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This article places the most recent study of PISA (Programme for International Student Assessment) in historical perspective, reviewing the role of international comparisons in efforts to build public education systems as key institutions of democratic societies. It discusses the findings for the United States, examining differences with other participating countries. It also looks at a paradox. Despite the high priority education has received in the United States in the past two decades, the country underperformed in a number of indicators in the PISA in comparison with many other countries participating in the study. The authors explain the findings as the result of an underlying paradigm to education reform that has given priority to efficiency improvements rather than to educational innovation to increase the relevancy of education in helping students gain the skills necessary in the twenty-first century. The authors argue that these findings underscore the need to give more attention to teacher preparation and to add the voice of the profession to the design and execution of education reform efforts.

The idea that all persons should be educated is a product of the Enlightenment, the philosophical movement that espoused that ordinary people can rule themselves, assisted by reason and science and by the capacity to associate with others to improve themselves and their communities, and in so doing reduce human suffering. Public education, like modern democratic government, is an outgrowth of the Enlightenment concept of self-rule, and, like democratic government, it aspires to empower individuals to take responsibility for their own lives and communities.

The ongoing construction of democratic societies and the public education systems that equip all citizens for self-rule are global movements that have benefited from the sharing of ideas and observations across national borders and across the centuries. Marc Antoine Jullien, a journalist who lived during the French Revolution, was the first person on record to propose giving systematic attention to the comparative study of educational practices and experiences as a way to help emerging democratic nations in Europe decide how to build public education systems.

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Jullien, who admired and studied the Swiss educator Henry Pestalozzi's model of schooling based on the concept that learners should be taught according to their stage of development, created a publication to engage various educators in a discussion of alternative ideas about how to educate children. He proposed that such exchange of ideas about global education approaches could support efforts to improve education around the world. He proposed also, but never implemented, what should have been the first comparative survey of education, a systematic effort to study how various districts and authorities were organizing schools, who attended, how they were grouped, who taught them, and what they were taught.

The Founding Fathers in North and South America borrowed and exchanged ideas about how to make the institutions of democracy work and how to create educational institutions that prepare citizens for self-rule. Francisco de Miranda, one of the leaders of the independence movement in South America, spent two years traveling in the United States and studying the institutions of the new nation. In 1784 he visited the college presidents Ezra Stiles of Yale and James Lloyd of Harvard to discuss the role of educational institutions in promoting an enlightened order.

In 1810 Simón Bolivar, a leader of the South American independence movement, visited Joseph Lancaster in London. Lancaster had devised a low-cost system, the monitorial system, for educating the children of the poor. In 1808 Lancaster and his followers had created a society to promote this educational approach, which inspired the first efforts to systematically prepare people for the teaching profession. Lancaster himself traveled widely in the Americas. At Bolivar's invitation, he lived in Venezuela between 1825 and 1827 and established the first teacher education school in that country. Also, several decades before Horace Mann launched his campaign for public education in Massachusetts, Lancaster gave a series of lectures in the eastern United States, explaining how this system could help expand access to education.

In 1804 John Quincy Adams, the sixth U.S. president, published his *Letters on Silesia* about the public schools in the region that is now part of Germany, Poland, and the Czech Republic. And in 1843, as secretary of education, Horace Mann visited Prussia to inform his thinking about how to strengthen public schools. He saw public schools as the wheel of the social machinery that would equip children of an already diverse country to develop the skills and the trust in one another needed to make democracy work.

Horace Mann's wife, Mary Tyler Peabody, also played an important role in facilitating the transfer of ideas about education across borders. She maintained an extensive correspondence with Domingo Faustino Sarmiento, the Argentinean educator and later president whose ideas provided the foundation of public education in South America. Sarmiento met Peabody in 1847 when he came to Massachusetts to discuss with Mann the recently published *Common School*.

The first center of comparative education in the United States, Teachers College at Columbia University, was established in 1893 in the hope that the study of comparative experience would benefit the teachers in training as they sought approaches that would be effective in inner city schools. The progressive educator John Dewey, who joined the faculty in the early twentieth century, drew many insights about the role of schools in a democratic society from his travels and systematic study of education in various nations.

In the 1960s the first systematic comparative study of educational systems was developed under the leadership of Torsten Husén, a prominent Swedish educator who helped create the field of comparative education. Drawing on the lessons of his comparative studies to support the reform of Swedish education, Husén helped create comprehensive and detracked schools. His six-country study led to the establishment of the International Association for the Evaluation of

Educational Achievement, an independent international cooperative that has produced comparative studies in language, mathematics, science, and civics.

