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Drivers of Student Performance: Middle East and North Africa Insights

Education 2017

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foreword

The PISA database is open to the world – a powerful resource for everyone who wants to understand education and help improve it, from policy-makers and researchers to school leaders, teachers and parents. Over recent years, McKinsey have done just this, drawing on PISA to identify the policies and practices that make a real difference. Their work began with ground-breaking reports on The World's Best School Systems And How To Build Them. And these new regional analyses of student-level performance represent another significant milestone.

The reports suggest that students' attitudes and motivation are critical drivers of achievement. So too are their experience in the classroom, of both teaching strategies and digital technology, as well as the time they spend in education. McKinsey's perceptive insights will encourage schools around the world to discover new ways to nurture and inspire their students.

What sets these reports apart is their regional focus. I often hear countries say that learning from the world's outstanding systems is vital, but that just as powerful is the chance to learn from their own neighbours, with similar cultural backgrounds and with shared problems and opportunities.

In every country, the search is on for ways to take education to the next level, to prepare young people for a dramatic and challenging century. This is complex work. What is the right mix of policies, implementation strategies and enabling conditions – in each country and region? How should they be prioritised, sequenced and linked? If we are really to secure achievement, well being and equity, on a global basis, then these will be the issues that educators need to work on. The new reports from McKinsey offer us a fresh and welcome perspective.

Andreas Schleicher
Director for the Directorate of Education and Skills | OECD

executive summary

A well-educated citizenry is an economic and social necessity. But there is little consensus about what it takes to deliver a quality education.

In two previous reports, one on the world's best-performing school systems (2007) and the other on the most improved ones (2010), we examined what great school systems look like, and how they can sustain significant improvements from any starting point. In this report, we switch our focus from systems to student performance, by applying advanced analytics and machine learning to the results of the Organization for Economic Cooperation and Development's (OECD) Program for International Student Assessment (PISA). Beginning in 2000 and every three years since, the OECD has tested 15-year-olds around the world on math, reading, and science; it also surveys students, principals, teachers, and parents on their social, economic, and attitudinal attributes.

Using this rich data set, we have created five regional reports that consider what drives student performance. In the Middle East and North Africa (MENA) six countries participated in the 2015 PISA: two members of the Gulf Cooperation Council (the United Arab Emirates and Qatar), two countries from North Africa (Algeria and Tunisia), and two countries from the Levant (Jordan and Lebanon). On the whole, MENA's PISA scores lag behind not only the OECD average but also behind other countries at a similar economic level.

This research is not intended as a roadmap to improvement; that was the theme of our 2010 report, which set out the interventions school systems need to undertake to move from poor to fair to good to great to excellent performance. Instead, this report examines five specific factors that we found to be particularly important to MENA student outcomes: mindsets, teaching practices, information technology, hours of instruction, and early childhood education.

The report's findings include the following five highlights:

Student mindsets have triple the effect of socioeconomic background on PISA outcomes.

It is hardly news that students' attitudes and beliefs influence their academic performance. The magnitude of this effect, and which mindsets matter most, is still under debate; and it is here that we focused our research. While there is likely a linkage between socioeconomics and student mindsets, we measured the effect of mindsets not explained by socioeconomics alone. By analyzing the PISA data, we found that mindset factors have about triple the predictive power (35 percent) compared to home environment and demographics (11 percent) on student PISA scores in the MENA countries surveyed. That is much greater than in other regions, where mindsets typically have about double the impact of home environment. Mindsets matter everywhere, then, but particularly in MENA.

Some mindsets are more important than others. For example, we compared motivation calibration (defined as being able to identify what motivation looks like in day-to-day life, including "working on tasks until everything is perfect" and "doing more than what is expected") to self-identified motivation (defined as "wanting to be the best" and "wanting to get top grades"). In the 2015 PISA assessment, motivation calibration has almost twice the impact of self-identified motivation. Students who had good motivation calibration score 14 percent (or 55 points) higher on the science test than poorly calibrated ones. The relationship is particularly strong

for students in poorly performing schools, where having a well-calibrated motivation mindset is equivalent to vaulting into a higher socioeconomic status. In these schools, Students in the lowest socioeconomic quartile who are well-calibrated perform better than those in the highest socioeconomic quartile who are poorly calibrated. In contrast, students with high self-identified motivation score just eight percent higher than those without.

We also found that students with a strong growth mindset—those who believe they can succeed if they work hard—outperform by 17 percent students with a fixed mindset—those who believe that their capabilities are static. Having a growth mindset is particularly predictive for students in poorly performing schools, and for those in lower-income quartiles. Other general mindsets that are predictive of student outcomes include instrumental motivation (believing that your school science work will be useful in the future), sense of belonging at school, and low test anxiety.

To be clear, mindsets alone cannot overcome economic and social barriers, and researchers still debate the extent to which interventions can shift student mindsets at the school system level. Our findings do, however, suggest that they matter a great deal, particularly for those living in the most challenging circumstances. The research on this subject is both nascent and predominantly US-based. Considering its importance, local experimentation in MENA and elsewhere should be a priority.

Students who receive a blend of inquiry-based and teacher-directed instruction have the best outcomes.

High-performing and fast-improving school systems require high-quality instruction. It's that simple—and that difficult. We evaluated two types of science instruction to understand how different teaching styles affect student outcomes. The first is "teacher-directed instruction," where the teacher explains and demonstrates scientific ideas, discusses questions, and leads classroom discussions. The second is "inquiry-based teaching," where students play a more active role, creating their own questions and engaging in experiments.

Our research found that student outcomes are highest with a combination of teacher-directed instruction in most or almost all classes, with inquiry-based teaching in some classes. If all students experienced this blend, average PISA scores in the six MENA countries would rise 14 PISA points, equivalent to almost half a school year of learning.

Given the strong support for inquiry-based pedagogy, this seems counterintuitive. We offer two hypotheses. First, students cannot progress to inquiry-based methods without a strong foundation of knowledge, gained through teacher-directed learning. Second, inquiry-based teaching is inherently more challenging to deliver, and teachers who attempt it without sufficient training and support will

In poorly performing schools having a well-calibrated motivation mindset is equivalent to vaulting into a higher socioeconomic status

struggle. Better teacher training, high-quality lesson plans, and school-based instructional leadership can help. It's also important to note that some kinds of inquiry-based teaching are better than others. For example, explaining how a science concept can be applied to a real-world situation appears to boost outcomes whereas having students design their own experiments does the opposite.

School-based technology yields the best results when placed in the hands of teachers.

Screens are not the problem when it comes to student outcomes, but neither are they the answer. Across all MENA subregions and types of hardware, the effect of adding devices to classrooms is small, ranging from 0.2 to 1.1 PISA points per device (with one exception, discussed below). Across the board, we found that deploying information and communications technology (ICT) to teachers, rather than students, works best. For example, adding a teacher computer per classroom has more than six times the effect of adding a student computer. Research from other regions suggests that the use of some technologies, such as e-readers and tablets in school, actually appear to have a negative impact on student performance.

We also found that ICT has greater impact in countries where penetration is low. Adding a teacher computer in the North African countries that took PISA, for example, increases

PISA scores 24.5 points. Doing the same in the two GCC countries, where classroom technology is more common, adds just 1.1 PISA points.

It is important to note that these results describe the impact of education technology as currently implemented, not its potential. Moreover, the findings evaluate only hardware, not software, and they do not consider how teachers use the technology. Even so, MENA leaders should not assume the impact of ICT will always be positive or even neutral. Systems should ensure that ICT programs are fully integrated with curriculum and instruction, and are supported by professional development and coaching.

Improving the quality of teaching is more important than increasing the number of hours students spend in school.

Note: This section looks only at the GCC countries of the UAE and Qatar. The other MENA countries surveyed did not provide enough data for evaluation.

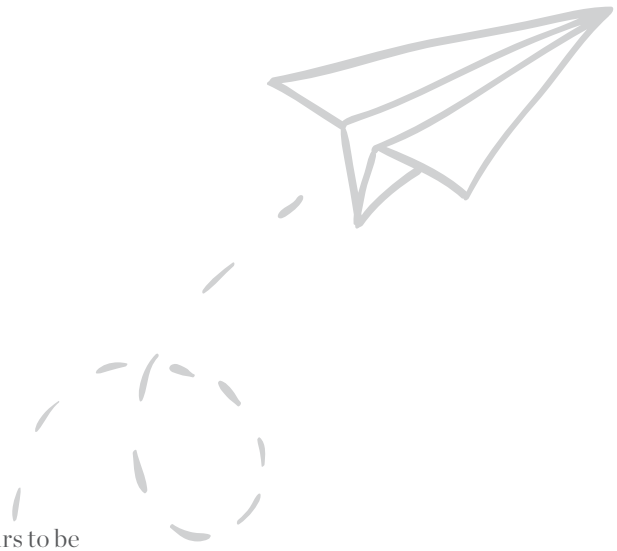
It makes intuitive sense that spending more time in school should improve performance, and the results bear that assumption out—up to a point. In the two GCC countries that took PISA, the average school day is approximately 5.5 hours, slightly above the global average. PISA science outcomes increase by 19.5 percent between 4 and 5 hours per day, but then only increase another 1.9 percent between 5 and 7 hours. Controlling for student socioeconomic status, type, and location of school, the highest scores are obtained by students who get 6.5 to 7 hours of instruction a day. With more than 95 percent of students in these countries already receiving 5 hours or more of instruction, there are limited gains to be made by increasing instructional hours further, especially given the added costs in terms of teacher time and infrastructure.

What matters more is improving the quality of instruction. Indeed, the UAE and Qatar did not score particularly well in the 2015 PISA in terms of PISA points per hour-in-school. They can make significant strides in improving student learning for every existing hour in school by minimizing non-instructional time and raising teacher quality through coaching and professional development.

Early childhood education had a positive academic impact on today's 15-year-olds. Low-income students, however, benefited less than high-income students.

Many studies have shown that quality early childhood education (ECE) improves social and academic outcomes, although there are some concerns about fade-out in later years. Our findings confirm the overall positive impact of ECE at age 15, but indicate that there may be a trade-off between increasing access and ensuring quality.

Overall, students with some ECE perform 27 points better on the PISA science test a decade later than those with none, but there are troubling differences among students from different backgrounds. Children from lower socioeconomic status homes are less likely to have experienced ECE; among those who did, there appears to be a smaller impact on their



eventual PISA scores. Starting too young appears to be detrimental: students who started ECE at age 2 or younger performed worse than those with no ECE at all. This raises concerns about the quality of ECE available, especially for younger children in lower-income families. The PISA data suggests that MENA educators would be well-served to first ensure quality universal ECE provision for four-to-five-year-olds from low-income families, and carefully monitor the quality of programs before enrolling younger children.

We are mindful of the limits of these five findings. One cannot find definitive answers from a single data source, no matter how broad or well designed. The direction of causality, sample sizes, missing variables, and nonlinear relationships are all important issues. There are still many questions that need to be resolved through a thoughtful research agenda and longitudinal experimentation. That said, we believe that these five findings provide important insights into how students succeed. MENA educators should incorporate them into their school improvement programs to deliver the progress their students deserve □

introduction

Effective education is essential to forge economic productivity, address inequality, and prepare children for constructive citizenship. No wonder, then, that there is broad interest in understanding how to build school systems that serve everyone well regardless of background, and in determining how to improve systems that are not making the grade.

For the past decade, McKinsey has studied these issues. In 2007, we published *How the world's best-performing school systems come out on top*, which examined why some school systems consistently perform better than others. This report highlighted the importance of getting the right people to become teachers, developing their skills, and ensuring that the system is able to offer the best possible instruction to every child. In 2010, *How the world's most improved school systems keep getting better* explored what it takes to achieve significant and sustained performance improvement. This report defined poor, fair, good, great, and excellent systems (see the analytical appendix for more detail) and outlined what school systems need to do to progress from one performance level to the next[1] (Exhibit 1).

These two reports focused on interventions at the system level. In this report, we undertook a quantitative analysis at the student level. To do so, we applied advanced analytics and machine learning to develop insights from the world's deepest and broadest education data set, the Program for International Student Assessment (PISA), run by the Organisation for Economic Co-operation and Development (OECD).

EXHIBIT 01: OUR 2010 REPORT OUTLINED WHAT INTERVENTIONS ARE REQUIRED AT EACH STAGE OF THE SCHOOL SYSTEM IMPROVEMENT JOURNEY

IMPROVEMENT JOURNEY	POOR TO FAIR	FAIR TO GOOD	GOOD TO GRANT	GREAT TO EXCELLENT
THEME	Achieving the basics of literacy and numeracy	Getting the foundations in place	Shaping the professional	Improving through peers and innovation
INTERVENTION CLUSTER	• **Providing motivation and scaffolding for low-skill teachers** – Scripted teaching materials – External coaches – Instructional time on task – School visits by center – Incentives for high performance • **Getting all schools to a minimum quality level** – Outcome targets – Additional support for low performing schools – School infrastructure improvement – Provision of textbooks • **Getting students in seats** – Expand school seats – Fulfill students' basic needs in order to raise attendance	• **Data and accountability foundation** – Transparency to schools and/or public on school performance – School inspections and inspections institutions • **Financial and organizational foundation** – Optimization of school and teacher volumes – Decentralizing financial and administrative rights – Increasing funding – Funding allocation model – Organizational redesign **Pedagogical foundation** – School model/ streaming – Language of instruction	• **Raising caliber of entering teachers and principals** – Recruiting programs – Preservice training – Certification requirements **Raising caliber of existing teachers and principals** – In-service training programs – Coaches – Career tracks – Teacher and community forums **School-based decision making** – Self-evaluation – Independent and specialized schools	• **Cultivating peer-led learning for teachers and principals** – Collaborative practice – Decentralizing pedagogical rights to schools and teachers – Rotation and secondment programs • **Creating additional support mechanisms for professionals** – Release professionals from administrative burden by providing additional administrative staff • **System-sponsored experimentation/ innovation across schools** – Providing additional funding for innovation – Sharing innovation from frontline to all schools
COMMON ACROSS ALL JOURNEYS	Six interventions: [1] Revising curriculum and standards; [2] Reviewing reward and remunerations structure; [3] Building technical skills; [4] Assessing students; [5] Utilizing student learning data, and [6] Establishing policy documents and education laws			

EXHIBIT 02: PISA IS A RICH SET OF ASSESSMENT AND SURVEY DATA

OECD PISA test performance + survey data

72	18,000	140,000	110,000	540,000
countries[1]	schools	parents	teachers	students
3	**~270**	**~150**	**~250**	**~770**
subjects	school variables	parent variables	teacher variables	student variables
• Math • Science • Reading	E.g., • Size • Resources • Governance and autonomy • Extra-curriculars	E.g., • Education • Income • Employment • Attitudes to school and education	E.g., • Experience • Certification • Professional development • Teaching strategies • Assessment strategies	E.g., • Attitude to study and learning • Growth mindset • Problem solving approach • Repeated grade • Economic and social status

Linked over time through mapping of variables across 2003-2006-2009-2012-2015
1 Report excludes Albania as it was not possible to match test and survey data, includes Argentina, Kazakhstan and Malaysia despite sampling concerns as our analysis examines drivers at the student level rather than country-level comparisons

Begun in 2000 and repeated every three years since, PISA examines 15-year-olds on applied mathematics, reading, and science. The most recent assessment, in 2015, covered nearly 540,000 students in 72 countries[2]. PISA test-takers also answer a rich set of attitudinal questions; students, teachers, parents, and principals completed surveys that provided information on home environment, economic status, student mindsets and behaviors, school resources and leadership, teaching practices, teacher background, and professional development (Exhibit 2). The 2015 PISA focused on scientific performance, with half of the student assessment related to science, and the other half split between reading and math.[3] The survey questions therefore largely addressed science teaching and learning.

