*Beyond performance: do 15 year old urban students perceive science issues differently than their rural peers?*

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**Reviewer notes:**

* What logic/literature led to the determination of the 100,000 person cut-off for urban and rural? These two are often distinguished by access to important amenities such as healthcare, education, basic living infrastructure, and so on. Where there any indicators to suggest that this 100,000 cut-point really distinguished rural and urban in terms of the features/quality of living?
* Moreover, if this has a clear population correlate, is it expected to be roughly the same across all of these countries?
* I think there is an implicit value to looking at science performance and epistemology and attitudes, but the argument for looking at these things in unison is not well made in the discussion of the motivation for the study. What can looking at these factors in unison tell us about urban and rural differences in science? How is that of greater value than just looking at test performance?
* Another question is how much other identity factors that might correlate with urban and rural might be influencing student response. For instance, do you see clear patterns of differences in affluence/class by rural and urban communities? If so, controlling for some of these other identity factors could be important to your analysis to determine if differences in response might be attributable to other factors than the rural-urban divide.
* The other thing I would want to know about is any limitations or concerns with the PISA data or indicators for investigating these issues.
* It was not entirely clear if you want to show that there are differences in students perceptions despite differences in learning. In other words, I do not know if you want to show that there urban students still lack of correct knowledge regarding environmental issues despite of their schooling presuming to be better than in rural settings. I think that part is confusing because although you mention controls and/or analysis of school performance, it is not clear how you will control if that is the case.

**Introduction**

In most countries and economies, students who attend schools in urban areas tend to perform at higher levels than students in non-urban areas.

Using data from the Program for International Student Assessment (PISA), this analysis examines differences in student science performance by school community (urban versus non-urban) across PISA countries over four separate cycles (2006, 2009, 2012, and 2015).

Using PISA 2015 data on student attitudes toward learning science, this analysis also examines (1) students’ awareness of environmental issues, (2) students’ optimism about environmental issues, and (3) students’ beliefs about scientific epistemology and how these three learning outcomes vary across urban and non-urban schools.

Measuring average academic performance across countries can mask inequities by subgroups such as school location. Understanding how variables that are connected to students’ perception and beliefs about science and science issues will provide insight into how to improve the overall learning environment.

**Research Methods**

This paper uses the school location variable of the PISA school questionnaire, which asks principals in what kind of community their school is located. An urban school is defined as a school located in a community of more than 100,000 people (OECD 2013). All other schools are defined as non-urban.

Students’ awareness of environmental issues is collected by students’ responses to a question about how informed students are about the following environmental issues: the increase of greenhouse gases in the atmosphere, the use of genetically modified organisms, nuclear waste, the consequences of clearing forests for other land use, air pollution, extinction of plants and animals, and water storage.

Results show the percentages of students who *have never heard about this,* and *have heard about this but would not be able to explain what it is really about*. Students who select these two responses are considered to be “unfamiliar.” Students who select that they *know something about this and could explain the general issue* or select that they are *familiar with this and would be able to explain this well* are considered to be “familiar.”

Students’ optimism about environmental issues concerns the same seven topics as the awareness question, and students’ are classified into the three groups: whether the students think the issues will *improve*, *stay about the same*, or *get worse*. For binary analyses, the response *improve* is coded as “optimism” and *get worse* and *stay about the same* are considered as “less optimistic” responses.

Beliefs about scientific epistemology are collected by students’ responses on a four-point Likert scale to six statements about scientific epistemology. The Likert scale is converted into a two-point scale for the binary analyses.

Statistical *t*-tests are performed for the comparison of achievement scores and percentage of students’ responses to the aforementioned questions. Linear, logit, and probit regression analyses are used to control for performance when using the non-cognitive variables as outcomes.

**Results**

In 2006, urban students performed better than their non-urban peers in 62% of countries. In 2009, this percentage was 67%, in 2012 it was 62%, and in 2015, urban students performed better than their non-urban peers in 78% of countries.

Urban students are generally more familiar but less optimistic about environmental issues. On the topic of air pollution, 47% countries whose urban students were more familiar with the issue was 47%, compared to 3% of countries whose urban students were less familiar with the issue. In only one country did urban students consider the issue of air pollution to improve in the next 20 years more than their non-urban peers.

A similar pattern was seen with issues of deforestation, extinction, GMOs, greenhouse gases, nuclear waste, and water shortages. The percentage of countries whose urban students were more familiar with these issues was 42%, 40%, 32%, 42%, 18%, and 33%, respectively. In only 5%, 3%, 11%, 3%, 4%, and 5% of countries were urban students more optimistic about these issues.

**Significance**

This paper provides a cross-national picture of student performance in science and explores how student awareness of environmental issues, optimism about environmental issues, and approaches to scientific epistemology varies by school location. Preliminary results show that in most countries, based on the PISA variables, urban students are more aware of environmental issues, less optimistic about the future with regard to the problems associated with environmental issues, and agree with epistemological questions of science. These are all variables that are generally correlated with performance on the science section of PISA, though a causal relationship cannot be inferred one way or the other.

**References**

OECD (2013), "What Makes Urban Schools Different?", *PISA in Focus*, No. 28, OECD Publishing, Paris.