In 2000 the Organisation for Economic Co-operation and Development (OECD) initiated what would become a periodic cross-national survey of student knowledge and skills and of students', teachers', and principals' reports of school practices, processes, and characteristics that had a bearing on instruction. In 2012 this study, known as the Programme for International Student Assessment (PISA), was administered in sixty-five countries, twenty-nine of them members of the OECD. The PISA study is based on knowledge and skills assessments and questionnaires administered to samples of fifteen-year-olds and their teachers and school principals. These questionnaires explore self-efficacy, effort, and persistence and how student knowledge is related to various student characteristics, including gender, immigrant status, and socioeconomic status. Students are chosen to be representative of the fifteen-year-old population of students in school in each participating country and, in some instances, in particular states or other subnational jurisdictions. The 2012 study focused on mathematics, and most of the follow-up analysis was based on data about math instruction, though students were also tested in the areas of literacy and science. The 2012 PISA reports include analyses of changes of student performance, comparing test data from 2012 with data collected in previous years, and comparing student achievement data from previous years with assessment data from samples of adults (ages sixteen to sixty-five) in literacy, mathematics, and problem solving collected in 2011–12.

Key Findings of the 2012 PISA Study

The OECD published six reports that analyze the findings of the PISA.[1] One report focuses on the implications of PISA for the United States. The following are among the key findings of the reports of particular relevance to the United States.

- What is learned in school has lasting consequences for economic and civic participation and for personal health. The survey of adult skills demonstrates strong correlations between the literacy and numeracy assessment results of particular age groups in 2012 and the PISA results for the same age group in an earlier assessment. Also, adults with high levels of literacy are significantly more likely to be employed and have high wages, to report high levels of political efficacy, to participate in volunteer activities, to have high levels of trust, and to report good health.[2] The United States, however, despite high levels of educational attainment, has greater proportions of adults with poor literacy and numeracy skills.
- Student knowledge and skills in mathematics, literacy, and science vary widely within countries and between countries. Forty countries showed improvement in average student performance over a decade in at least one of the three assessments. One of the strongest predictors of that performance is the socioeconomic background of students, though this relationship also varies across countries.
- The performance of U.S. students compared with that of all other students was average in the three domains assessed. Twenty-five percent of the students in the United States do not reach the most basic levels of math proficiency, and only 9 percent reach the highest levels. The levels of inequality in student knowledge and skills for students of different socioeconomic backgrounds in the United States are greater than the average for all participating countries. Though some of the countries participating in the assessment

showed improvement in PISA scores, the United States showed no improvements in a decade.

- Beliefs about self-efficacy, effort, and persistence are interrelated and vary across schools and countries. Four of five students in the OECD report that they are happy in school and that they feel they belong in school. Tardiness, however, is common, with one in three students reporting that he or she arrived late to school. One in four reported that he or she skipped classes. These findings are negatively related to student performance.
- Student achievement is related to the ability to handle a lot of information, to understand things quickly, and to link facts together easily. It is also related to whether students seek explanations and like to solve complex problems.
- The highest performing education systems allocate resources equitably across schools, give teachers and principals autonomy over curriculum and assessment, and engage all stakeholders in education, including students, by providing them avenues to offer feedback on teacher practices.
- Compared with all other students, immigrant and low-income students perform at lower levels, on average, on the assessments, and this relationship is strong. The impact of this relationship, however, varies among countries, and, for some countries, the impact has diminished in the past decade. In all countries, a certain percentage of students in the bottom quartile of the income distribution perform at the highest levels on the assessments, though this percentage varies across countries. In the United States the relationship between student achievement and socioeconomic background is similar to the average relationship in the OECD. Also, in the United States, the percentage of immigrant students is larger and grew more than for other OECD countries on average. For the OECD, immigrant students increased from 9 percent in 2003 to 12 percent in 2012, whereas for the United States, the corresponding figures were 15 percent and 22 percent. But, for the OECD, the achievement gap associated with immigrant students diminished during that same period. Canada, Ireland, Israel, New Zealand, and the United Kingdom show no achievement gap associated with immigrant status. Immigrant students tend to be segregated in disadvantaged schools. In the United States, immigrants make up 40 percent of the students in disadvantaged schools, compared with 13 percent in advantaged schools.
- Many countries, including the United States, have gender gaps in knowledge and skills, as well as in students' attitudes toward mathematics, with girls reporting less perseverance, less motivation to learn mathematics, less self-efficacy, and more anxiety.
- By age fifteen students who participate in preschool have higher levels of achievement in mathematics, representing more than a year of schooling on average. Once socioeconomic status is accounted for, this advantage disappears for the United States and a few other countries.
- On average, OECD countries allocate the same number of mathematics teachers to socioeconomically disadvantaged schools as to advantaged schools, though school principals in disadvantaged schools report greater difficulty attracting qualified teachers. No differences were observed in the United States between disadvantaged and advantaged schools in the levels of education and in student-teacher ratios.
- Several countries, such as Estonia, Poland, Brazil, Colombia, Japan, and Mexico, have implemented reforms aimed at strengthening the teaching profession by increasing the requirements to obtain a teaching license, providing incentives for high-quality applicants