Standardized tests have their shortcomings. They cannot measure important soft skills or nonacademic outcomes, and they are subject to teaching to the test and gaming the system. Even so, we believe that PISA provides powerful insights on global student performance, especially because it aims to test the understanding and application of ideas, rather than facts derived from rote memorization.

In this report, we examine educational performance in the Middle East and North Africa (MENA). For the purposes of this work, this comprises six countries in three subregions that took the PISA test in 2015: two members of the Gulf Cooperation Council (the United Arab Emirates and Qatar), two countries from North Africa (Algeria and Tunisia), and two countries from the Levant (Jordan and Lebanon). We

are aware that the surveyed countries may not be precisely representative of all countries in their cohort, but we believe that the results are broadly relevant. There are some commonalities across all six MENA countries; there are also clear trends and similarities within the three subregions.

While we concentrate on the 2015 PISA results, we also consider previous ones, using a range of traditional and advanced analytical techniques. First, we used a supervised machine learning and feature discovery tool that identified variables and groups of variables that were most predictive of student performance. We then applied more traditional descriptive and statistical analyses to factors that were shown to be most important in contributing to students' PISA performance. (For more, see the analytical appendix at the end of the report).

We looked not only at macro-performance, but also at how patterns differed by the system performance levels outlined in our 2010 report, and by students' economic, social, and cultural status (or ESCS; see the analytical appendix for an explanation). Our research resulted in five key findings regarding mindsets, teaching practices, information technology, duration of classroom instruction, and early childhood education. These findings emerged as both highly predictive of student performance and potentially responsive to school system interventions, and therefore should be subject to further exploration.

In what follows, we examine the performance of the MENA countries; then discuss each of the five findings, before suggesting possible implications for school systems. Our intention is to offer insights that policymakers and practitioners can use to design and deliver improvements □

setting the context:

Educational performance in the Middle East and North Africa

Educational performance can be measured in terms of overall quality (absolute scores), cost-effectiveness (performance per dollar spent) and equity (differences in performance between boys and girls, and among different economic and ethnic groups).

In terms of overall quality, MENA's PISA scores are well below the OECD average in math, reading, and science (Exhibit 3).

EXHIBIT 03: MENA'S PISA SCORES ARE BELOW THE OECD AVERAGE IN ALL SUBJECTS

PISA score 2015

Science 2015

Rank	Country	Mean
1	Singapore	556
2	Japan	538
3	Estonia	534
4	Taiwan	532
5	Finland	531
	OECD	**493**
45	Malaysia	443
46	**UAE**	**437**
56	**Qatar**	**418**
61	**Jordan**	**409**
65	**Lebanon**	**386**
66	**Tunisia**	**386**
67	FYROM[1]	384
68	Kosovo	378
69	**Algeria**	**376**
70	Dominican Republic	332

Reading 2015

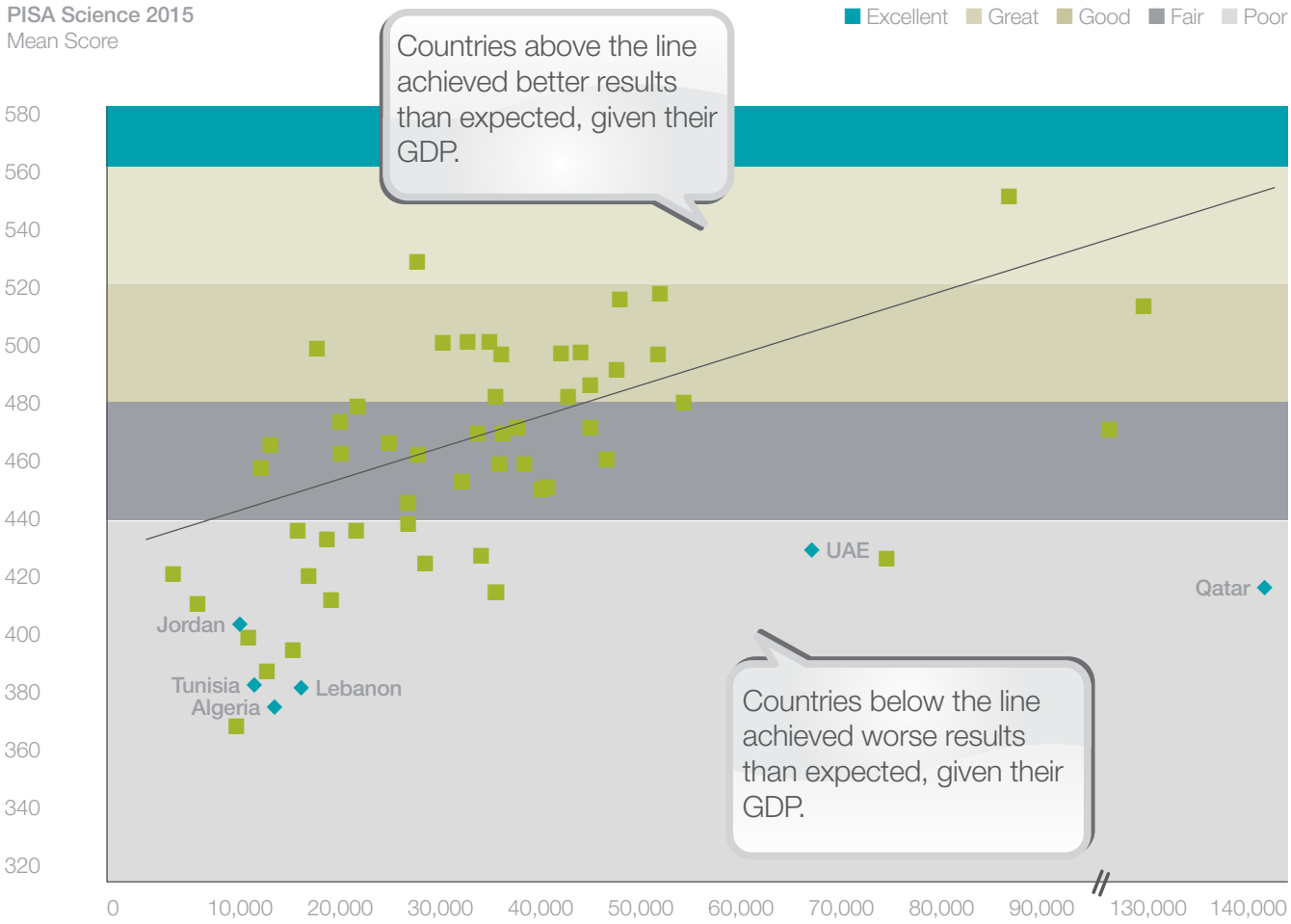
Rank	Country	Mean
1	Singapore	535
2	Hong Kong (China)	527
3	Canada	527
4	Finland	526
5	Ireland	521
	OECD	**493**
45	Uruguay	435
47	**UAE**	**434**
58	**Jordan**	**408**
61	**Qatar**	**402**
65	**Tunisia**	**361**
66	Dominican Republic	358
67	FYROM[1]	352
68	**Algeria**	**350**
69	Kosovo	347
70	**Lebanon**	**347**

Math 2015

Rank	Country	Mean
1	Singapore	564
2	Hong Kong (China)	548
3	Macao (China)	544
4	Taiwan	542
5	Japan	532
	OECD	**490**
45	Bulgaria	446
47	**UAE**	**427**
58	**Qatar**	**402**
60	**Lebanon**	**396**
64	**Jordan**	**380**
66	FYROM[1]	371
67	**Tunisia**	**367**
68	Kosova	362
69	**Algeria**	**360**
70	Dominican Republic	328

1 Former Yugoslav Republic of Macedonia
Source: PISA 2015

EXHIBIT 04: MENA COUNTRIES PERFORM WORSE THAN EXPECTED GIVEN THEIR GDP PER CAPITA

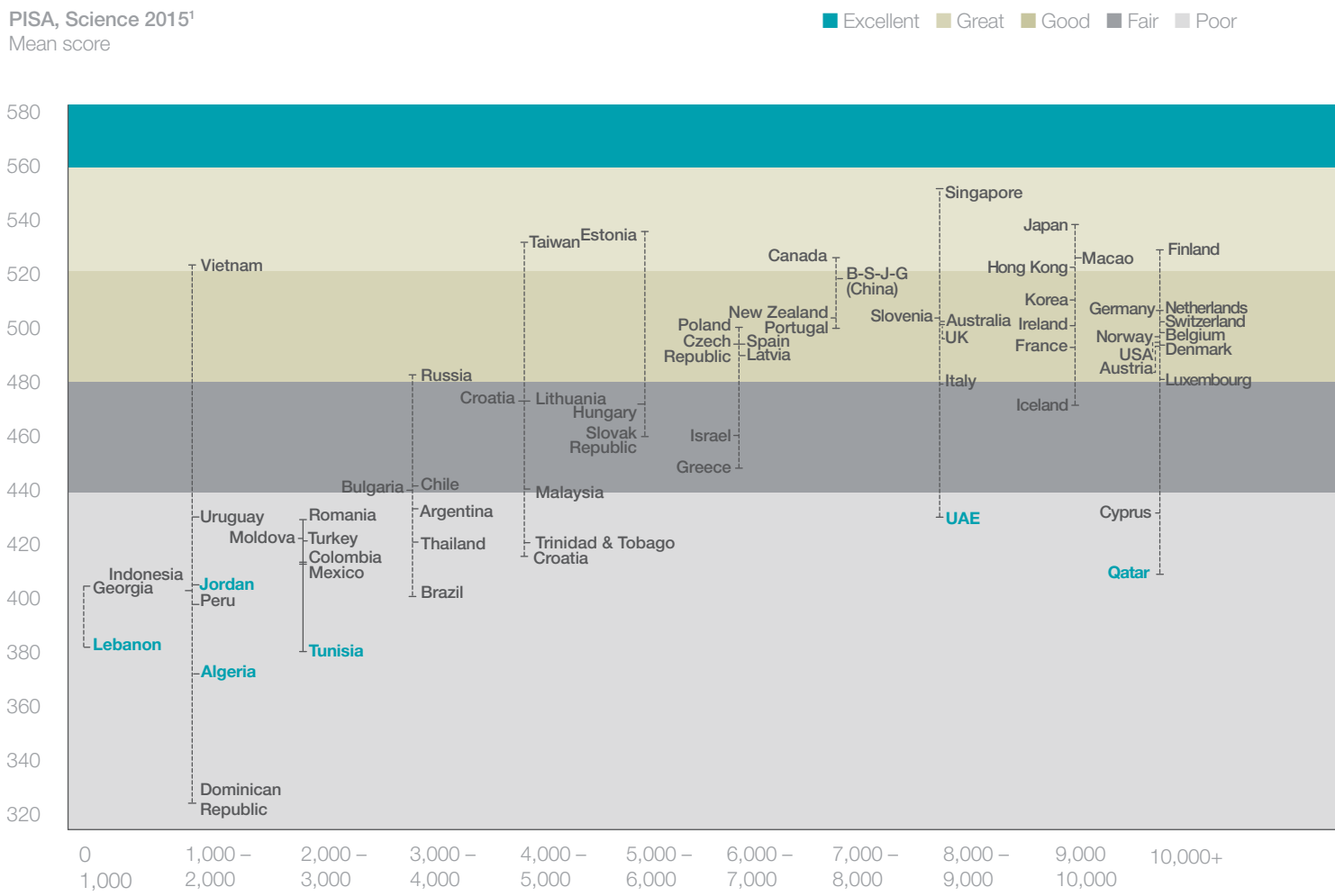


Source: PISA 2015

Even when considered against peers with a similar level of GDP and education spending, MENA countries do not perform well, suggesting low levels of cost-effectiveness (Exhibits 4 and 5).

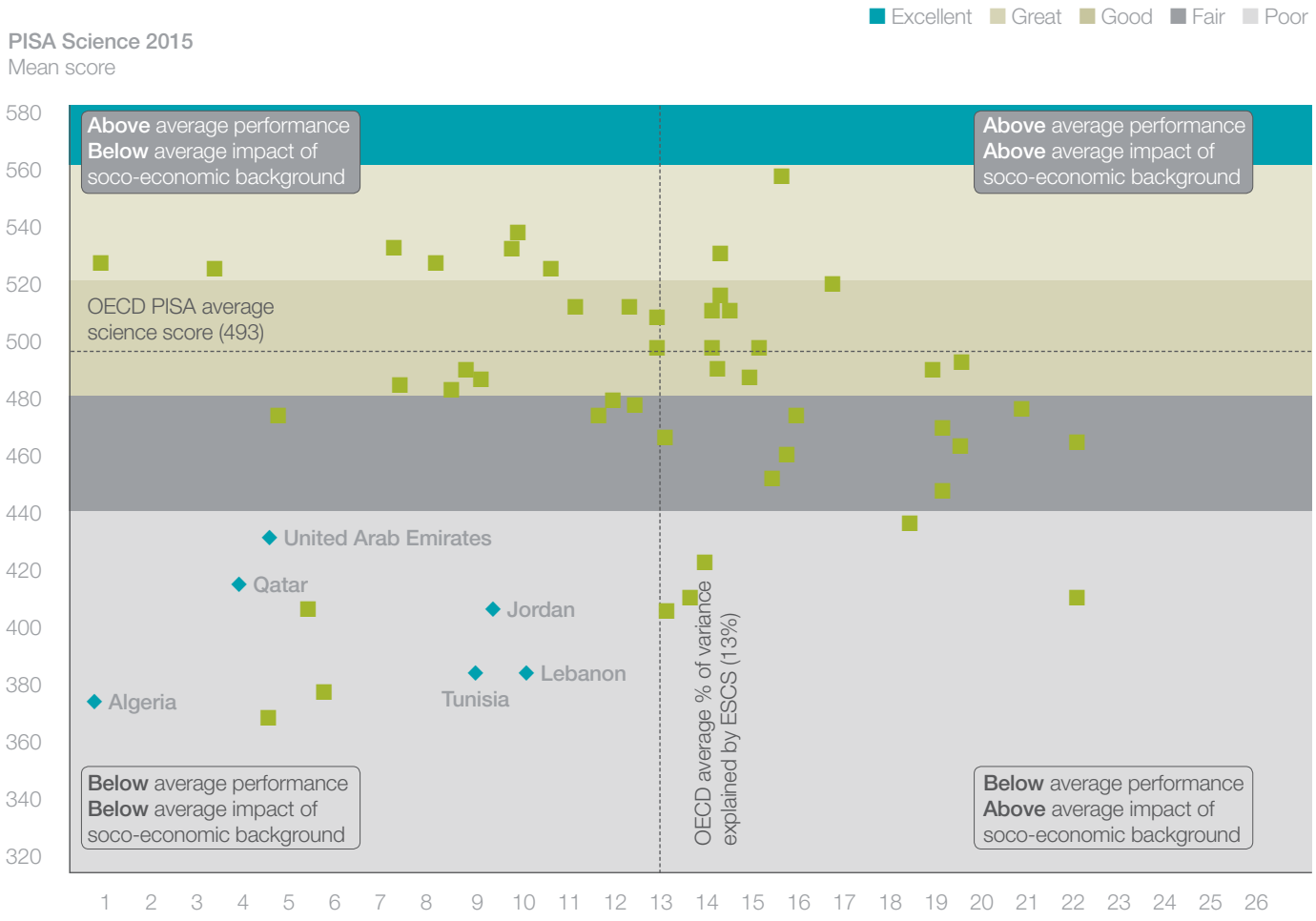
EXHIBIT 05: OTHER COUNTRIES AND REGIONS ACHIEVE BETTER RESULTS AT SIMILAR LEVELS OF SPENDING

PISA, Science 2015[1]
Mean score



1 If 2015 unavailable, most recent year used.
Source: World Bank EdStats; IMF; UNESCO; PISA, Global Insight; McKinsey & Company

EXHIBIT 06: SOCIOECONOMIC STATUS HAS LESS EFFECT ON SCORES IN MENA THAN IN MOST OTHER COUNTRIES.



