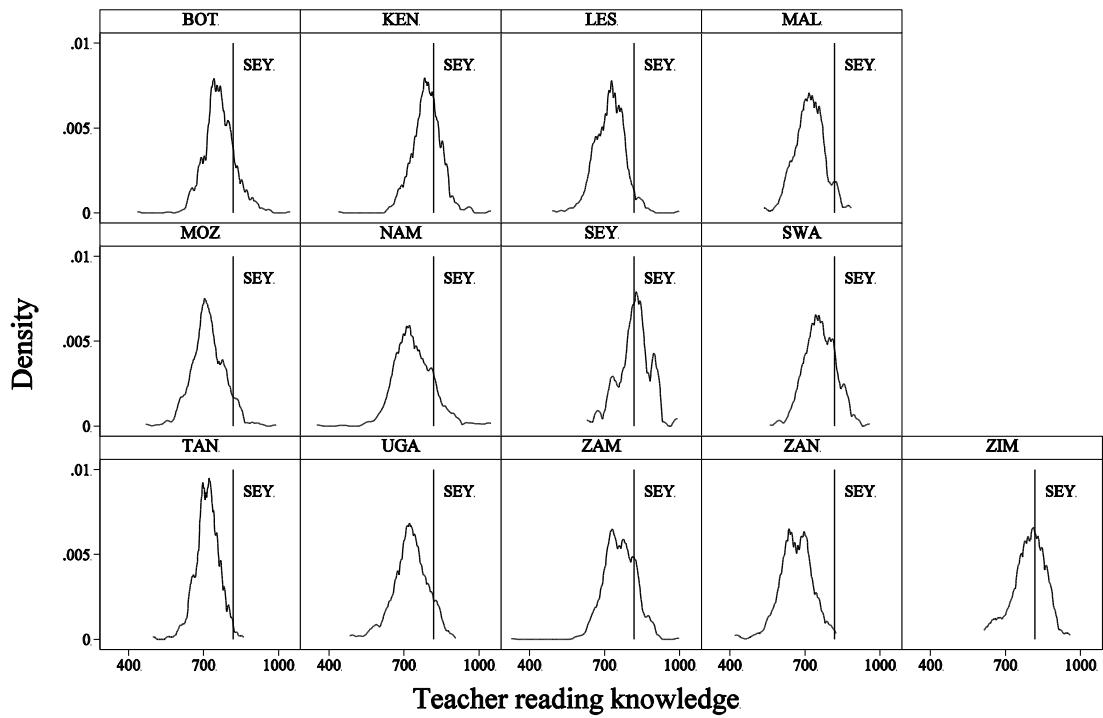


Figure A-1  
Distribution of Teacher Math Knowledge by Country  
Source: SACMEQ.

Note: Kernel density plots of teacher math knowledge separately for each country. Vertical lines indicate the average math knowledge of teachers in Kenya, the country in our sample with the highest average teacher math knowledge. Country abbreviations: BOT = Botswana, KEN = Kenya, LES = Lesotho, MAL = Malawi, MOZ = Mozambique, NAM = Namibia, SEY = Seychelles, SWA = Swaziland, TAN = Tanzania, UGA = Uganda, ZAM = Zambia, ZAN = Zanzibar, ZIM = Zimbabwe.



**Figure A-2**

### Distribution of Teacher Reading Knowledge by Country

Source: SACMEQ.

Note: Kernel density plots of teacher reading knowledge separately for each country. Vertical lines indicate the average reading knowledge of teachers in the Seychelles, the country in our sample with the highest average teacher reading knowledge. Country abbreviations: BOT = Botswana, KEN = Kenya, LES = Lesotho, MAL = Malawi, MOZ = Mozambique, NAM = Namibia, SEY = Seychelles, SWA = Swaziland, TAN = Tanzania, UGA = Uganda, ZAM = Zambia, ZAN = Zanzibar, ZIM = Zimbabwe.

Table A-1  
Summary Statistics of Student Performance and Teacher Subject Knowledge

|                     | Pooled       | Botswana    | Kenya        | Lesotho      | Malawi      | Mozambique  | Namibia      |
|---------------------|--------------|-------------|--------------|--------------|-------------|-------------|--------------|
| Students            |              |             |              |              |             |             |              |
| Math performance    | 497<br>(88)  | 517<br>(81) | 561<br>(90)  | 463<br>(64)  | 441<br>(61) | 504<br>(68) | 459<br>(84)  |
| Reading performance | 502<br>(95)  | 529<br>(94) | 548<br>(95)  | 460<br>(64)  | 430<br>(51) | 491<br>(72) | 482<br>(94)  |
| # Students          | 74,708       | 6,375       | 6,778        | 6,895        | 4,733       | 5,308       | 10,365       |
| Teachers            |              |             |              |              |             |             |              |
| Math knowledge      | 793<br>(108) | 769<br>(82) | 926<br>(103) | 741<br>(70)  | 767<br>(88) | 760<br>(90) | 763<br>(111) |
| Reading knowledge   | 742<br>(74)  | 764<br>(62) | 791<br>(59)  | 721<br>(61)  | 718<br>(60) | 718<br>(67) | 739<br>(81)  |
| # Math teachers     | 5,421        | 730         | 474          | 422          | 278         | 586         | 587          |
| # Reading teachers  | 5,466        | 725         | 480          | 421          | 288         | 603         | 561          |
|                     | Seychelles   | Swaziland   | Tanzania     | Uganda       | Zambia      | Zanzibar    | Zimbabwe     |
| Students            |              |             |              |              |             |             |              |
| Math performance    | 549<br>(100) | 531<br>(64) | 542<br>(86)  | 486<br>(86)  | 432<br>(70) | 485<br>(66) | 513<br>(96)  |
| Reading performance | 575<br>(122) | 542<br>(66) | 566<br>(89)  | 477<br>(80)  | 433<br>(77) | 509<br>(88) | 502<br>(100) |
| # Students          | 2,820        | 6,700       | 6,455        | 6,498        | 4,745       | 4,317       | 2,719        |
| Teachers            |              |             |              |              |             |             |              |
| Math knowledge      | 848<br>(75)  | 809<br>(89) | 814<br>(81)  | 830<br>(103) | 748<br>(89) | 697<br>(85) | 855<br>(93)  |
| Reading knowledge   | 818<br>(65)  | 761<br>(63) | 715<br>(49)  | 725<br>(71)  | 761<br>(63) | 664<br>(66) | 794<br>(67)  |
| # Math teachers     | 91           | 336         | 397          | 355          | 534         | 362         | 269          |
| # Reading teachers  | 105          | 336         | 398          | 359          | 534         | 387         | 269          |

Source: SACMEQ.

Note: Means and standard deviations (in parentheses) reported. The pooled sample includes 8,742 teachers in total, some of them teaching both math and reading. Statistics are based on individual-level observations.