to enter the teaching profession, and aligning the incentives for career advancement with professional development. Other countries, such as Japan and Portugal, have reformed curriculum to align it with students' interests and twenty-first-century skills. Israel, Germany, Mexico, Turkey, Brazil, and others have targeted policies and resources to improve low-performing schools. Colombia, Poland, Korea, and others have given schools and local authorities more autonomy and instituted policies to encourage collaboration and accountability.

Noting the relationship between socioeconomic disadvantages and educational achievement, the volume 2 report, *Excellence through Equity*, suggests new approaches to improve educational opportunity. It recommends, for example, that countries with large concentrations of low-performing students in particular schools target interventions to those schools and that countries in which low-performing students are more equally distributed across schools target interventions to specific students. The United States is one such country. According to the report, personalized interventions might involve a specialized curriculum, additional instructional resources or economic assistance, or professional development for teachers that emphasizes best practice for students in low socioeconomic levels. For countries with relatively weak relationships between socioeconomic background and performance, the report recommends applying policies to improve education for all students.

The Paradox of Underachievement despite Equality of Educational Opportunity in the United States

The United States spends more money on education than most other countries and its citizenry and government have made education an important priority, yet, compared with students in the other countries participating in the PISA assessment, U.S. students obtain results that are mediocre in terms of average performance of students and in terms of the extent to which the student achievement gap relates to socioeconomic background. U.S. students underperform with respect to the size of the U.S. economy, spending per student, parental education levels, and the share of socioeconomically disadvantaged students. With respect to the percentage of immigrant students, U.S. performance levels are average.[3]

How can we explain the paradox that even though education is a priority in the United States we obtain poor results? Are we not doing enough? Are we doing the wrong things? Should we focus more of our efforts outside of schools? Are we emphasizing knowledge and skills not measured in the PISA studies?

Since the publication of *A Nation at Risk* in 1983, the United States has made efforts to reform education that have focused on assessing student performance, defining and raising educational standards, and introducing accountability measures based on those standards. The most recent effort was the establishment of consistent national standards, known as the Common Core. The goal of these new standards is to elevate expectations for learning for all students, level those expectations, allow a seamless transfer of students across schools within and between states, identify good practices across states, and develop innovations to support instructional improvement in ways that benefit from the scale that a national framework of standards would provide. Though the recent PISA study was conducted before the Common Core standards were implemented, the report for the United States compares the items of the PISA mathematics assessment with those in the Common Core and concludes that, if well implemented, the

Common Core might help improve the overall performance of U.S. students relative to their peers in other OECD nations.

The report for the United States includes a chart titled "School principals' views of how teacher behavior affects learning."[4] The principals reported that the following had relatively little influence in their schools: lack of encouragement of students by their teachers to achieve their full potential (89 percent), poor teacher-student relations (94 percent), teachers having to teach students of heterogeneous ability levels in the same class (68 percent), teachers having to teach students of diverse ethnic backgrounds in the same class (76 percent), teachers having low expectations of their students (83 percent), teachers not meeting individual students' needs (76 percent), teacher absenteeism (91 percent), staff resistance to change (72 percent), teachers being too strict (95 percent), teachers being late for classes (99 percent), and teachers not being well prepared for class (93 percent). In all these indicators, the situation reported by U.S. principals is better than the situation reported by principals for the OECD on average. Furthermore, these indicators suggest a strong sense of professionalism among U.S. teachers. Most teachers have good relations with their students. They are not absent, not too strict, and not late for classes, and they prepare for classes. Areas for improvement include, most notably, developing skills to teach heterogeneous classrooms, helping to meet individual students' needs, being open to change, developing higher expectations of students, and encouraging students to achieve to their full potential.

These efforts and achievements suggest that where the United States underperforms relative to other countries, it is not for lack of trying. But it is possible that the U.S. strategies of educational improvement have not emphasized teacher development as much as elements such as standard setting, assessment, and accountability. We return to this point in the next section.