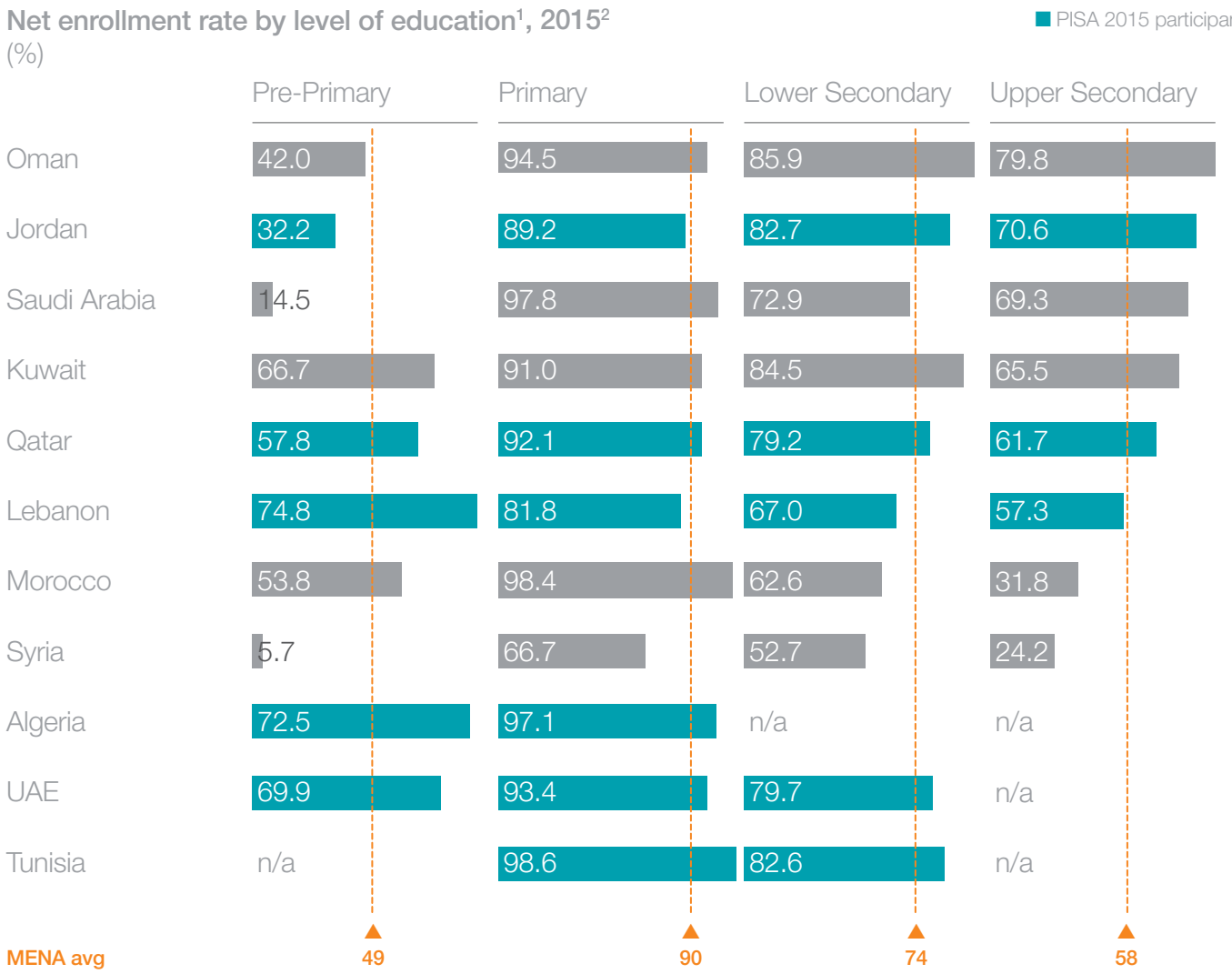
Source: PISA 2015

In terms of educational equity, the results are better: in all six MENA countries, students' socioeconomic background has less effect on performance than the global average (Exhibit 6).

Enrollment data from UNESCO highlights several challenges for the region. At the pre-primary level, enrollment rates in MENA vary widely, suggesting there is significant opportunity for expansion. Except for Syria and Lebanon, both of them greatly affected by conflict, countries in the region have achieved primary-school enrollment of 90 percent or more. At the secondary level, the picture is mixed. Even rich countries such as the UAE and Kuwait report only about two-thirds of students enrolled in upper secondary school (Exhibit 7). Encouraging more children to stay in school for longer is therefore part of the challenge for educators in the region.

EXHIBIT 07: ENROLLMENT AND COMPLETION IS A CHALLENGE FOR MANY MENA COUNTRIES, ESPECIALLY AT THE UPPER SECONDARY LEVEL.

Net enrollment rate by level of education[1], 2015[2]
(%)

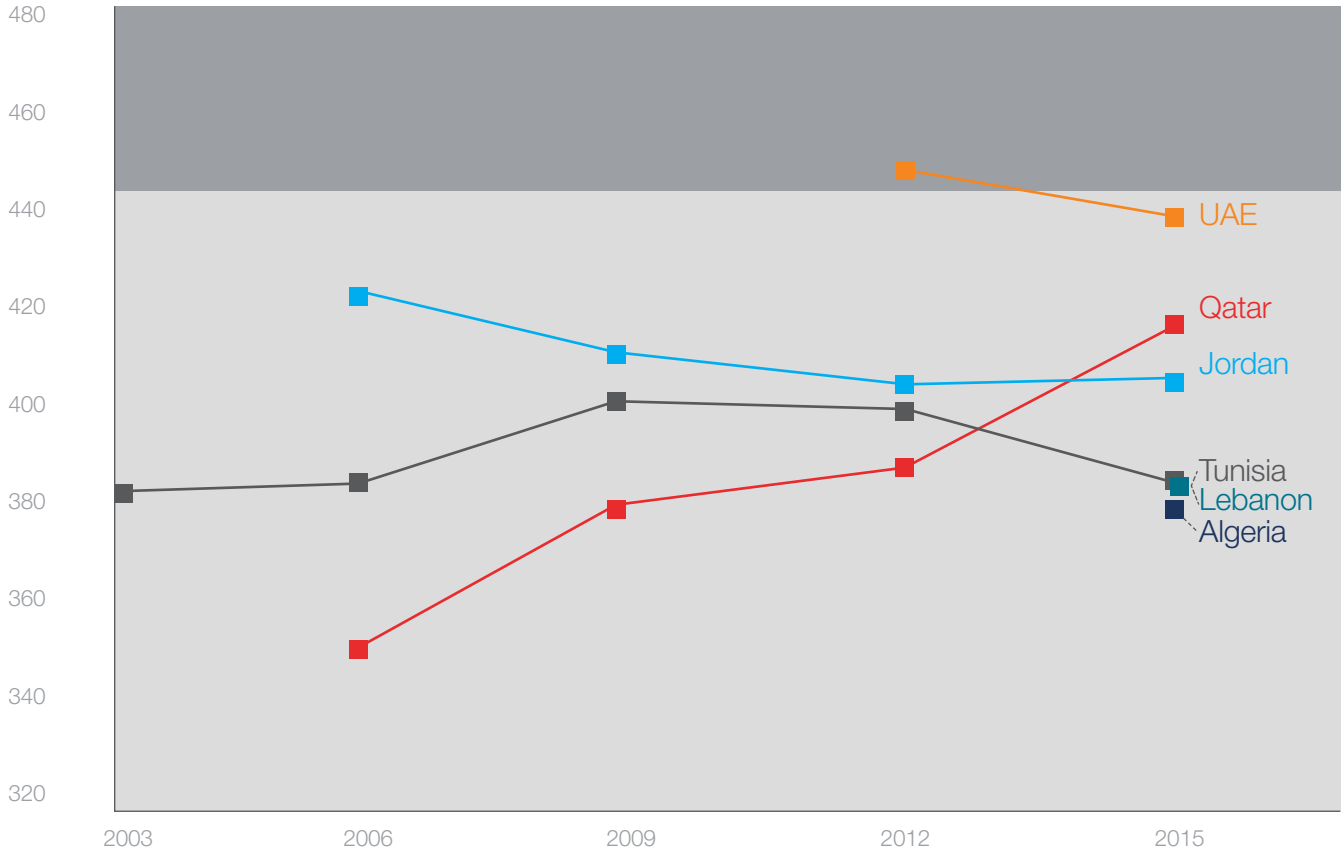


1 Levels defined according to International Standard Classification of Education (ISCED); pre-primary level 0 includes preschool and kindergarten programs; primary level 1 begins ages ~5–7 years, continues 4–6 years; lower secondary level 2 begins ~ age 11, equivalent of intermediate school, middle school, or junior high school; upper secondary level 3 includes general (academic), technical, and vocational education, equivalent of senior high school.
2 If 2015 data unavailable, latest available data used; UNESCO data used for cross-country comparability but data not available for all MENA countries.
Source: UNESCO

A number of MENA countries have worked to improve their educational performance. Many reform efforts have focused on improving the recruitment and training of teachers. Several countries have overhauled their primary and secondary-level curriculums and expanded early childhood education. There has also been increased spending on technology and infrastructure.

EXHIBIT 08: QATAR IS THE ONLY MENA COUNTRY WITH SIGNIFICANT IMPROVEMENTS IN PISA SCIENCE SCORE SINCE 2006

PISA Science 2015 Mean score



Source: PISA 2003–15

There are both region-specific challenges and important subregional differences. The two GCC systems that PISA surveyed have large numbers of expatriate children who attend private schools that offer a range of international curricula; an increasing number of nationals are shifting to this option. At the other end of the spectrum, Jordan and Lebanon are dealing with the influx of Syrian children displaced by civil war. Across MENA, each country has to decide what approach to take regarding the language of instruction—whether it should be in Arabic as well as French and/or English.

Conditions and experiences in MENA vary so widely that generalizations are difficult. What we can say, however, is that achievement has been flat, with one exception: in the 2015 PISA, Qatar showed significant improvement since 2006 (Exhibit 8). Qatar's science score rose 20 percent, from 349 PISA points in 2006 to 418 in 2015—a noteworthy improvement over that period.

Two factors go far to explain Qatar's improvement. First, the immigrant population quadrupled between 2006 and 2015.[4] This matters because children of immigrants outscored native-born Qataris by 25 percent in both 2006 and 2015. Excluding their results, Qatar's 2015 PISA science score would have improved to 400 rather than 418. Second, there has been a shift in the mix of students attending private schools. Public schools in Qatar improved their scores 6 percent while private schools improved 14 percent; this is significant because the share of PISA test takers in private schools went from 7 percent to 34 percent. If these two factors had stayed the same as in 2006, Qatar's score would have improved 13 percent rather than 20 percent. That said, Qatar's system is still defined as "poor" and has some way to go to improve to "fair," which is defined as a score of 440 and above.

In terms of equity, Qatar has gone in the opposite direction: the gap in performance between the highest-quartile socioeconomic students and the lowest has grown since 2006. In Jordan and Tunisia, it narrowed (Exhibit 9). (The other three MENA countries surveyed did not participate in PISA in 2006).

This, then, is where MENA stands. The question is how these countries can do better faster in terms of both performance and equity. For school systems in the poor and fair stages of improvement—meaning all six MENA countries surveyed—our 2010 report defined three priorities: enrolling students, getting all schools to a minimum quality level, and providing motivation and training for low-skilled teachers. We also highlighted six interventions that are important at every stage: revising curriculum and standards; reviewing reward and

EXHIBIT 09: THE EQUITY GAP HAS WIDENED IN QATAR, AND NARROWED IN JORDAN AND TUNISIA

Equity gap in science scores, 2006 and 2015

% difference between scores of highest and lowest socioeconomic status students[1]

1 Only Jordan, Qatar and Tunisia took the PISA assessment in both 2006 and 2015 Low socioeconomic students = PISA ESCS Quartile 1; High socioeconomic students = PISA ESCS Quartile 4
Source: PISA 2006 and 2015

remunerations structure; building technical skills; assessing students; using student learning data, and establishing policy documents and education laws.

Our analysis of the PISA findings delve deeper into some of these system priorities, and add new insights gained from the student-level analysis: what mindsets are most beneficial for students? What does great teaching look like? How can technology help? How long should the school day be? When should education begin?

We believe the following five findings, which complement the interventions outlined in the 2010 report, are part of the answer □

Finding 1: Student mindsets have triple the effect of socioeconomic background on PISA outcomes

The role of mindsets in educational achievement is a nascent but intriguing field of study. In her 2006 book, *Mindset: The New Psychology of Success*, Carol S. Dweck argued that individuals with "growth mindsets"—that is, those who believed that their success was due to hard work and learning—were more resilient and likely to be motivated to succeed than those with "fixed mindsets"—those who believed that their innate abilities were static and could not be developed. Dweck also argued that growth mindsets could be taught. A large-scale 2016 Stanford University study of all tenth graders in Chile—the largest to date—found that having a strong growth mindset rivals socioeconomic status in predicting achievement, and that low-income students with strong growth mindsets were able to achieve at the same level as high-income students with fixed mindsets.[5]

In 2016, psychologist Angela Duckworth highlighted the importance of "grit" as a predictor of performance in *Grit: The Power of Passion and Perseverance*. Others have explored the role of broader character traits like perseverance, curiosity, conscientiousness, optimism, and self-control in children's success. Other researchers, however, have questioned both the magnitude of the effect, and the usefulness of interventions in this area.[6]

We had three objectives in reviewing the role of mindsets: to quantify the effect of mindsets on student performance; to assess which mindsets matter most; and to understand which types of schools and students benefit the most from certain mindsets.

