

# Instruction Time and Student Achievement: The Moderating Role of Teacher Qualifications

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## Motivation

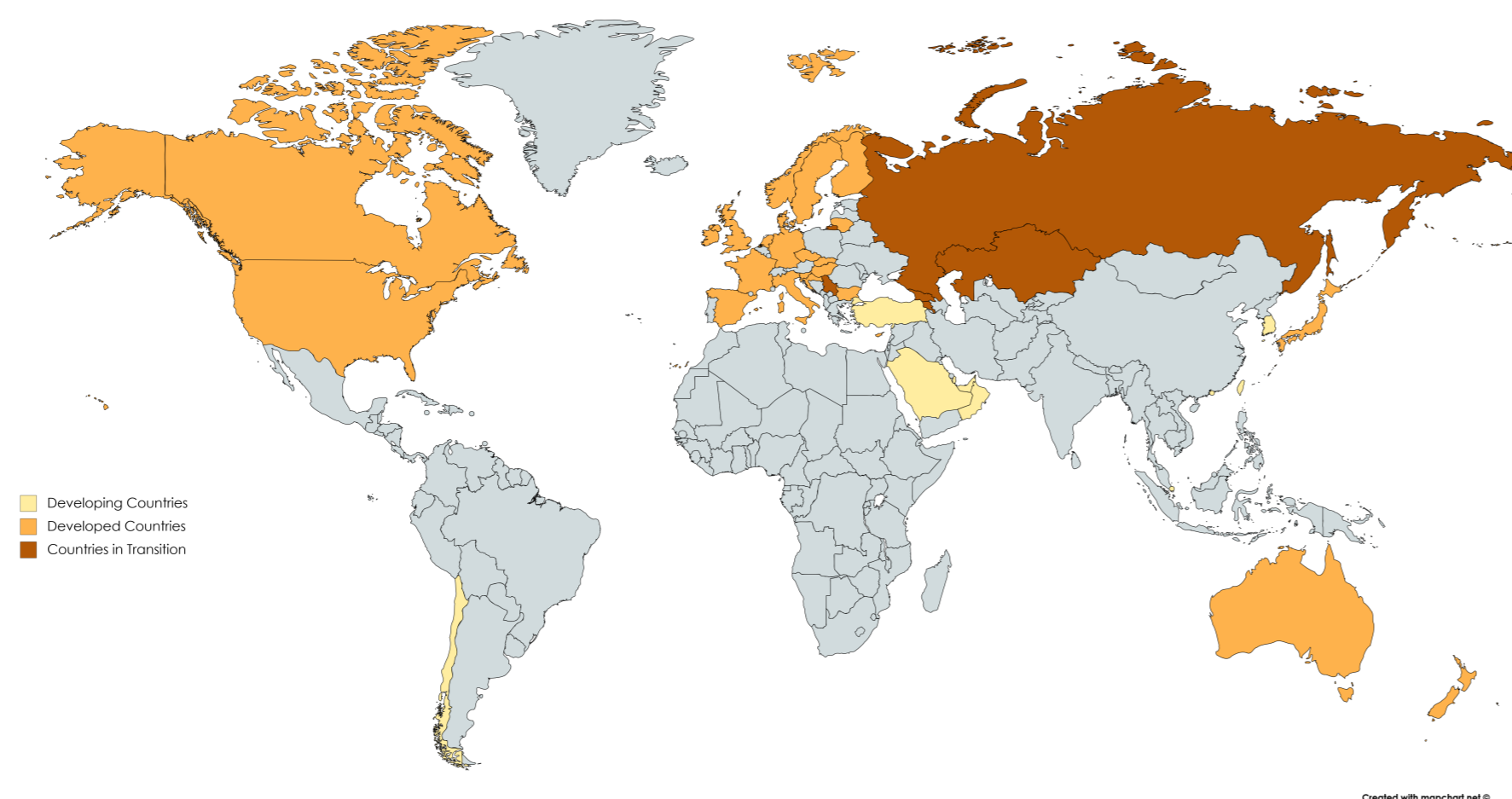
- **Quantity and quality** of instruction are both important for student achievement  
→ **Trade-off**: Effect of instruction time might depend on instructional and teacher quality
- Additional instruction time might only be of benefit if teachers actively use the time for teaching, i.e. by covering new or revising old content instead of classroom management or administrative tasks
- Important how well a teacher knows the subject that she is teaching
- Recent studies find a **positive impact** of instruction time on student achievement (Lavy (EJ, 2015), Rivkin & Schiman (EJ, 2015))
- Effect of instruction time is smaller in developing countries than developed countries
- Effect of instruction time is larger in classrooms with better environments in terms of student behavior