It may be that there is a limit to how much schools can compensate for social disadvantage, though the PISA reports find no national-level relationship between income inequality and the extent to which socioeconomic background of students relates to student performance. Similarly, there are no differences in the performance of students in schools in large urban areas and those in small rural areas. This finding suggests that underachievement is not exclusive to students in poor neighborhoods. Thus, it is not the overall level of income disparities in the country that explains the underperformance of poor children but rather the influence of factors associated to living in poverty. Poor children, for example, may suffer the consequences of hunger or of poor nutrition or of living in environments where adult caregivers have limited time and skills to support their education, or where they are exposed to violence and other risks. They may also suffer disadvantages that could be mediated by schools, such as being enrolled in schools that have few resources or in schools where they experience classroom discipline challenges or where their teachers have low expectations for them or are not able to teach them effectively.

Unraveling the U.S. Paradox and Refocusing on the Teaching Profession to Link Policy to Practice

Reform efforts in the United States have emphasized policy shifts and governance and leadership by those with formal authority for educational administration, rather than the expertise or agency of teachers and students. Ideas imported from business management, such as "what gets measured gets managed," have dominated over ideas generated in the education field about how students learn and about the proximal influences in learning of students or teachers. These

traditional ideas imported from business management, which view educational systems as hierarchies rather than as professional networks, have led to reforms aimed at improving efficiency rather than fostering innovation.[5] If Marc Antoine Jullien were alive today, leading his comparative education network, he would describe U.S. education reformers as obsessed with defining standards and measuring everything, enamored with their own leadership, disdainful of their teachers, somewhat aloof with students and learning, and inattentive to the purposes of education and to how those shape relevance and quality.

In taking a top-down, hierarchical, view of educational change, the reform movement has largely ignored the potential of bottom-up improvement and innovation networks. Abundant efforts and monies have been spent on developing and administering tests to students, and now to teachers, and in developing methodologies to model the contributions of teachers to learning. Considerably less attention has been given to discerning what role teachers can and should play in shaping efforts to improve education and how best to support them in their role. In an age when technology, relying on collective intelligence, increasingly enables networks to collaborate in the solution of complex problems,[6] the dependence of the U.S. education reform movement on early twentieth-century management approaches in the hope of supporting twenty-first-century education is anachronistic. It undermines the profession and constrain the innovation needed to teach students the skills they will need in the twenty-first century and to respond to other adaptive challenges.

Compounding the challenges that result from using dated ideas about the management of hierarchical organizations to support adaptive innovation, reformers have too often depended on a narrative that announces that our education system is in crisis. Some reformers have suggested that teachers are lazy and out to help themselves rather than the students and that the country's economic future is at stake if we do not find a way to catch up with the rest of the world, especially with the countries whose students are scoring higher than our students in assessments such as PISA and TIMSS (Trends in International Mathematics and Science Study). This approach may serve politicians seeking to "create space" for reform, or it may appeal to the extremists who, despite the fact that they represent a small percentage of the population, have captured much of our political space.[7] Those extremists, at both ends of the political spectrum, have most recently made common cause in opposing the Common Core, though they could not possibly agree on an alternative approach to improving opportunities for children to be educated. This approach may also serve other interest groups who wish to access a portion of taxpayer or philanthropic funds for the latest innovation, technology, assessment system, or theory. But the narrative of crisis is more likely to undermine the teaching profession than to build it and unlikely to support the risk taking and creativity that are necessary to innovate for adaptive improvement.

The experience of countries that have shown the most sustained levels of educational improvement, such as Singapore, South Korea, Poland, and Germany, suggest that educational change should focus on developing a growth mindset that emphasizes possibility and values what students and teachers do and what they have to say about how to continuously improve their schools. This approach requires taking the conversation to the local level, where much of the control of our schools has traditionally been. We need to create a sound education system that allows each person to learn from his or her own experience and from the experience of others and, as a result, to continuously improve. Technological platforms, such as Quora, allow for the use of such forms of collective intelligence in improving schools in unprecedented ways. In such a networked system teachers and students are central, for their practice, shaped by their

aspirations, motivation, skills, and learning, matters most to how students learn and develop. In that system, teachers, who are selected rigorously and educated to lead the education system as they engage in cycles of continuous experimentation, learning, and improvement.

Perhaps it is also time that we begin to tone down our rhetoric about the importance of "leadership" and replace it with a narrative about professionalism and expertise that recognizes that the interactions between students and teachers are core to helping all students develop the full range of competencies they will need in the twenty-first century. We must begin to build and depend more on networks that effectively mobilize all the knowledge of key stakeholders in education. To the extent that we should care about how our education system compares with the education systems in other countries, maybe we should care less about developing test after test for every single skill and piece of knowledge mastered by the students and the teachers and focus on the professional development of teachers and in building systems of collective intelligence that can support innovation and disruption. The goal should be achieving meaningful educational purposes rather than simply making gains in efficiency to achieve the goals of the past.