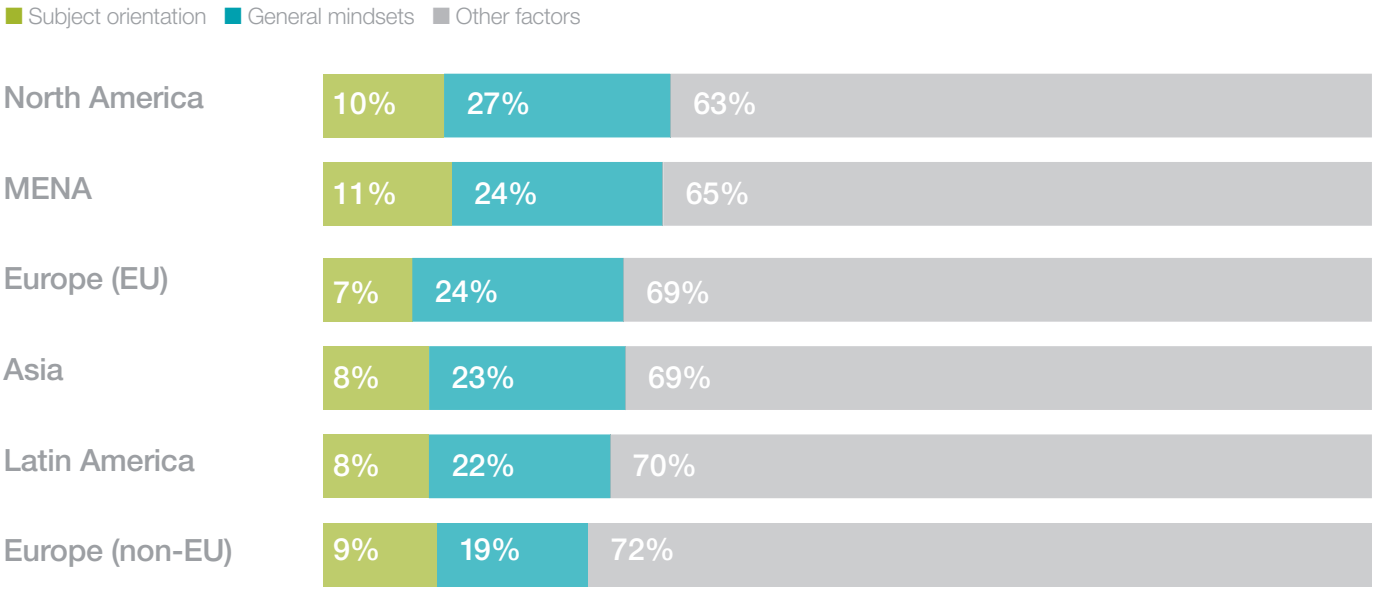
To quantify the effect of mindsets, we sorted the 100 most predictive variables (see the analytical appendix for more detail) emerging from the PISA surveys into several categories: mindset factors, home environment (including socioeconomic status), school factors, teacher factors, student behaviors, and others.[7] We separated mindsets into two types: "subject orientation" and "general mindsets." Subject orientation refers to a measure of a student's attitudes about science as a discipline (science, specifically, because that was the focus of the 2015 PISA). General mindsets refer to a student's broader sense of belonging, motivation, and expectations.

To be conservative, we excluded from the analysis variables where we believed the direction of causality was largely from score-to-mindset rather than from mindset-to-score. For example, we judged that students' academic performance was more likely to influence their future educational expectations (whether they will complete college) than the other way around, and thus excluded this variable from our model.

We then determined how influential each category was in terms of predicting student performance. Our conclusion: more than a third of the ability to predict a MENA student's score from survey questions came from mindset factors.[8] In global terms, only North America was that high; in all other regions, the figure was around 30 percent (Exhibit 10).

EXHIBIT 10: MINDSETS PLAY A SIGNIFICANT ROLE IN STUDENT OUTCOMES IN ALL REGIONS.

Factors driving student PISA science scores, 2015[1]
% of predictive power by catagory of variable



1 Numbers may not add up to 100 due to rounding
2 2015 mindsets data available for Qatar, Tunisia, and UAE only
Source: OECD PISA 2015, McKinsey analysis

Examples of subject orientation mindsets:

"I have fun learning science.

I am interested in the universe and its history.

Air pollution will get worse over the next 20 years."

Examples of general mindsets:

"I see myself as an ambitious person.

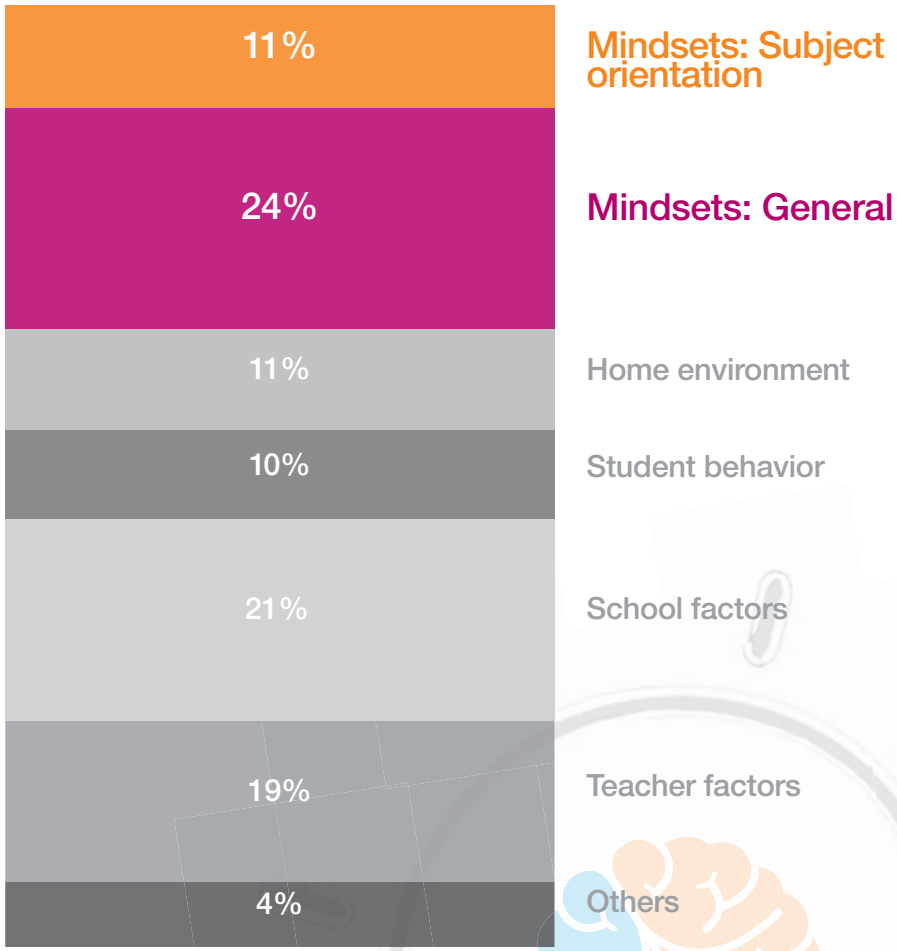
What I learn in school will help get me a job.

If I put in enough effort, I can succeed."

EXHIBIT 11:
MINDSETS ARE FAR MORE IMPORTANT THAN THE HOME ENVIRONMENT IN PREDICTING STUDENT ACHIEVEMENT[9]

Factors in MENA students' PISA science performance, 2015

% of predictive power by category of variable



Source: OECD PISA 2015, McKinsey analysis

Controlling for all other factors, student mindsets in the MENA countries surveyed were more than three times as powerful (at 35 percent of total predictive power) as the home environment, and almost as much as all school and teacher factors combined. Furthermore, general mindsets accounted for two-thirds of the effect found (Exhibit 11 and 12).

EXHIBIT 12: GUIDE TO MINDSETS TESTED

Motivation calibration

The ability to identify what motivation looks like in day-to-day life For example: “preparing for class”, “doing more than expected”, and working on tasks until everything is perfect”

Motivation

Self-identifying as motivated For example: “wanting to be the best” and “wanting to get top grades”

Instrumental motivation

Believing what you learn in school is relevant to your future career For example: “this will help me in the work I want to do later” and “what I learn will help me get a job”

Sense of belonging

Feeling a sense of belonging at school For example: “Making friends easily” and NOT “feeling lonely at school” or “feeling awkward and out of place at school”

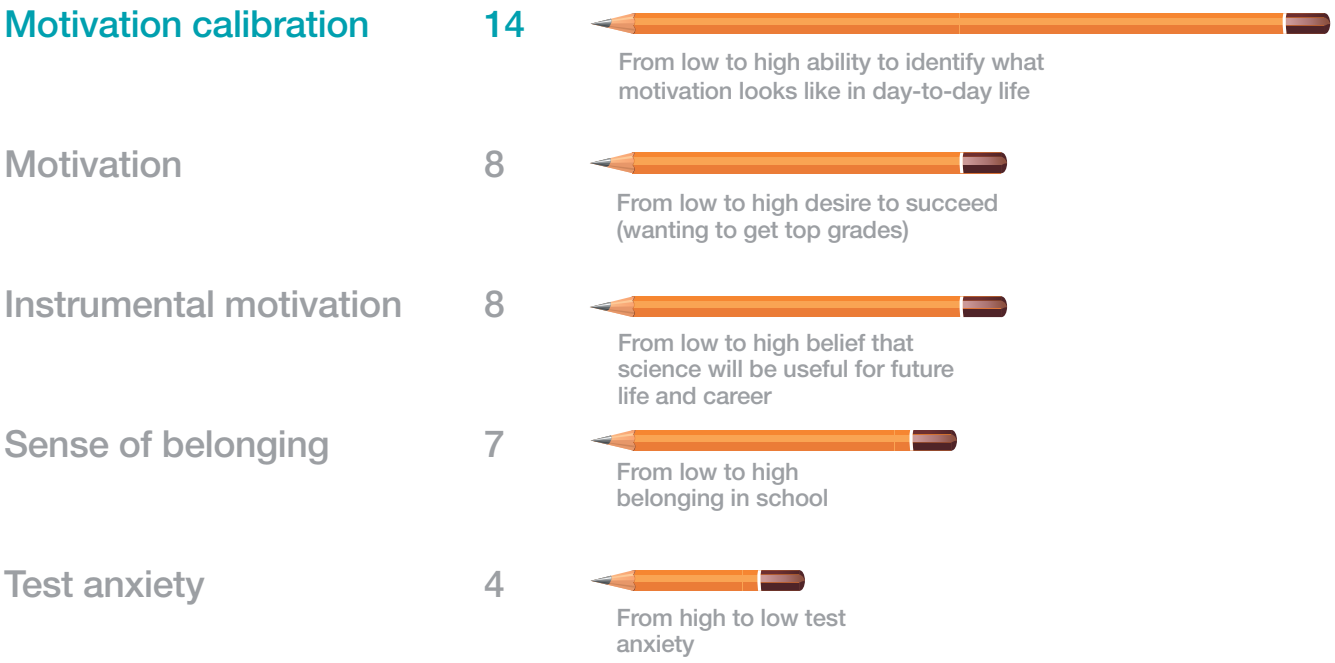
Test anxiety

Feeling anxious about schoolwork and testing For example: “worrying I will get poor grades” and “getting tense when I study for a test”

Source: OECD PISA 2015, McKinsey analysis

EXHIBIT 13: WHAT MINDSETS MATTER MOST?

MENA score improvement for top general mindset measures[1]
Percent increase in PISA science score



1 Qatar, Tunisia, and UAE only (remaining MENA countries only took paper-based survey). Statistically significant in regression controlling for socioeconomic status, school type and location
Source: OECD PISA 2015, McKinsey analysis

In countries that completed the full assessment, several specific general mindsets emerged as most predictive of performance in 2015[10] (Exhibit 13).

"Motivation calibration"—defined as the ability of students to correctly assess what motivation looks like—was the single most predictive mindset. To measure this, in 2015, PISA asked test-takers to assess the motivation of three hypothetical students (Exhibit 14).

Based on the responses to these questions, we created an index of "motivation calibration" (see analytical appendix).[11] What we found was that simply understanding what motivation looks like in daily practice is a powerful performance indicator. Across MENA, students who have good motivation calibration score 14 percent (or 54 points) higher than poorly calibrated students. This relationship held even after controlling for socioeconomic status, location, and type of school.

EXHIBIT 14: WHAT IS MOTIVATION CALIBRATION?

Student evaluation of the motivation of other students: "Is the following student motivated?"

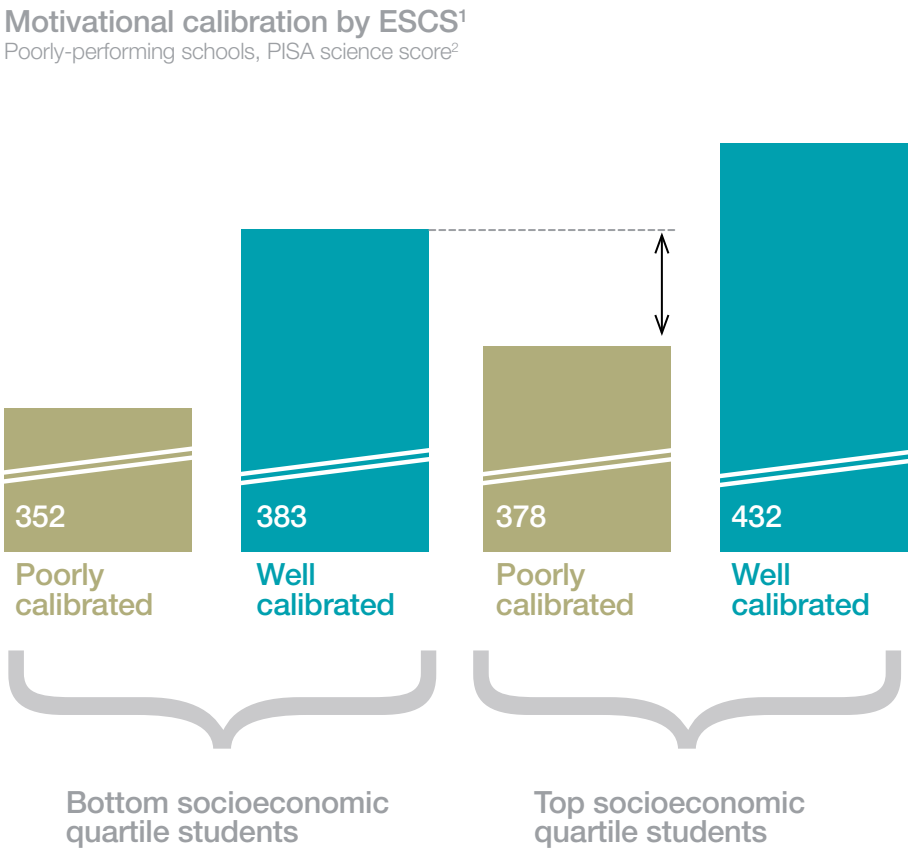
Sara
Gives up easily when confronted with a problem and is often not prepared for class.

Ahmed
Mostly remains interested in the tasks he starts and sometimes does more than what is expected from him.

Yasmin
Wants to get top grades at school and continues working on tasks until everything is perfect.

