Teaching Practices and Cognitive Skills

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Introduction

National Teaching Standards (NTS) in the United States call for a shift from traditional teaching practices, such as lecturing and the use of drill worksheets, towards modern ones, such as group work and discussion among students. This is supposed to **promote students' reasoning skills** over mere factual knowledge and routine problem solving skills. The motivation for this change is that reasoning skills are perceived to be increasingly important in the labor market.

A small literature in economics has consistently found that **teachers who emphasize traditional teaching practices are associated with higher test scores**, while the evidence on the effects of modern teaching practices on test scores is less clear. **Are NTS wrong in calling for a shift towards modern teaching practices in schools? Or are the skills that these practices promote just not measured well in standardized tests?**

In this paper, I study the effects of traditional and modern teaching practices on different cognitive skills of students. I provide answers to the questions raised above and I gauge the potential consequences of a shift from traditional towards modern teaching practices for students' learning outcomes.

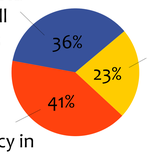
Data

The empirical analysis uses data from the 2007 wave of the **Trends in International Mathematics and Science Study** (TIMSS) for United States 8th-grade students.

Measuring Cognitive Skills

Students take standardized tests which assess their knowledge of the 8th-grade math and science curricula. These tests are organized around **three cognitive skill dimensions**, which have different shares of score points allocated to them:

knowing: measures students' ability to recall definitions and facts



reasoning: measures students' capacity for logical, systematic thinking

applying: measures students' competency in solving routine problems

Data (continued)

The **knowing and applying dimensions** measure the skills that have traditionally been emphasized in schools, while the **reasoning dimension** measures the skills that NTS want to promote. Next to overall test scores, the data contains subscores measuring performance on each cognitive skill dimension. I transform these scores to have mean 0 and SD 1.

Measuring Teaching Practices

The TIMSS student questionnaire asked students how often they engaged in a range of different activities in their math class and in their science class. I assign the value 0 to the answer "never", 0.25 to "some lessons", 0.5 to "about half the lessons", and 1 to "every or almost every lesson." This means that students' answers can be interpreted as the percentage of lessons in which a particular teaching practice was used.

I refer to NTS to identify activities reflecting traditional and modern teaching practices in the questionnaire and **construct two class-level indices of traditional and modern teaching:**

Activities reflecting...	
traditional teaching practices	**modern teaching practices**
• listening to lectures • memorizing facts & formulas • working routine problems	• working in small groups • giving explanations • relating content to daily life

Take the mean of the answers across the three practices and average at the class level

traditional teaching index (mean=0.63, SD=0.10)

modern teaching index (mean=0.53, SD=0.11)

These indices reflect the emphasis that a teacher places on traditional versus modern teaching practices in a particular class. The indices are weakly positively correlated (ρ=0.22).

Regressions include both indices at the same time, which means that results can be interpreted as the effect of the traditional (modern) teaching index on test scores, *holding the modern (traditional) teaching index constant*.

Empirical Strategy

I exploit the fact that students and their teachers are observed in two subjects to estimate a student fixed-effects model:

$$A_{ijs} = \alpha + TradTI_{ijs}\beta + ModnTI_{ijs}\gamma + X_{js}\delta + \lambda_i + \epsilon_{ijs}$$

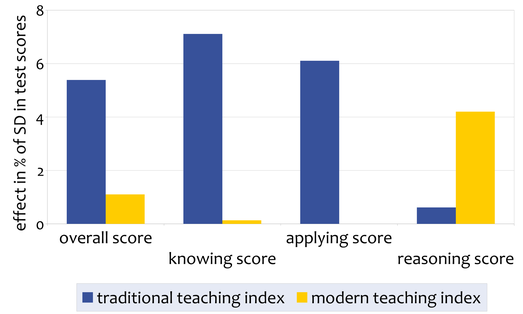
where *i* indexes students, *s* indexes subjects, and *j* indexes teachers. *A* denotes the test score, *TradTI* and *ModnTI* are the traditional and modern teaching indices, respectively, and *X* is a vector of teacher and class controls. **The effects of interest are identified using the variation in teaching practices across subjects for each student in this model.**

Headline Results

	overall score	knowing score	applying score	reasoning score
Traditional teaching index	0.317**	0.418**	0.359**	0.036
	(0.107)	(0.134)	(0.123)	(0.136)
Modern teaching index	0.058	0.007	-0.014	0.221*
	(0.118)	(0.105)	(0.119)	(0.110)
Number of students	6,057	6,057	6,057	6,057
H_0: Trad'l = mod'n (*p* value)	0.136	0.019	0.040	0.337

Notes: Results from student fixed-effect regressions which control for the teacher's gender, experience, certification status, education level, college major, and age, as well as for class size and teaching time. */** denote significance at the 5/1 percent level.

Interpreting the size of the estimated coefficients: holding the modern (traditional) teaching index constant, what is the effect on test scores of moving a student from the 20th to the 80th percentile of the traditional (modern) teaching index?



Discussion

Traditional teaching practices promote students' factual knowledge and routine problem-solving skills, while modern teaching practices promote students' reasoning skills.

The sizable effect of the modern teaching index on reasoning scores is masked in the overall test score regression because questions measuring reasoning skills only accounted for 23% of the overall test. Importantly, this percentage is similar in other standardized tests such as the NAEP.

In summary, a shift from traditional towards modern teaching practices in schools is expected to decrease standardized test scores, but to increase students' reasoning skills.

Further Results

Robustness to Alternative Measurements of Teaching Practices

Quantitatively and qualitatively similar results are obtained when alternative definitions of the traditional and modern teaching indices are considered. Qualitatively similar results are obtained when the relative emphasis on traditional versus modern teaching as measured by the "gap" *TradTI - ModnTI* is used as a treatment.

Heterogeneity of Results by Subject and by Student Traits

Results are qualitatively similar for math and for science. Results are quantitatively and qualitatively similar for students of different socioeconomic status and for boys and girls.

Extension of Analysis to Other Countries

In an extension, **I exploit the international dimension of TIMSS** to analyze the effects of traditional and modern teaching practices in nine other advanced economies. The results are quantitatively and qualitatively similar to those obtained for the United States.

Conclusion

As NTS assume, a shift towards modern teaching practices is expected to increase students' reasoning skills. However, if policy makers are serious about promoting these skills, standardized tests should be adapted to reflect them. Otherwise, teachers, whose salary nowadays often depends on their students' performance on these tests, have no incentive to use modern teaching practices and to thus foster these skills.