Fortunately we will not have to start from scratch to build this new approach, but we will need to change the negative views and low levels of trust that as a society we seem to have about our teachers. It will be necessary also to find out what is working well and why and to celebrate it and share it widely. There are plenty of good practices and results to celebrate, newspapers headlines of PISA results notwithstanding. For example, in keeping with the OECD average, 80 percent of the students in U.S. schools report being happy in school and most students report having good relationships with their teachers. Another cause for celebration is that, as reported by their students, our teachers are more likely to deploy a wider range of effective teacher practices than their counterparts in the OECD.

Numerous reported findings point to the critical importance of teacher practice and preparation, while the findings about the importance of governance reforms are less conclusive. For example, the strong relationship between principals reporting low morale among teachers and teachers' practice having a negative impact on student learning suggests that teachers are more effective when their morale is high. Morale is related to several factors, including school climate, which in the United States is particularly poor in disadvantaged schools. When teachers are not prepared to address classroom management and to plan effectively how to deal with it, or how to be effective with children who come unprepared to engage in the teaching and learning process, they do not fare well and, as a result, their morale declines. Large numbers of once highly motivated and optimistic teachers leave the profession within the first five years when they report feeling disempowered and ineffective in their teaching. That high level of attrition in the teaching profession in the United States needs to be studied systematically.

We also need studies to help us understand the causes of our teacher shortages. Though there are no differences between advantaged and disadvantaged schools in the number of teachers per student or in teachers' educational qualifications, U.S. principals who report that teacher shortages hinder learning are in schools where students have lower levels of achievement. Principals of disadvantaged schools in the United States are more likely than principals in advantaged schools to report teacher shortages. This fact suggests that having a university degree is a poor proxy for teacher quality, and that there are large variations in quality, as perceived by principals, even among teachers who have university degrees. These variations in quality result from the large heterogeneity of U.S. universities and teacher education programs in particular and from the fact that the education reform movement has largely ignored teacher preparation.

The conditions in which teachers work vary also in ways that make disadvantaged schools less attractive and effective. School principals in advantaged schools are more likely to report that material resources are adequate than their counterparts in disadvantaged schools.

The assessment of the performance of U.S. students in the PISA mathematics test, compared with the performance of their peers in high-performing countries, reveals that U.S. students underperform in geometrical reasoning and in the ability to mathematically model real world problems, to interpret real world aspects, and to use the number pi. These knowledge and skill gaps in higher-order activities suggest that changes in the pedagogy and in the curriculum may help students gain competency. It is well known, for example, that effective math teachers have mastered the math content and the pedagogical skills to teach it and also that they can develop curriculum and implement it effectively. Yet, many teacher preparation programs emphasize the math content knowledge, the kind of knowledge measured in teacher tests across the nation, leaving it up to individual teachers to figure out how to be effective in teaching higher-order mathematical thinking and skills. It is unlikely that we will be able to help students gain these skills with the same pedagogies we have used in the past. Differences in the kind of activities students engage in in the United States and those students engage in in other countries support the idea that a richer pedagogical repertoire might contribute to student achievement. For example, less than 20 percent of the boys and about 5 percent of the girls in the United States program computers, below the average in the other OECD countries. There is a similar gap between the percentage of boys who play chess (20 percent) and girls who do (5 percent). There are also differences, though smaller, between more and less advantaged students in their participation of these activities.

Students' reports that suggest that a greater percentage of U.S. teachers deploy effective practices than the OECD average suggest also that those teachers who do not use effective practices, a significant percentage of teachers in the United States, could use professional development. For example, when asked about their teachers' use of cognitive-activation strategies, only 69 percent of the U.S. students reported that their teachers asked them questions to make them reflect on the problems they were studying, 70 percent reported that their teachers gave them problems that required them to think for an extended period, 47 percent said their teachers asked them to decide on their own procedures for solving complex problems, 55 percent said their teachers presented problems for which there is no immediate obvious method of solution, 68 percent reported that teachers presented problems in different contexts to help them know they had understood the concepts, 73 percent said teachers helped them learn from the mistakes they had made, 77 percent reported teachers asked them to report how they had solved a problem, 76 percent said teachers presented problems that required them to apply what they had learned to new contexts, and 69 percent said teachers gave them problems that can be solved in different ways.[8]

Teachers in the United States are also more likely to use teacher-directed instruction than the OECD average. Seventy-four percent of the students report that teachers set clear goals for learning, 65 percent report that teachers ask students to present their reasoning at some length, 80 percent report that teachers ask questions to check for understanding, 49 percent report that teachers start lessons with a short summary of the previous lesson, and 83 percent report that teachers tell students what they have to learn (fig. III.5.7).