Source: OECD PISA 2015, McKinsey analysis

EXHIBIT 15: HAVING A WELL-CALIBRATED MOTIVATION MINDSET IS EQUIVALENT TO LEAPFROGGING INTO A HIGHER SOCIOECONOMIC QUARTILE



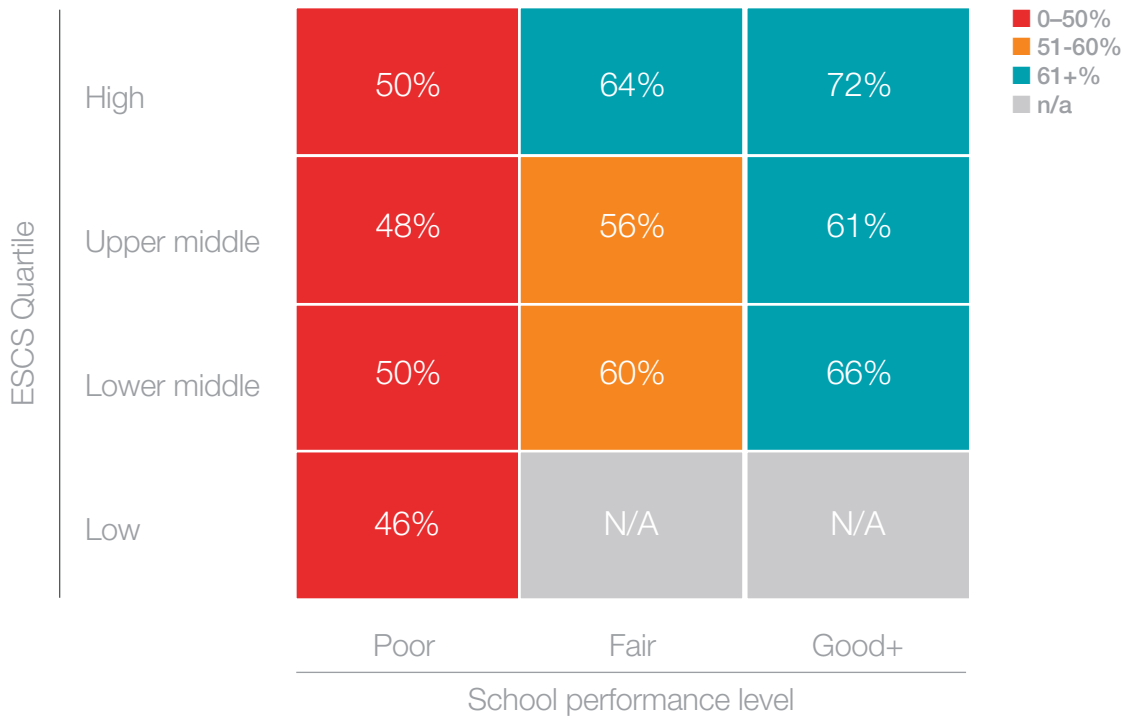
1 PISA's index of economic, social and cultural status.
2 Qatar, Tunisia, UAE only.
Source: OECD PISA 2015, McKinsey analysis

In contrast, students who self-identified as "wanting to be the best and wanting top grades" scored just 8 percent higher than those who did not. Why is this the case? Our hypothesis is that students are more likely to be honest when talking about a third person versus directly assessing their own motivation, and that calibration itself is important. Students cannot exhibit positive behaviors if they do not know what they look like. Calibrating to a norm helps to improve students' actual study habits. The relationship between motivation calibration and performance is particularly strong for students in poorly performing schools (nearly 90 percent of all MENA students).

Improving motivation calibration can also help to narrow the equity gap. Within poorly performing schools students in the lowest socioeconomic status quartile who are well calibrated perform better than those in the highest socioeconomic status quartile who are poorly calibrated (Exhibit 15).

EXHIBIT 16: POOR STUDENTS IN POORLY PERFORMING SCHOOLS ALSO TEND TO HAVE POOR MOTIVATION CALIBRATION.

Percent of MENA students with well-calibrated motivation[1]



1 Qatar, Tunisia, UAE only.
Source: OECD PISA 2015, McKinsey analysis

Unfortunately, the students who need good calibration the most are the least likely to have it; only 46 percent of low socioeconomic status students in poorly-performing schools compared to 72 percent of high-status students in good schools (Exhibit 16).

These mindset findings were consistent with those of previous PISA tests. In 2012, for example, PISA asked respondents from the UAE, Jordan, Qatar, and Tunisia a series of questions about growth versus fixed mindsets.[12] Specifically, students answered questions about the extent to which they agreed that their academic results are fixed ("I do badly whether or not I study") or could be changed through personal effort ("If I put in enough effort, I can succeed").

Students with a strong growth mindset outperformed students with a fixed mindset by 17 percent. Growth mindsets were particularly predictive for students in poorly performing schools, and those in

GCC spotlight

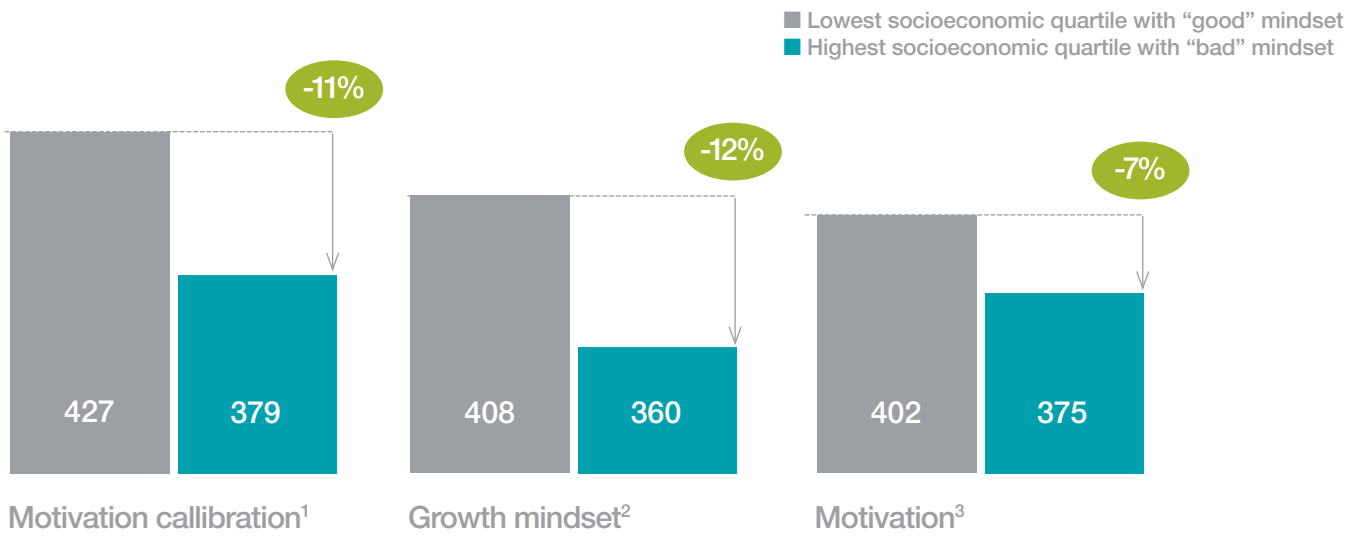
In the UAE and Qatar, the two GCC countries that took PISA, mindsets appear to be particularly important. In 2012, students in those countries with a strong growth mindset outperformed fixed-mindset peers by 22 percent (versus 13 percent for Tunisia and 18 percent for Jordan, the other MENA countries that had enough mindset data to evaluate). In 2015, students in these GCC countries with strong motivation calibration outperformed students with poor calibration by 21 percent (versus 10 percent for Tunisia).

In the two GCC countries, the "leapfrog effect" is apparent for the mindsets of motivation calibration, self-identified motivation and growth mindset. That is, students in the lowest socioeconomic quartile with these positive mindsets outperform those in the highest quartile with negatives ones (Exhibit 17). Given the importance of mindsets on outcomes, we estimated how scores might change if the 46 percent of GCC students with low motivation calibration could be shifted to a well-calibrated mindset. Assuming that the relationship between mindsets and scores held, we estimate that scores would rise 8.5 percent.

Interestingly, the prevalence and impact of mindsets differ substantially between native-born students versus first- and second-generation immigrants, who make up a large share of the student population in both the UAE and Qatar. Native-born students are far less likely to have a good motivation calibration mindset—46 percent compared to 61 percent of first-generation immigrants. Native-born students are also less likely to have strong instrumental motivation, sense of belonging, and self-identified motivation, and are more likely to experience test anxiety. They are, however, more likely to expect that they will complete post-secondary education. Switching to a more positive mindset has more impact for native-born students, suggesting high potential for well-crafted interventions.

EXHIBIT 17: POSITIVE MINDSETS ENABLE LOW SOCIOECONOMIC STATUS STUDENTS TO OUTPERFORM HIGHER SOCIOECONOMIC STATUS STUDENTS

PISA science scores for GCC by mindset and socioeconomic quartile
(Poor and fair performing schools)



1 "2015 PISA; Good" mindset is high motivation calibration; "bad" mindset is low motivation calibration 2 2012 PISA; "Good" mindset is a strong growth mindset; "bad" mindset is fixed mindset 3 2015 PISA; "Good mindset is high motivation (desire to achieve good grades and be top of class", "bad" is low motivation
Source: OECD PISA 2012, McKinsey analysis

lower socioeconomic quartiles.[13] However, students in poor-performing schools were less likely to have a strong growth mindset, with only 24 percent of them having a strong growth mindset compared with 32 percent of students in excellent and great schools.

Mindsets alone cannot overcome economic and social barriers. This research does suggest, however, that they are a powerful predictor of student outcomes, particularly for those living in the most challenging circumstances. The question is what, if anything, can be done to improve them at a system-wide level.

Research is being done to answer that question—albeit much of it focused on the United States—and there are promising indications that it may be possible for schools to make effective interventions. For example, on growth mindsets, a 2015 study of 1,500 secondary-school students in 13 different

How do mindsets vary between boys and girls in MENA?

In four of the six MENA countries girls have a higher mean science score than boys. Only in Tunisia and Lebanon do boys outperform girls, and then only marginally. In the GCC countries that took PISA, girls mean science score was 23 to 26 points higher than boys. Globally on average boys score four PISA points higher than girls. What is going wrong for boys in MENA?

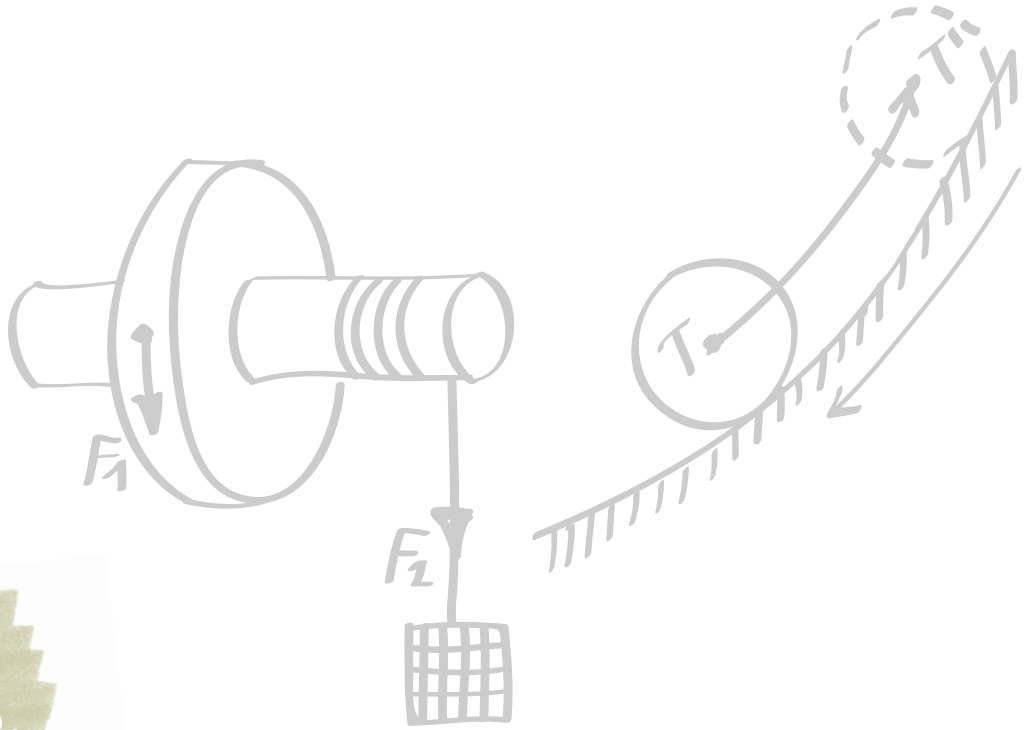
Mindsets may well be part of the answer. Looking specifically at the predictive mindsets highlighted in this paper, girls in MENA are more likely to have beneficial mindsets than boys across all the motivation mindsets. Although girls in every region are more likely than boys to have strong motivation calibration, self-identified motivation and instrumental motivation, the gap between boys and girls is largest in MENA - about double that of other regions. Specifically of students who completed the mindset question, 58% of girls in MENA had strong motivation calibration versus just 44% of boys; 79% of girls versus 69% of boys had strong self-identified motivation; and 36% of girls versus 29% of boys had high instrumental motivation. For sense of belonging and joy in science the difference between MENA and other regions was even more stark. In all the other regions a greater proportion of boys than girls said they had a strong sense of belonging in school. MENA was the only region where more girls reported a strong sense of belonging to school than boys. Similarly more girls in MENA reported having a high joy in science than boys; a pattern reversed in most other regions. In fact the only mindset where boys showed more positive mindsets than girls in MENA was test and school-work related anxiety (with 48% of boys versus 62% of girls having high test anxiety) however even here the delta was smaller than in other regions (in North America for example 45% of boys and 69% of girls have high test anxiety).

What is encouraging for boys in the region is that they are equally if not more likely to benefit from positive mindsets. This suggests that educators in the region would be well served to pilot mindset interventions for all students, but perhaps especially for boys.

schools, rich and poor, from all over the United States, found that growth mindset and sense-of-purpose interventions delivered significant results. The researchers administered two 45-minute online modules to students over the course of a semester. The growth-mindset modules provided direct instruction on the physiological growth potential of the brain given hard work; they also guided students through writing exercises in which they summarized what they had learned, and coached a theoretical student who was losing confidence in his intelligence. In the sense-of-purpose module, students did a writing exercise on how they wished the world could be a better place; provided examples of why other students work hard; and finished with another writing exercise in which students explained how working hard could help them achieve their own goals. The results were positive: students at risk of dropping out of high school, who constituted a third of the sample, increased their grade point averages (GPA) in core academic courses by 0.13 to 0.18 (on a 4.0 scale), and their core course pass rates increased by 6.4 percent.[14]

Similarly, on motivation calibration, recent research suggests that metacognition and self-regulation strategies can improve student outcomes. Interventions to help students plan, monitor and evaluate their learning may be a promising way to improve student motivation and perseverance as they tackle challenging academic content.[15]

Such research is a work in progress, but these and other experiments indicate that harnessing the power of mindsets may be a promising way to support achievement—in addition, of course, to teaching the fundamentals. Academics and policy-makers should be encouraged to design, implement, and evaluate further interventions □



Finding 2: Students who receive a blend of inquiry-based and teacher-directed instruction have the best outcomes

Teachers matter. Multiple research reports, including our own, have demonstrated that high-performing school systems require effective teachers and teaching. To improve, systems must improve the capabilities of their teachers. Part of the challenge is to determine what teaching practices work, and how teachers can deliver high-quality instruction.

