Session 5
How we can study the impact of educational policies
Joan Ferrini-Mundy
U.S. National Science Foundation

Mathematical and scientific skills and knowledge are an educational imperative in today's global and increasingly technological economy. Access to opportunities to learn these subjects is critical for achieving a workforce able to innovate. For instance, OECD's Survey of Adult Skills (2013) found that "proficiency in mathematics is a strong predictor of positive outcomes for young adults."[1] Educational policies of different types might promote improved achievement in mathematics and science, although the challenges of assessing the impact of education policies is significant. Correlational methods seem to be the primary approach for describing the relationship of policy and achievement, although often policies are informed by experimental research. Three policy areas that hold promise for improving mathematics and science education, and where additional research examining causality is needed, are discussed.

Teacher Preparation and Compensation Policies

Findings from the International Association for the Evaluation of Educational Achievement (IEA) Teacher Education and Development Study in Mathematics (TEDS-M)[2] suggest that in general, prospective teachers had higher scores on TEDS-M assessments in countries that had teacher education programs with comprehensive opportunities to learn university *and* school-level mathematics.[3] The TEDS-M report indicates that countries with high student achievement enact policies that enable the preparation of high quality teachers, balance teacher demand and supply, have a rigorous system of accreditation of teacher education programs, and set high entry standards for the profession, such as licensing requirements. For example, Chinese Taipei and Singapore have strong quality assurance measures, which include policies that make teaching an attractive career and high entrance requirements to teacher education programs, and their teachers score highly on examinations of mathematics content knowledge and mathematics pedagogical content knowledge.[4] Nonetheless, the U.S. National Mathematics Advisory Panel[5] found, based on meta-analyses, that "little is known from high-quality research about what effective teachers do to generate greater gains in student learning" and so it is unclear how policy can directly enable effective teaching practice.

Learning Opportunities for All and Expectations of Success

Policies that govern access to schooling and that determine which groups of students have access to which content can be critical for overcoming differences along lines of socioeconomic status. The concept of "resilient" students –those who can exceed expectations that would normally be appropriate for their socioeconomic status– is of interest internationally (see *PISA 2012 Results in Focus*). Such

[1] Organisation for Economic Co-operation and Development, (2013). *PISA 2012 results in focus: what 15-year-olds know and what they can do with what they know*. Programme for International Student Assessment, OECD, Paris, page 6.
[2] Tatto, M.T. (Ed.). (2013). *The Teacher Education and Development Study in Mathematics (TEDS-M): Policy, practice, and readiness to teach primary and secondary mathematics in 17 countries. Technical report*. Amsterdam: IEA.
[3] Tatto, M. T., Schwille, J., Senk, S. L., Ingvarson, L., Rowley, G., Peck, R., et al. (2012). *Policy, practice, and readiness to teach primary and secondary mathematics in 17 countries: Findings from the IEA Teacher Education and Development Study in Mathematics (TEDS-M).* Amsterdam: IEA.
[4] Ingvarson, L., Schwille, J., Tatto, M.T., Rowley, G., Peck, R., & Senk, S.L. (2013). *An analysis of teacher education context, structure, and quality-assurance arrangements in TEDS-M countries: Findings from the IEA Teacher Education and Development Study in Mathematics (TEDS-M)*. Amsterdam: IEA.
[5] National Mathematics Advisory Panel (2008). *Foundations for success.* Washington DC: US Department of Education, p. xxi.

strategies as allocating equal or greater numbers of teacher per student in high-needs or economically disadvantaged schools are associated with higher student achievement. Investment in early diagnosis through assessment of students who are challenged can also be associated with improved performance. Many factors, some of which can be influenced by policy, may contribute to differences in mathematics and science achievement within a country. The Trends in International Mathematics and Science Study (TIMSS)[6] reported strong correlations between high school students' scores and attendance at schools that foster academic success through rigorous curricular goals, effective teachers, high student motivation, and parental support. This study and others have shown that home resources are strongly related to science and mathematics achievement. The PISA 2012 data indicate that teacher mentoring partially mitigates the effect of a student's socio-economic status on performance. This is an area that can be influenced by policy.

Common Standards

Accreditation and quality assurance structures vary widely both within and across countries, which makes comparisons of specific policies difficult. For example, in the United States, school accreditation is conducted at the state level and quality assurance occurs at the district level – and there are nearly 15,000 school districts in the country. The role of national curricular standards varies significantly around the world. Findings from the TIMSS Curriculum Study[7] indicate that coherent, common standards and curriculum are associated with countries whose students achieve well. In the US, with the introduction of Common Core State Standards in Mathematics, a number of efforts to study this policy change are underway.

I look forward to continued discussion of how to improve our ability to understand the impact of educational policies. Most of our knowledge of their relationship to student outcomes is gathered through correlational studies. The challenge of designing studies and analytic approaches to determining causal relationships in this domain is significant, and is critical for the design and implementation of effective education policy.

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[6] Mullis, I.V.S., Martin, M.O., Foy, P., and Arora, A. (2012c). TIMSS 2011 International Results in Mathematics. Chestnut Hill, MA: Boston College, TIMSS and PIRLS International Study Center [online]. Available: http://timssandpirls.bc.edu/timss2011/reports/international-results-mathematics.html.

[7] See Schmidt, W.H. (2001). Why schools matter: a cross-national comparison of curriculum and learning, Jossey Bass.