Teachers in the United States are less student oriented than teacher directed. Nineteen percent of the students in the United States, compared with 30 percent in the OECD, report that teachers differentiate the work they give to struggling students and the work they give to fast

learners. Thirty percent of U.S. students report that teachers assign projects that require at least a week to complete; the OECD average is 17 percent. Fifty percent of U.S. students report that teachers have them work in small groups; the OECD average is 23 percent. And 17 percent of U.S. students report that teachers ask them to help plan a class; the OECD average is the same (fig. III.5.8).

Teachers in the United States are also more likely than those in the other OECD countries to use formative assessments, though many could improve in this domain. Forty-six percent of U.S. students report that teachers provide them feedback on their performance, 33 percent report that teachers point out their strengths and weaknesses, 74 percent report that teachers tell them what is expected in an assignment or test, and 51 percent report that teachers tell them what they need to do to become better in mathematics (fig III.5.9).

The report for the United States also reveals that basic issues of class management need attention. Though on average U.S. principals report a disciplinary climate that compares well with that in other countries, students reporting the worst disciplinary climates are almost twice as likely to be among the lowest performers. One issue is absenteeism, which includes skipping classes or whole days of school. Student absenteeism in the United States, reported by 28 percent of students, is negatively associated with student achievement and more likely to occur among lower-income students. On a scale that measures socioeconomic advantage, 25 percent of the students from the top quarter skip classes, whereas 40 percent from the bottom quarter do. A third of the students who skip classes are in schools where more than half of the students skip classes. In the past decade, disadvantaged students have become more likely to skip classes.

Teachers need also to develop skills that help students develop drive, self-efficacy, and a sense of belonging in schools. The report shows a significantly higher sense of belonging among students from higher socioeconomic backgrounds than from their poorer peers, even when their actual performance in mathematics is identical. This difference is greater in the United States than the average for the OECD. Also, compared with the average for the OECD (70 percent), fewer students in the United States (60 percent) are in schools where there is a consensus on the importance of the social and emotional development of students. This figure is lower than that for the United States in only eight countries. Another measure that is related to student achievement, openness to problem solving, is higher in the United States for boys than for girls and higher for more socioeconomically advantaged students than for their poorer peers, even when their actual mathematics performance is the same. Mathematical self-efficacy, another construct related to mathematics performance, is higher for boys than for girls, even when their actual performance is identical.

Another finding of the report is that governance matters only to the extent that it gives teachers voice in school decision-making. Whether students attend public or private schools, for example, makes no difference, after accounting for the socioeconomic intake of the school. What does matter, however, is school autonomy, the posting of achievement data, and teacher accountability and discretion over decisions. These factors are all associated with higher levels of student achievement. There is also an interaction between school autonomy and teacher collaboration with management. In schools with poor teacher collaboration with management, more autonomous schools have lower levels of student achievement than less autonomous schools, whereas the reverse is true in schools with better teacher collaboration with management.

Finally, the report highlights the need for U.S. teachers to be able to personalize instruction. Because of the heterogeneity of U.S. classrooms, the most effective approaches to

closing equity gaps among those discussed in the assessment would be those that attend to individual differences. Developing the skills to do so requires a high level of professional expertise and perhaps more effective use of technology to personalize instruction.

These findings suggest that teacher preparation should be significantly more central in the education reform movement than it has been to date, and that teachers need to play a central role in designing and implementing that reform, in contributing what they know about practices that can help students learn, and in building effective platforms for collective intelligence of the profession on these issues. Continuing to view teachers as objects of education reform when they should be professional partners in the design and execution of education reform reflects a managerial approach that was designed to improve the efficiency of factories in the early twentieth century, not the approach we need to sustain innovation in addressing the adaptive challenges faced by our schools.

Lessons from PISA

Many states have recently begun to implement the new Common Core standards. We need to wait to measure their effectiveness in teaching the kind of knowledge and skills measured in the PISA studies. A content analysis of those standards, however, suggests that they are likely to provide access to higher-level mathematical knowledge. Also, the experience in Massachusetts, where student performance in the PISA study is significantly better than it is for U.S. students on average, suggests that the Common Core standards may lead to higher math achievement. In Massachusetts, the state standards have been aligned with the Common Core for the past three years, and the previous state standards were more in line with the Common Core than those in other states. But though the Common Core standards are a promising avenue to improve educational opportunity in this country, to fulfill that promise, they must be accompanied by adequate teacher preparation and support and by an approach that resembles the innovation networks of the twenty-first century, rather than the hierarchical bureaucracies of the past.