We evaluated two types of science instruction to understand the relationship between teaching styles and student outcomes. The first is "teacher-directed instruction" where the teacher explains and demonstrates scientific ideas, discusses student questions, and leads class discussions. The second is "inquiry-based teaching," where students play a more active role, creating their own questions, designing experiments to test their hypotheses, drawing conclusions, and relating learning to their experiences (Exhibit 18). There is active debate over which approach is preferable.

EXHIBIT 18: OECD PISA ASKED STUDENTS HOW OFTEN THEY EXPERIENCED CERTAIN TEACHING PRACTICES.

How often does this happen in your school science class…

Teacher-directed instruction

- The teacher explains scientific ideas.
- A whole class discussion takes place with the teacher.
- The teacher discusses our questions.
- The teacher demonstrates an idea.

Inquiry-based teaching

- Students are given opportunities to explain their ideas.
- Students spend time in the laboratory doing practical experiments.
- Students are required to argue about science questions.
- Students are asked to draw conclusions from an experiment.
- The teacher explains how science ideas can be applied.
- Students are allowed to design their own experiments.
- There is a class debate about investigations.
- The teacher explains the relevance of concepts to our lives.
- Students are asked to do an investigation to test ideas.

EXHIBIT 19: WHEN TEACHERS TAKE THE LEAD, PISA SCORES ARE HIGHER.

Impact of teacher-directed instruction

Average PISA science score with different amounts of teacher-directed instruction

1 Statistically significant in regression controlling for ESCS, public–private school, and urban–rural location. Numbers may not add to 100 due to rounding
Source: OECD PISA 2015, McKinsey analysis

Based on the PISA 2015 results, the more teacher-directed instruction, the higher the scores in all six MENA countries surveyed. Classrooms that never or hardly ever used teacher-directed methods score 11 percent lower than those in which it was dominant (Exhibit 19); the results were particularly striking in the two GCC countries surveyed.

EXHIBIT 20: INQUIRY-BASED INSTRUCTION DELIVERS MIXED RESULTS.

Impact of inquiry-based instruction
Average PISA science score with different amounts of inquiry-based instruction

1 Statistically significant in regression controlling for ESCS, public–private school, and urban–rural location. Numbers may not add to 100 due to rounding
Source: OECD PISA 2015, McKinsey analysis

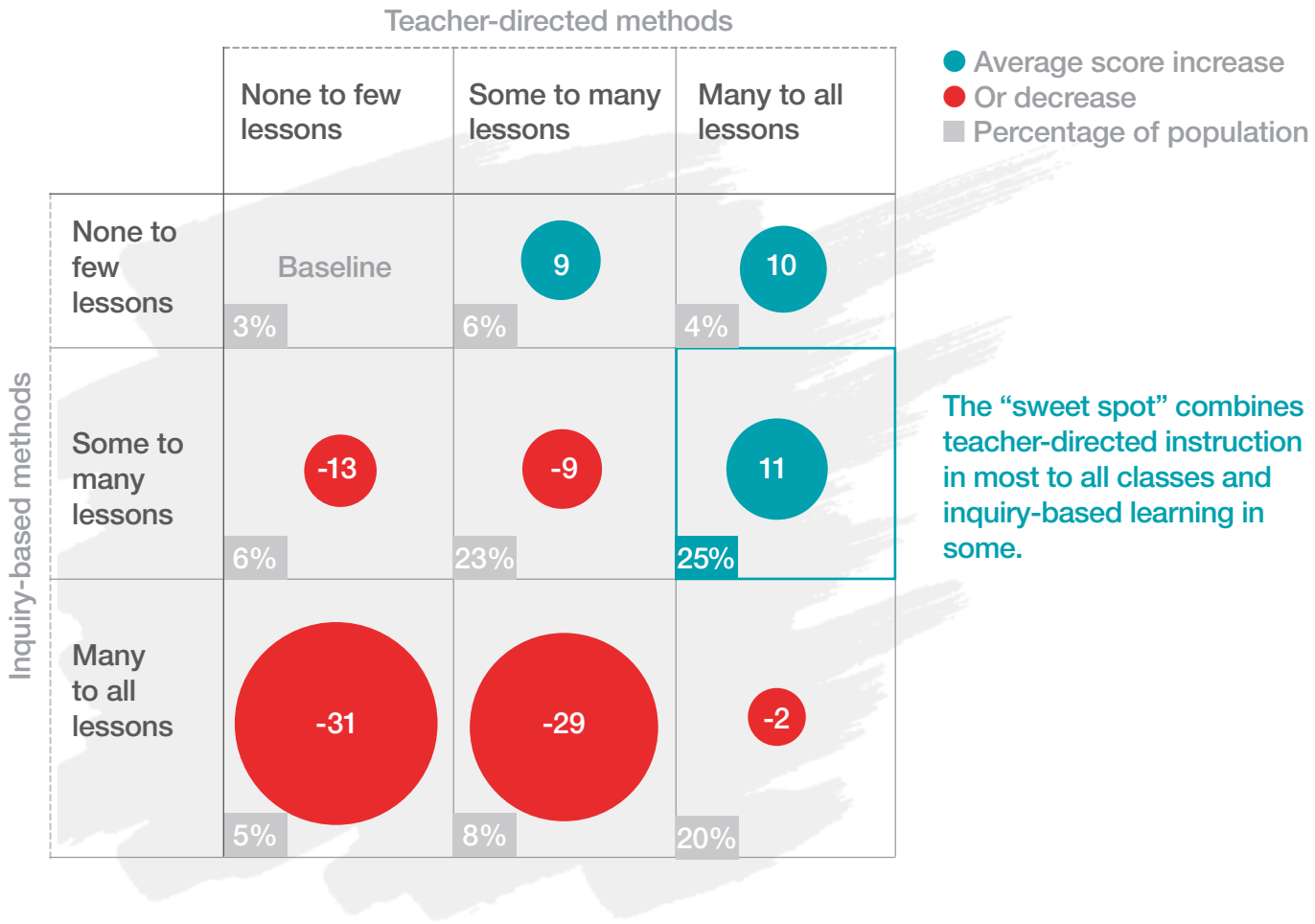
The picture for inquiry-based teaching is more complex. In all regions, PISA science scores initially rise with some inquiry-based teaching, but after a certain point, the more this method is used, the more scores fall (Exhibit 20).

At first blush, then, inquiry-based teaching looks like a less-effective choice. But when we dug into the data, we found a more interesting story. In an ideal world, there is a place for both: what matters is the interplay between the two types of teaching. Inquiry-based teaching can be effective—but only when strong teacher-directed instruction is in place. This suggests that teachers need to be able to explain scientific concepts clearly and students need to have content mastery to fully benefit from inquiry-based teaching.

Based on the PISA results, the most effective combination appears to be teacher-directed instruction in most or almost all classes, with inquiry-based teaching in some of them. MENA students who received this blend outperformed those who experienced high levels of inquiry-based teaching without a strong foundation of teacher-directed instruction by more than 40 PISA points (Exhibit 21). To put it another way, the more teacher-directed instruction there is, the better it supports inquiry-based teaching.

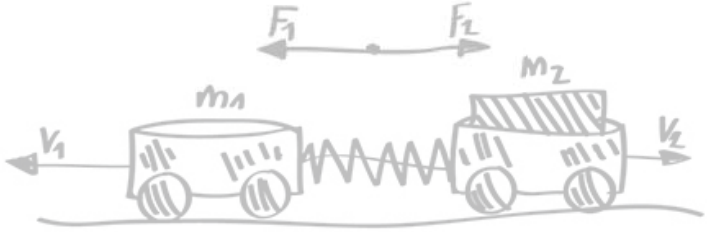
EXHIBIT 21: FINDING THE SWEET SPOT: THE BEST STUDENT OUTCOMES COMBINE BOTH TEACHING STYLES.

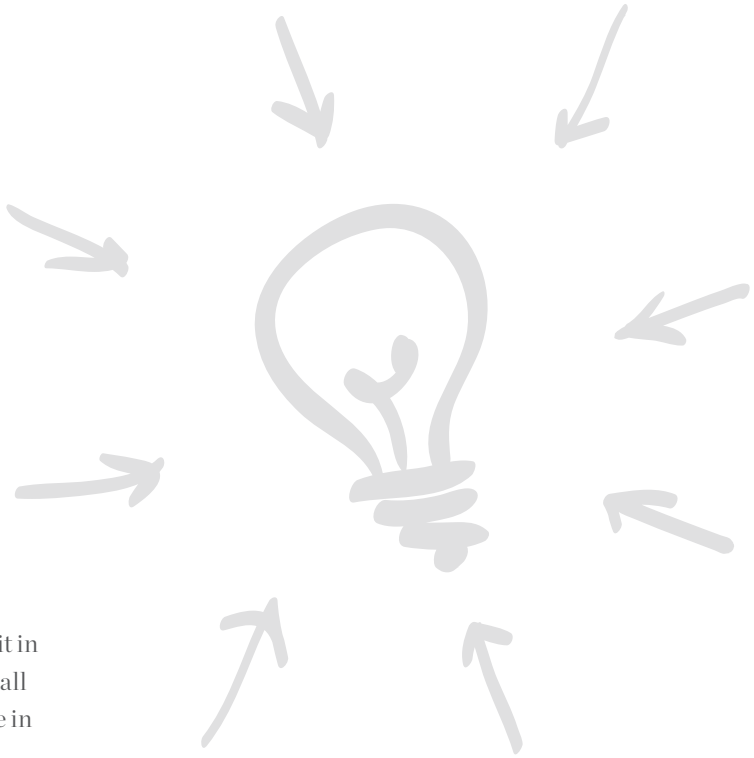
Average point change in PISA science score relative to baseline[1]



The "sweet spot" combines teacher-directed instruction in most to all classes and inquiry-based learning in some.

1 Statistically significant expected change in score controlling for ESCS, urban–rural location, and public–private school.
2 Numbers may not add to 100 due to rounding
Source: OECD PISA 2015, McKinsey analysis





In the six MENA countries studied, a quarter of students sit in the "sweet spot" of teacher-directed instruction in most to all classes, and inquiry-based teaching in some; 42 percent are in classrooms that appear to overuse inquiry-based methods.

The implication is that changing teaching practices would be broadly beneficial. Indeed, if the MENA countries surveyed could move all their students into the sweet spot, we estimate their PISA science scores would improve 3.6 percent (or 14 points), equivalent to almost half a school year of learning. This will not be easy. Even the highest-performing school systems struggle to change teacher practices in the classroom. But even just moving all students to a "low inquiry-based, high teacher-directed" style (the upper right corner of the matrix) would improve scores 3.4 percent, or 13 points across the region. This could be done by implementing lesson guides and reducing the emphasis on inquiry-based teaching.

These results do not take into account how good the teaching itself is. There are certainly quality gaps in teacher-directed classrooms; relentless rote learning and memorization isn't effective either. The gaps are even bigger, though, in inquiry-based classrooms, given the need to control the necessary chaos, set standards and limits, monitor progress, and support students of different capabilities.

Inquiry-based and teacher-directed approaches are composed of specific practices, and these have discrete effects. Inquiry-based teaching practices with heavy teacher facilitation (for example "The teacher explains how ideas can be applied" and "The teacher clearly explains relevance of broad science concepts to our lives") correlate positively to higher PISA scores. Inquiry-based practices with low facilitation (for example "Students are allowed to design their own experiments) correlate to lower scores (Exhibit 22).

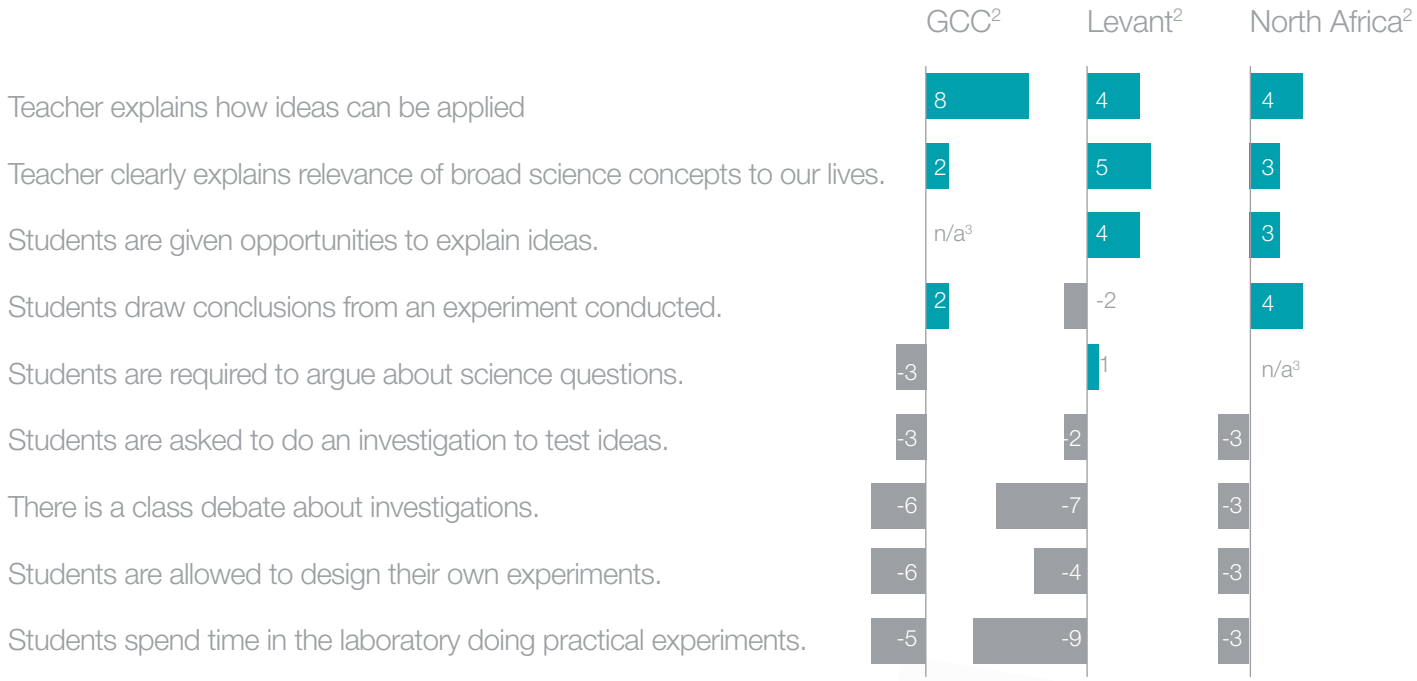
Given the strong support for inquiry-based pedagogy, these findings may seem counterintuitive. We offer two hypotheses. First, students cannot progress to inquiry-based methods without a foundation of knowledge gained through teacher-directed instruction. Second, inquiry-based teaching is more challenging to deliver, and teachers who attempt it without sufficient training and support will struggle. This is especially true in poor and fair school systems. Our 2010 report found that a more teacher-directed approach accelerated student learning for systems in these performance bands.

Knowing all this is only the start, and raises a slew of questions about how to find the right balance between teacher-directed and inquiry-based teaching, and how to improve the quality of each. At a minimum, our research suggests that teachers need to fully understand the content they are teaching, and be able to explain it, before they can proceed to inquiry-based exercises □

EXHIBIT 22: INQUIRY-BASED PRACTICES WITH MORE TEACHER FACILITATION LEAD TO BETTER STUDENT OUTCOMES.