## This Paper

- Examines the **interaction between instruction time and teacher qualifications**. So far, none of the previous studies addresses the trade-off between quantity and quality → contribution
- Finds that **teacher qualifications play a moderating role** for the effect of instruction time on student achievement:
  - Effect of instruction time is significantly larger for students with better qualified teachers
  - Especially relevant in **developing countries**

## Data: Trends in International Mathematics and Science Study (2015)

- Cross-sectional data, wave 2015, 4<sup>th</sup> grade
- Sample: 115,071 students in 42 countries
- 2 observations per student (math/science)



### Variables

- Dependent variable: Standardized **test score** in math/science
- Main independent variable: **Instruction time** (hours per week) in math/science (aggregated on school by subject level), reported by teachers
- **Teacher qualifications**:
  - Participation in **professional development** during the last 2 years (yes/no)
  - **Teacher training with specialization** in the relevant subject (yes/no)
  - Completing the relevant subject as the **main subject with a Bachelor's degree** (or higher) (yes/no)
  - **Experience** (in years)
- Further variables: Student, teacher, school and country characteristics

## Empirical Strategy

### Student Fixed Effects Model

- Uses **within-student between-subject** variation
- Accounts for individual-specific factors (constant within individuals)
- Controls for unobservable student characteristics (e.g. unobserved ability) → no heterogeneity in ability, habits or school quality

### Limitations

- Effect of instruction time is assumed to be the same for both subjects
- Impact of instruction time is net of spillovers from other subjects

### Regression Equation

$$\text{test score}_{ijk} = \beta_1 H_{kj} + \beta_2 X_{ij} + \beta_3 Q_{lj} + \beta_4 H_{kj} Q_{lj} + \mu_i + \epsilon_j + \eta_k + u_{ijk} \quad (1)$$

- test score<sub>ijk</sub>: test score of student *i* in school *j* in subject *k* (*k* ∈ math, science)
- H<sub>kj</sub>: instruction time (in hours) in school *j* in subject *k*
- X<sub>ij</sub>: student characteristics of student *i* in school *j* and teacher characteristics
- Q<sub>lj</sub>: teacher characteristics of teacher *l* in school *j*
- μ<sub>i</sub>: student fixed effects
- ε<sub>j</sub>: unobserved school characteristics
- η<sub>k</sub>: unobserved subject-specific characteristics
- u<sub>ijk</sub>: error term