The PISA study, like most international comparative studies, focuses on specific content knowledge and skills. We should therefore continue to use this content to evaluate the effectiveness of our education system in that particular set of knowledge and skills. But that is not enough. PISA does not measure other important content knowledge and skills, such as creativity, innovative skills, socioemotional skills, and cognitive organizational skills, all of which are also essential to the functioning and growth of individuals and societies. Consequently, our educational efforts should be aligned not to what PISA measures but to goals of education that prepare students to live, work, and participate civically in the twenty-first century. Efforts are ongoing in the United States, and in other nations, to engage schools in the development of a new, more ambitious range of competencies. These efforts are aligned with the Partnership for Twenty-First-Century Skills (P21), a policy advocacy coalition that is active in nineteen states. The P21 initiative, which highlights the importance of information and communication skills, critical thinking and problem solving, and interpersonal and self-direction skills, developed a framework identifying eighteen key skills, grouped in six areas that should be included in the curriculum: core subjects, life skills, learning and thinking skills, twenty-first-century content, twenty-first- century assessment, and information and communications technology.

P21 emphasizes global awareness; civic literacy; health and wellness awareness; and financial, economic, and business literacy. Many of these important domains are not measured by PISA, nor are they measured by the existing assessment systems in place in the United States.

In Massachusetts, the Board of Elementary and Secondary Education has, over the past six years, appointed two task forces charged with defining a strategy to foster twenty-first-century skills in the state's schools. In 2008, the task force published a report that, in line with the P21 framework and definitions, identifies five levers for change: educator training and development; standards; assessment; accountability; and demonstration sites. With regard to educator training, the report recommends "overhauling the state's teacher training and professional development programs to recruit and retain high achieving educators who have a background in and up-to-date knowledge of twenty-first-century skills." For the other levers, the report proposes embedding twenty-first-century skills and content in every subject throughout the commonwealth curriculum, revising the Massachusetts Comprehensive Assessment System, and establishing accountability mechanisms for students, teachers, and leaders that focus on twenty-first-century skill development. The demonstration sites would be up to five districts that would transform themselves into twenty-first-century districts and up to ten schools that would transform themselves into twenty-first-century schools. The report also recommends expanding learning time in a hundred or more schools, and expanding teaching partners initiative, which would bring to schools professionals and artists in a range of fields. The report also outlines a process to manage the implementation of this plan that includes creating an advisory council charged with building support, including the various professional education associations of teachers, superintendents, and school committees in this process and collaborating with other states in New England.[9]

A more recent report, published in 2012, *From Cradle to Career: Educating Our Students for Lifelong Success*, emphasizes the importance of more intentionally preparing students for work: "Students who are able to gain experience and exposure to the world of work while in high school are better prepared to persist in and complete a postsecondary education and succeed in pursuing livable wage careers."[10] The report proposes a new definition of career readiness encompassing knowledge, skills, and experiences that draw on academic knowledge, workplace readiness, and personal and social development.

In response to the 2012 report, the Board of Elementary and Secondary Education and the Board of Higher Education adopted an expanded definition of college and career readiness, according to which "Massachusetts students who are college and career ready will demonstrate the knowledge, skills and abilities that are necessary to successfully complete entry-level, credit-bearing college courses, participate in certificate or workplace training programs, and enter economically viable career pathways."[11] The definition goes beyond career-ready levels of competency in English language and mathematics to include a foundation in the disciplines in the MassCore course of study and competencies for workplace readiness as identified in the 2012 report. Workplace readiness involves demonstrating a work ethic and professionalism and effective communication and interpersonal skills.

As states such as Massachusetts move to the next generation of education reform, they would do well to align those efforts to the standards and aspirations that these various reports have defined as appropriate to the twenty-first-century, rather than to the old assessment systems that measure the narrow set of competencies deemed sufficient preparation for the jobs of the past.

Using the PISA studies to assess the performance of our schools provides a rather narrow window through which to explore the learning outcomes as well as the variables that may be impacting those results. These variables, such as socioeconomic status, immigration status, and level of education of the parents, help us understand the extent to which schools provide equal

education opportunity. The studies focus also on characteristics of systems that are useful, and practically measurable, for international comparisons of governance and financing. But when it comes to predictors that characterize teacher practice or preparation, the studies are more limited. The information on the level of preparation of the teachers is too general (whether teachers have a BA, for example) to be of much use. Characteristics of teacher preparation, such as the teaching program they attended, the practicum in their preparation, the professional development they received in mathematics, and whether they are teaching the subject matter for which they prepared, and the conditions in which they teach are important in any effort to understand how best to support teachers. For example, is the traditional form of professional development, which depends largely on professional learning communities where teachers help each other improve their practice, sufficient to help teachers develop new practices to help students access the new content at higher cognitive levels that characterizes the Common Core? According to the Massachusetts college and career readiness definition, students who are college and career ready in mathematics will be "academically prepared" to "solve problems involving the major content with connections to the mathematical practices"; "solve problems involving the additional and supporting content"; express mathematic reasoning by constructing mathematical arguments"; and "solve real world problems, engaging particularly in the modeling practice." The PISA study, however, does not answer the operative questions for teacher preparation by describing, for example, specific programs that could help teachers engage in practices, such as teaching modeling, that for most of them will be new. The answers to these urgent questions could help Massachusetts achieve its education objectives.