Impact of Inquiry-based practices

Expected % increase in PISA science score between limited use and use in many/most classes[1]



1 Regression output (controlling for ESCS, public–private, urban–rural school type), normalized over average PISA score for subregion.
2 GCC refers to Qatar and UAE; Levant refers to Jordan and Lebanon; North Africa refers to Algeria and Tunisia.
3 Data not statistically significant for these practices in these regions.
Source: OECD PISA 2015, McKinsey analysis

Finding 3: School-based technology yields the best results when placed inthe hands of teachers

The potential of technology is obvious. It can help to individualize learning, assist teachers with curriculum and lesson plans, and equip students with the digital skills that will be an important part of the 21st-century economy. Spending on information and communications technology (ICT) in education is rising; so are the hopes that ICT can help to improve performance.

Reflecting this global optimism, the Middle East's e-learning market has grown more than 8 percent a year, to about $560 million in 2016.[16] MENA governments have been active in expanding technology in the classroom. The UAE, for example, is working with Microsoft on its Leading Countries of the World in Transforming Education initiative[17], and Jordan and Lebanon are using ICT to improve the education of poor and refugee children.

Students in the six MENA countries examined in this report did not take the PISA ICT survey. As a proxy, we analyzed the results from the survey of school principals pertaining to ICT equipment. This information is useful but limited because while we can look at hardware, we cannot consider software,

or how technology is used. However, we could use this data to compare the penetration of ICT in MENA versus other regions, and to understand how ICT availability in schools can affect educational performance.

There are big differences among the subregions (Exhibit 22) in terms of the availability of ICT equipment in the classroom. In the two GCC countries that took PISA, technology availability is comparable to the European Union (EU). The two Levant countries are roughly equivalent to Latin America. The two North African countries, however, have low penetration of technology even compared to other developing regions (Exhibit 23).

Given all the money and attention ICT is getting, it is important to ask whether it actually improves learning. A 2015 OECD global report[18] concluded that the evidence is "mixed at best." Among countries that invested heavily in ICT, the report concluded there was "no appreciable improvements in student achievement in reading, mathematics, or science." Others worry that technology in the classroom dehumanizes education and disempowers teachers.

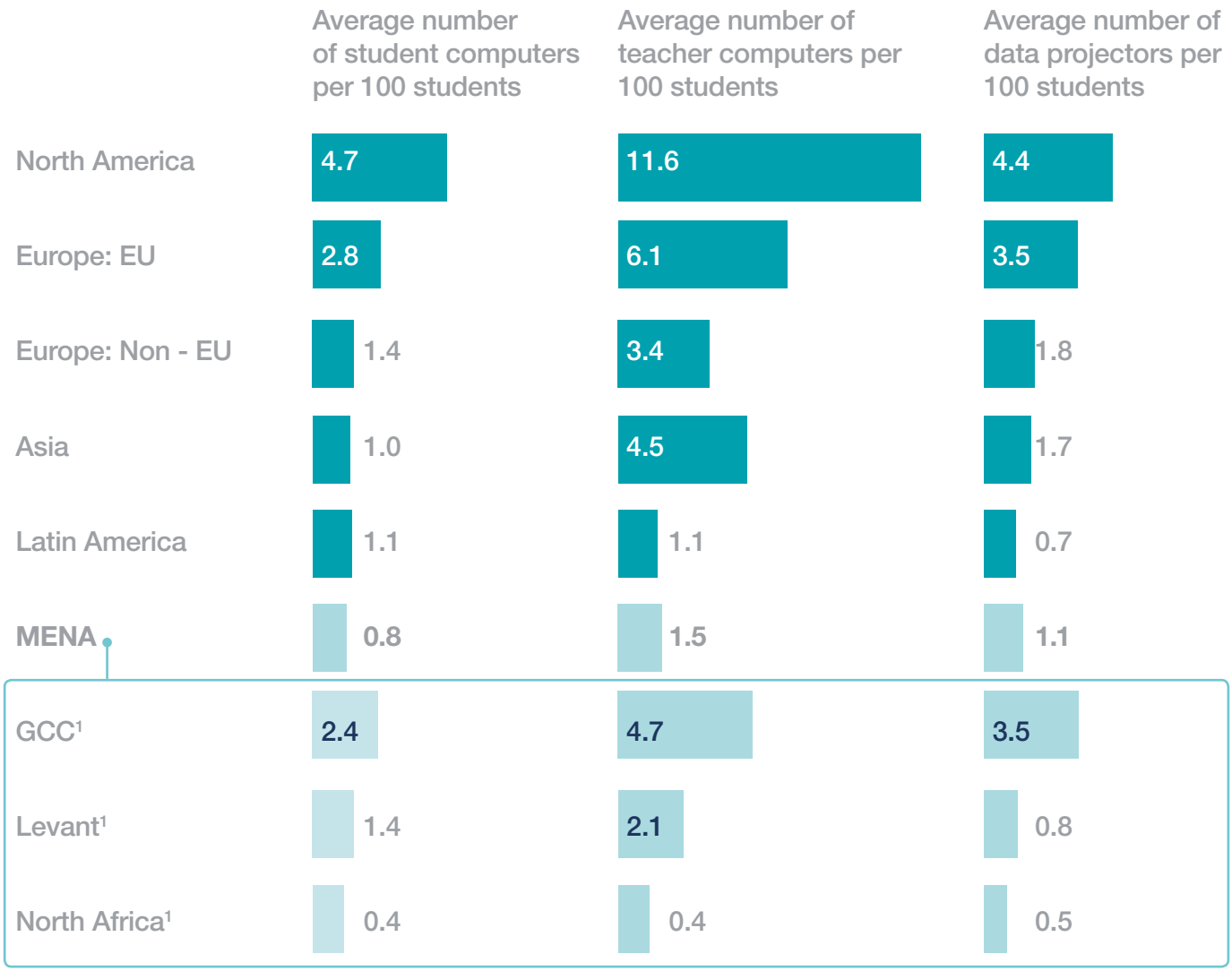
The data from the MENA countries surveyed indicates that, on the whole, adding ICT equipment to schools has a small but positive effect on performance (Exhibit 24).

There are two related insights. First, in each of the three subregions, technology seems to be most effective when deployed to teachers. Across the MENA countries surveyed, adding a student computer to a classroom increases student scores by just 0.3 PISA points. Data from other regions suggests that the use of some student-directed equipment in schools, such as tablets and e-readers, seem to actually hurt performance.

Second, ICT appears to have a greater impact in countries that have the lowest existing penetration. Specifically, adding a teacher computer in the two North African countries improves scores almost 25 points; for the two GCC countries, adding another teacher computer boosts scores only 1.1 points. The same pattern holds true for data projectors.

These results should be treated with caution. The PISA survey describes the impact of education technology as currently implemented, not its long-term potential. The results tell us only about hardware, not about software or specific interventions like well-executed personalized learning. Furthermore, education technology is evolving rapidly. Future interventions could help raise achievement at the system level. For now, however, MENA school system leaders should be careful not to assume that all technology is beneficial or even neutral to student achievement. They should work to ensure that ICT is fully integrated with instruction and support teachers to enable them to use ICT effectively□

EXHIBIT 23: THE AVAILABILITY OF ICT EQUIPMENT VARIES WIDELY IN MENA.



1 GCC = Qatar + UAE, Levant = Jordan + Lebanon, North Africa = Algeria + Tunisia
Source: OECD PISA 2015, McKinsey analysis

EXHIBIT 24: ICT EQUIPMENT IS NOT HAVING MUCH OF AN EFFECT IN MENA.

Impact on PISA Science Score, PISA points

■ Not statistically significant

	Adding 1 student computer to a classroom	Adding 1 teacher computer to a classroom	Adding 1 data projector to a classroom
MENA	**0.3**	**1.8**	**0.2**
GCC[2]	0.1	1.1	0.3
Levant[2]	0.3	1.4	0.1
North Africa[2]	0.1	24.5	0.6

1 Statistically significant at 95% confidence level based on regression, controlling for variables such as ESCS, school performance. Values that are not significant are colored grey. Note that impact of Levant student computer and MENA teacher computer are statistically significant at 80% level.
2 GCC = Qatar + UAE, Levant = Jordan + Lebanon, North Africa = Algeria + Tunisia
Source: OECD PISA 2015, McKinsey analysis

Finding 4: Improving the quality of teaching is more important than increasing the number of hours students spend in school

Note: This section looks only at the GCC countries of the UAE and Qatar. The other four MENA countries did not provide enough data for evaluation.[19]

The average reported school day in the two GCC countries that took PISA is approximately 5.5 hours, slightly above the global average (5.3 hours). Only 4.5 percent of students in these countries report being in school less than five hours a day, and 8.2 percent are in school more than 6.5 hours.

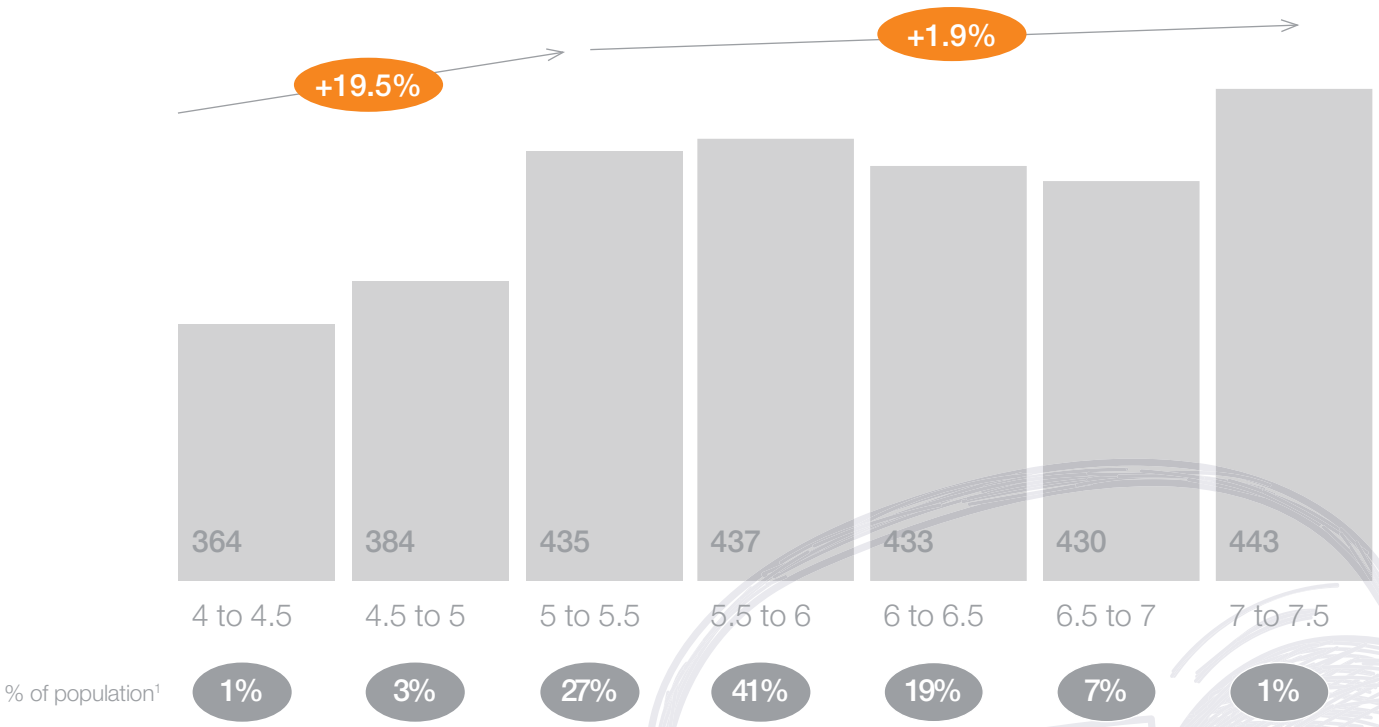
Based on the 2015 PISA data, student scores rise swiftly with each additional half hour of instruction up to five hours but then level off. (Exhibit 25).[20] Controlling for student socioeconomic status, school type, and location, most of the benefit of additional time is indeed realized in a school day of five hours, with the highest scores obtained by students who are in school for 6.5 to 7 hours. Although there may be sample size and self-selection issues for students with fewer hours in the GCC, these results are in line with those from other regions around the world. Globally the optimal school day ranges from five to seven hours of instruction.

The implication is that simply adding more hours of instruction is unlikely to significantly improve student outcomes in the GCC countries who took PISA; 95 percent of students in those countries already receive five hours or more of instruction, and there is little incremental benefit beyond this time. What matters more is improving the quality of the time spent in the classroom. This is difficult to measure, but one useful metric is PISA points scored per hour of instruction. By this admittedly limited standard, the UAE and Qatar seem to fall short according to the 2015 PISA (Exhibit 26). By raising the share of classroom time used for learning, and improving instruction quality through teacher coaching and professional development, it is possible to improve student learning for every existing hour in school □

EXHIBIT 25: THE BENEFIT OF ADDITIONAL INSTRUCTION LEVELS OFF AFTER FIVE HOURS.