## Results: Interaction between Instruction Time and Teacher Qualifications

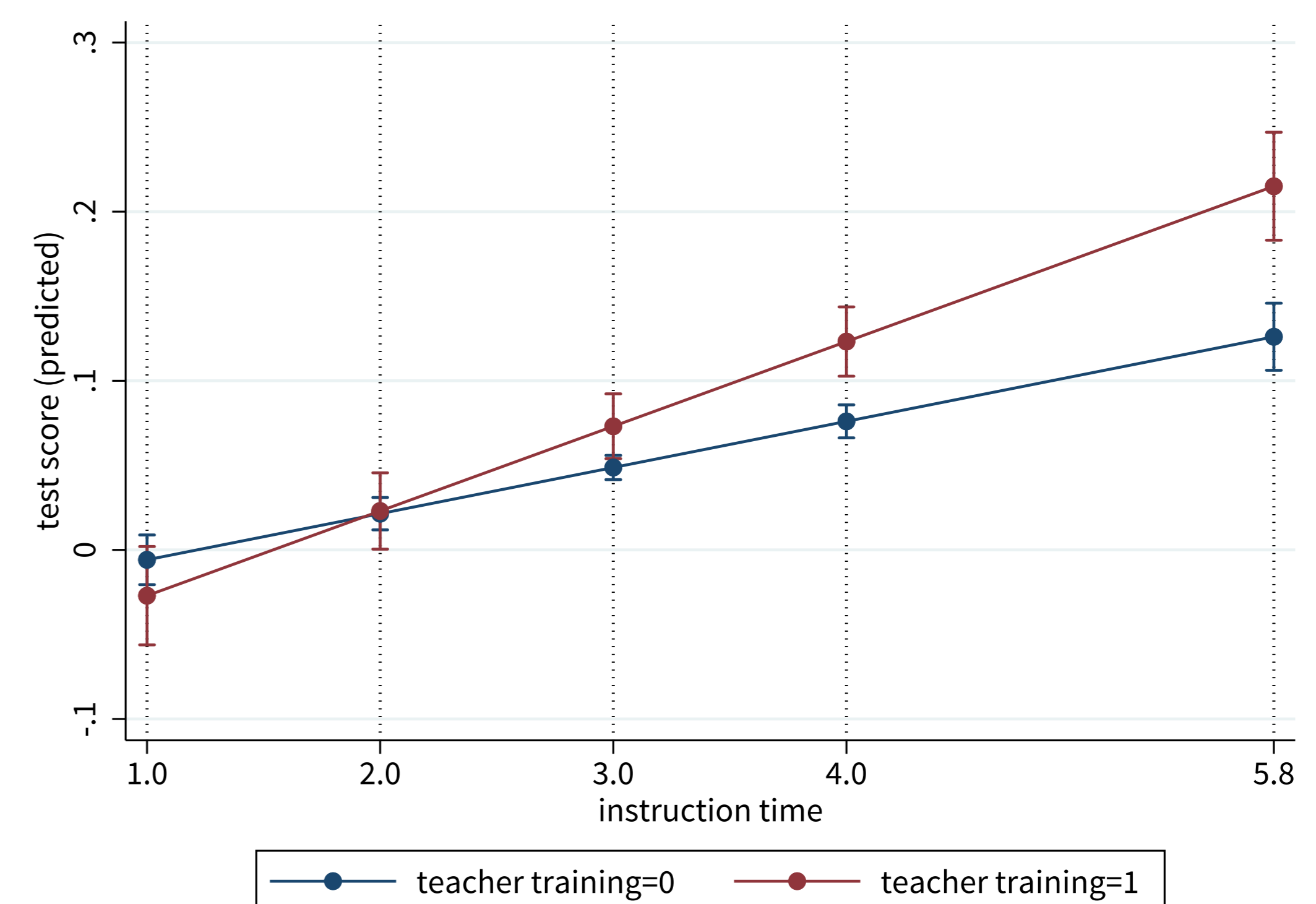
### Regression Results

VARIABLES	(1) test score	(2) test score	(3) test score	(4) test score	(5) test score
Instruction time	0.032*** (0.003)	0.017*** (0.004)	0.027*** (0.003)	0.027*** (0.003)	0.036*** (0.003)
PD x instruction time		0.025*** (0.004)			
education specialization x instruction time			0.022*** (0.005)		
major degree x instruction time				0.027*** (0.005)	
experience x instruction time					-0.012*** (0.004)
Observations	230,142	230,142	230,142	230,142	230,142
R-squared	0.923	0.923	0.923	0.923	0.923
Student FE	Yes	Yes	Yes	Yes	Yes
Subject FE	Yes	Yes	Yes	Yes	Yes
Teacher Controls	Yes	Yes	Yes	Yes	Yes
effect for high qualification		0.042*** (0.00351)	0.050*** (0.00501)	0.054*** (0.00475)	0.024*** (0.00397)

Clustered standard errors at school level in parentheses  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Notes: The dependent variable is a student's test score in math/science. Instruction time is aggregated on school-by-subject level. Regressions run as in equation 1. PD stands for professional development. Effect for high qualification shows the coefficient on instruction time when the respective teacher qualification (PD, education specialization, major degree, experience) equals 1.

### Marginal Effects (teacher training with specialization used as teacher qualification)



- Figure suggests that a teacher with a pedagogical background and specialization in the subject who teaches three hours has the same impact on student achievement as a teacher who teaches four hours but does not meet these criteria.

## Developed vs. Developing Countries

- Coefficient on instruction time is larger and statistically significant in developed countries, not in developing countries.
- Interaction with teacher qualifications:
  - Having a teacher who participated in **professional development** or having a teacher who completed the relevant subject as a **main subject with a Bachelor's degree (or higher)** **enhances the impact of instruction time in developing countries**. Impact of instruction time is even **negative** when having a low-qualified teacher.
  - In comparison, having a teacher with a **teacher training** background in **developed countries** seems to **enhance** the impact, similar as having a teacher who completed the relevant subject as a main subject with a Bachelor's degree (or higher).

## Conclusion

- On average, an additional hour of instruction time leads to an increase of 0.03 standard deviations in students' test scores across all countries.
  - No effect in developing countries
- **Teacher qualifications play a moderating role** for the effect of instruction time on student achievement:
  - Effect of instruction time is significantly larger for students with **better qualified teachers**, resulting in an **increase in test scores** of 0.04 to 0.05 standard deviations.
  - Especially relevant in **developing countries**: Instruction time **increases test scores** by 0.02 standard deviations when taught by a high-qualified teacher.