If we want to improve education outcomes, we would do well to think of improvement as increasing the relevancy of the education our schools offer, rather than continue to look for efficiency gains in teaching the skills of the past. To achieve these adaptive reforms we should engaging a central actor of the education process: the teachers, both in supporting their development and in creating effective networks of collective intelligence. Teacher professional development has largely been an afterthought in many education reforms, including the U.S. education reform movement, and teachers have been treated as spectators rather than the experts, the professionals, that they are. It is time to reframe education reform in ways that invite teachers to play a central role in designing it, implementing it, measuring it, assessing it, and engaging the broader community in shaping the aspirations for and the conditions to support reform. After all, that is what professionals do; they define the profession through their practice. The practice of education is in the hands of the teachers and to have a practice that is aligned with the ambitious requirements to prepare their students for the twenty-first century, they need to be professionally prepared and supported. And in giving teachers voice, it is time to start using the technologies and ideas of the twenty-first century to engage large groups of individuals in social networks that can effectively use the talent of all their members to solve education challenges that, as the challenges of democratic governance, are as complex as they are urgent.

Notes

[1] OECD, *PISA 2012 Results*, vol. 1, *What Students Know and Can Do: Student Performance in Mathematics, Reading, and Science;* vol. 2, *Excellence through Equity: Giving Every Student the Chance to Succeed*; vol. 3, *Ready to Learn: Students' Engagement, Drive, and Self-Beliefs;* vol. 4, *What Makes Schools Successful?: Resources, Policies, and Practices*; *Strong Performers and Successful Reformers in Education: Lessons from PISA 2012 for the United States*; *Skills Outlook 2013: First Results from the Survey of Adult Skills* (Paris: OECD, 2013).

[2] OECD, *Skills Outlook 2013*, 27.

[3] OECD, *Strong Performers and Successful Reformers*, box. 2.1.

[4] Ibid., fig. 2.6.

[5] Clayton Christensen has observed that the focus on metrics that emphasize efficiency leads business firms to improve the efficiency of existing firms rather than to look for innovations that create new jobs or new markets. He attributes to this the sustained lack of innovation in the United States and other economies in the past decades. Clayton M. Christensen and Derek van Bever, "The Capitalist's Dilemma," *Harvard Business Review*, June 2014.

[6] For more discussion on the notion of collective intelligence, as an approach enabled by technology to allow collaboration in the solution of complex problems, see Michael Nielsen, *Reinventing Discovery*: *The New Era of Networked Science* (Princeton: Princeton University Press, 2012); Pierre Lévy, *Collective Intelligence: Mankind's Emerging World in Cyberspace* (Cambridge, MA: Perseus Books, 1997), 13; Lawrence Lessig, *Code Version 2.0*, 2nd ed. (New York: Basic Books, 2006); James Surowiecki, *The Wisdom of Crowds*. New York. Anchor Books. 2004;Aaron Weiss, "The Power of Collective Intelligence," *Collective Intelligence*, September 2005, 16–23.

[7] The "capture" of political and public institutions by small groups of individuals in the United States and the consequences for representation has been well analyzed by Lawrence Lessig in *The USA Is Lesterland: The Nature of Congressional Corruption* (n.p.: CreateSpace, 2014). Along the same lines, in a recent essay, Francis Fukuyama attributes the decay of U.S. institutions to a political system that is unable to represent majority interests, favoring instead organized groups representing polarized politics. Fukuyama, "America in Decay: The Sources of Political Dysfunction," *Foreign Affairs*, September–October 2014, 5–26.

[8] OECD, *Ready to Learn*, fig. III.5.6. In further discussions of this report, where percentages are listed, figure numbers appear in parentheses in the text.

[9] Massachusetts Department of Elementary and Secondary Education, *School Reform in the New Millennium: Preparing All Children for 21st Century Success* (Boston: Author, 2008), 23.

[10] Massachusetts Department of Elementary and Secondary Education, *From Cradle to Career: Educating Our Students for Lifelong Success* (Boston: Author, 2012), 5.

[11] Massachusetts Department of Elementary and Secondary Education and Massachusetts Department of Higher Education, *Massachusetts Definition of College and Career Readiness* (Boston: Author, 2013), http://www.mass.edu/library/documents/2013college&careerreadinessdefinition.pdf.