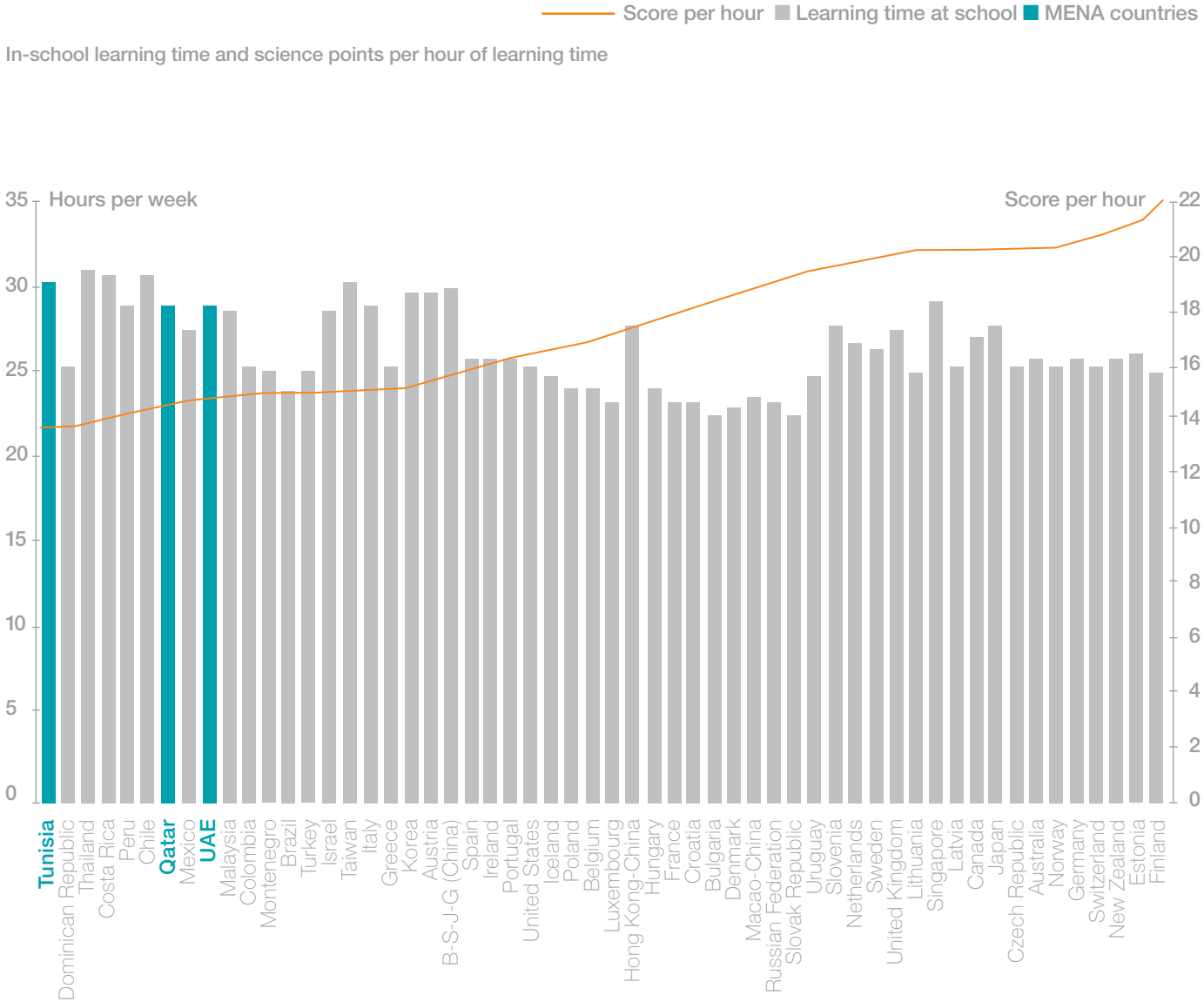
PISA science score, by hours of instruction

GCC countries of Qatar and UAE, average PISA science score



1 Numbers may not add to 100 due to rounding
Source: OECD PISA 2015, McKinsey analysis

EXHIBIT 26: MENA COUNTRIES DO NOT USE THEIR CLASSROOM TIME PRODUCTIVELY



Source: OECD PISA 2015, McKinsey analysis


In PSHCE we have been discussing the different layers of our personalities.
We used these designs create some glue pictur

Finding 5: Early childhood education had a positive academic impact on today's 15 year old. Low-income students, however, benefitted less than high-income students

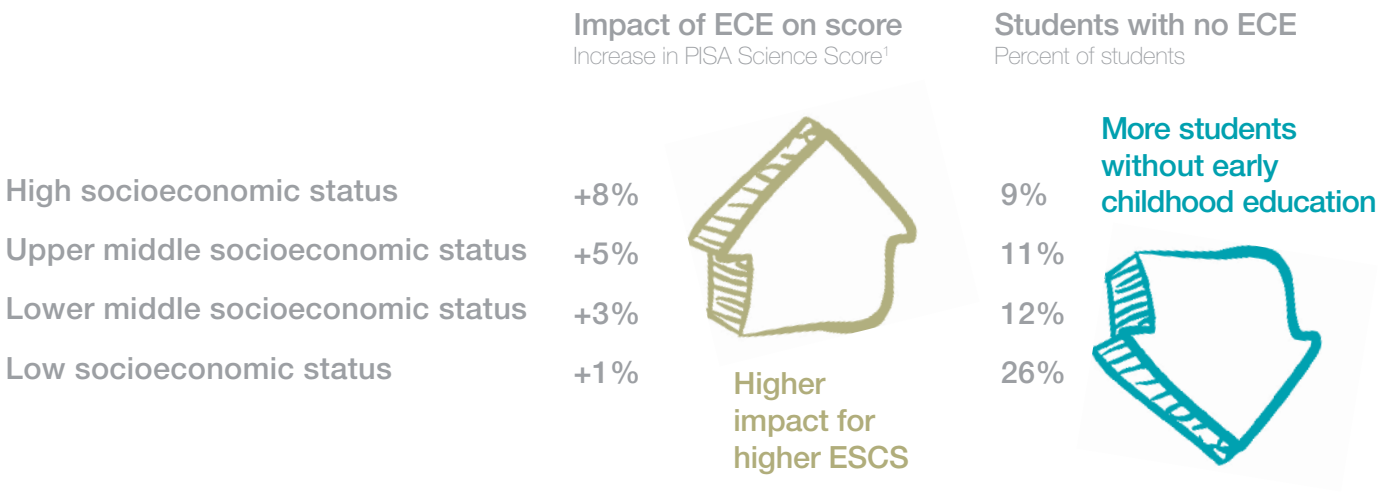
More than half of the synaptic connections that allow people to think, see, hear, and speak are formed before age three.[21] Although brain plasticity persists into adulthood, the brain is most receptive to interventions in early childhood. That is the promise of quality early-childhood education, and indeed such programs have been shown to improve academic and social outcomes, especially for disadvantaged children.[22] Although there are some concerns that the benefits may fade out in later years, good ECE programs can help to narrow the achievement gap by helping disadvantaged children gain cognitive, social, and other skills before starting kindergarten.

Many MENA governments recognize the potential of ECE. In February 2017, representatives from 15 MENA countries met to discuss how the region could meet the Sustainable Development Goal target of ensuring all girls and boys have access to quality early childhood development, care, and pre-primary education.[23]

The PISA survey asked students in the UAE, Qatar, and Tunisia how old they were when they started formal education. Their answers highlight the challenge of navigating the trade-off between increasing access and ensuring quality.

In these three MENA countries, 78 percent of students told PISA they had received some form of ECE by age five. Those with some ECE score seven percent (or 27 points) higher on the PISA science assessment than those with none. Even after controlling for socioeconomic status and type of school, students with some ECE score 8 points higher. There are substantial differences, however, between children from different socioeconomic backgrounds. Specifically, early-childhood programs do not appear to be narrowing the achievement gap between lower- and higher-socioeconomic status students. Poorer students are less likely to get ECE in the first place, and those who do see a smaller impact on their PISA

EXHIBIT 27: ECE DOES NOT APPEAR TO WORK AS WELL FOR LOWER-SOCIOECONOMIC-STATUS STUDENTS



1 Statistically significant in regression with standard controls, when compared against scores of students with no early childhood exposure (except for ESCS 1).
Source: OECD PISA 2015, McKinsey analysis

scores (Exhibit 27). This pattern holds when looking just at native-born students (that is, excluding immigrants).

The optimal age to start early education across the MENA region is three to four years old, after controlling for student socioeconomic and immigration status, and school type and location. It is possible to start too young. Specifically students starting at age two or less had statistically significantly worse results than those with no ECE. Students starting at 12 months or less scored 37 PISA points lower than those who received no ECE at all.

These raises questions about the quality of ECE available to lower-socioeconomic-status and younger children. Although some of these patterns might be due to smaller sample sizes and self-selection, we believe that lower-quality ECE could be another factor.

What is "quality" ECE? How can it be measured? The elements are clear: a focus on not just cognitive skills but also social and emotional skills and physical and mental health; trained teachers; low staff-to-child ratios; adequate infrastructure; clear learning standards; and positive student-teacher relationships. Several accepted assessments of quality exist based on both measurement of minimum standards and direct-observation toolkits.[24] In the Middle East however few reliable evaluations of ECE exist, making it difficult to assess its quality.

Of course, ECE is about more than scoring well on PISA tests many years later. Noncognitive attributes, such as children's social and emotional development, are also important. Furthermore, more than a decade has passed since these students were in ECE; several countries have made significant investments over that period. Nonetheless, our analysis of the PISA data suggests that MENA systems may have to make a trade-off between improving ECE quality and broadening access. As school systems try to enroll younger children, they should also consider what alternatives this care is replacing, and monitor the quality of both public and private ECE programs □

Conclusion

Our research has mapped some areas previously blank, and also identified new territories worthy of further exploration.

More insight could be extracted on the region's performance if more MENA countries participated more broadly in PISA, including the teacher, ICT, and parent surveys. Our analyses of other regions have been considerably richer because we have been able to integrate this additional data.

In addition, the six MENA nations surveyed are complex societies, with a variety of language and ethnic groups, and high levels of immigration. Pairing the PISA data with national data on ethnicity would provide insight on how different groups perform.

Beyond PISA, there is a need for further research in several areas. In terms of mindsets, the priority is to determine what system-level interventions can make a difference, and what effect these interventions could have on student outcomes. For teaching practices, more research is needed on how to effectively combine teacher-directed and inquiry-based teaching. For ICT, we need more rigorous longitudinal studies that consider not only what hardware works, but also what software and system supports lead to successful outcomes. Across the board, more research is needed on how to strike the right balance between increasing access and improving quality. This is particularly relevant in terms of increasing hours of instruction and in rolling out government-provided ECE.

In an important sense, then, this report—like our previous two—is part of a longer journey. With its emphasis on data and analysis, our research aims to help Middle Eastern and North African school systems move from poor to fair to good and beyond. Even a survey as large and rigorous as the PISA data set provides only some of the answers. But we believe that these five findings, combined with the conclusions of our 2010 report on the world's most improved school systems, provide useful insights to guide policy makers as they make their way to their ultimate destination: improving the education and thus the lives of the region's students ■

analytical appendix

To analyze the PISA dataset, we used a variety of modern machine learning and traditional statistical techniques.

First, we used SparkBeyond, an automated feature-discovery engine that uses large-scale combinatorial testing of millions of transformations on raw data to identify relevant drivers of outcomes—in our case, PISA student scores. SparkBeyond can create features from numeric, time series, text, and other inputs, and works best with complex data sets with thousands of variables and millions of data points. For the 2015 OECD PISA data, this entailed testing more than 1,000 survey variables derived from student, teacher, parent, and principal surveys for the approximately 540,000 students who took the PISA examination. This identified variables and groups of variables that were most predictive of student performance.

We excluded from our SparkBeyond and subsequent analysis highly predictive variables where the direction of causality was strongly in question, including grade repetition, student self-efficacy, environmental awareness, expected educational attainment, and epistemological beliefs.

We then carried out traditional descriptive and predictive statistical analyses on the identified features that were most important in determining performance both within 2015 dataset and across the PISA surveys since 2000.

For every analysis, we tested whether findings held in a regression controlling for economic, social, and cultural status (ESCS), type of school (SC013Q01: is your school a public or private school school?) and location of school (SC001Q01: which of the following definitions best describes the community in which your school is located?).

For the 2015 OECD PISA data, this entailed testing more than 1,000 survey variables derived from student, teacher, parent, and principal surveys for the approximately 540,000 students who took the PISA examination.

Where the regression results were consistent with the descriptive analysis, we have used the descriptive analysis in the report. Where the regression tells a different story from the description, we have reported regression coefficients to preserve the rigor of our findings.

We also tested our insights by school and student segment, creating two more screens—specifically, school performance level and student socioeconomic status.

School performance:

we used the numerical cut-offs from our 2010 report to define poor, fair, good, great, and excellent school systems. Each category represents approximately one school-year equivalent, or 40 PISA points.

- Excellent: >560 points
- Great: 520-560 points
- Good: 480-520 points
- Fair: 440-480 points
- Poor: <440 points

Distribution of students by school performance level

Students	Poor (%)	Fair (%)	Good (%)	Great (%)	Excellent (%)
N America	14	23	39	18	5
Latin America	76	15	6	2	0
W Europe	25	19	26	18	13
E Europe	22	24	34	16	5
MENA	89	8	2	1	0
Asia	43	16	15	13	13

Then we applied these cut-offs to individual schools as well as to school systems. We did this because there may be pockets of poorly performing schools in otherwise good systems. In these schools, the interventions applicable to poor systems may apply, even if they are in a country that on the whole performs at a "good" level. Based on this analysis, we could determine the percentage of students in differently performing schools for each region and country

Student socioeconomic status:

We use the term "student-socioeconomic-status quartile" throughout the report. This refers to PISA's ESCS indicator that integrates a number of measures related to students' backgrounds, including their parents' occupations, education levels, and possessions. We created ESCS quartiles by region based upon student weights.

Target variables and plausible values

We used the 2015 PISA science score as the target variable because the 2015 test focused on science both for the assessment and survey questions (in 2012, PISA focused on math, and in 2009, on reading). To calculate the PISA science score at the student level, we averaged the results of all the plausible values for science (PV1 to PV10 for science).

To roll up scores at the regional level, we used student weights to represent each country based on its student population. For example, the Latin American numbers all refer to weighted average student scores across Latin America; the same is true for all other regions.

For consistency with OECD publications, we used a slightly different methodology in the overview of historical regional performance. This approach creates a country-level average, first using student weights (such as "average score for Brazil"), but then takes the straight average of the scores of countries in a particular region or a group (such as "all OECD countries").

Description of specific variables

In addition to using existing OECD PISA variables and indices, we created our own indices for some analyses.

Motivation calibration:

Motivation calibration is a measure of a student's ability to recognize motivation in others, or the extent to which the student's definition of motivation agrees with the standard definition. Specifically, we took the PISA question ST121, which presented three student archetypes and asked the respondent to what extent they agree that each archetype is motivated on a four-point scale, ranging from "strongly disagree" to "strongly agree."

Based on our assessment of the motivation level of each archetype, we assigned a weight of -2 to the first student (NAME 1—highly unmotivated), +1 to the second student (NAME 2—somewhat motivated), and +2 to the third student (NAME 3—highly motivated).

For example, a student who strongly disagreed that <NAME 1> is motivated, agreed that <NAME 2> is motivated, and strongly agreed that <NAME 3> is motivated would accumulate the following score:

- 1 * -2 = -2: one point for strongly disagree with a weight of -2 for <NAME 1>
- 3 * 1 = 3: three points for agree with a weight of 1 for <NAME 2>
- 4 * 2 = 8: four points for strongly agree with a weight of 2 for <NAME 3>
- Total score: -2 + 3 + 8 = 9

ST121 Please read the descriptions about the following three students. Based on the information provided here, how much would you disagree or agree with the statement that this student is motivated? (Please select one response in each row.)

		Strongly disagree	Disagree	Strongly Agree	Agree
ST121Q01NA	<NAME 1> gives up easily when confronted with a problem and is often not prepared for his classes. <Name 1> is motivated.	☐1	☐2	☐3	☐4
ST121Q02NA	<NAME 2> mostly remains interested in the tasks she starts and sometimes does more than what is expected from her. <Name 2> is motivated.	☐1	☐2	☐3	☐4
ST121Q03NA	<NAME 3> wants to get top grades at school and continues working on tasks until everything is perfect. <Name 3> is motivated.	☐1	☐2	☐3	☐4

ST034 Thinking about your school: to what extent do you agree with the following statements? (Please select one response in each row.)

		Strongly disagree	Disagree	Strongly Agree	Agree
ST034Q01TA	I feel like an outsider (or left out of things) at school.	☐1	☐2	☐3	☐4
ST034Q02TA	I make friends easily at school.	☐1	☐2	☐3	☐4
ST034Q03TA	I feel like I belong at school.	☐1	☐2	☐3	☐4
ST034Q04TA	I feel awkward and out of place in my school.	☐1	☐2	☐3	☐4
ST034Q05TA	Other students seem to like me.	☐1	☐2	☐3	☐4
ST034Q06TA	I feel lonely at school.	☐1	☐2	☐3	☐4

ST119 To what extent do you disagree or agree with the following statements about yourself? (Please select one response in each row.)

		Strongly disagree	Disagree	Strongly Agree	Agree
ST119Q01NA	I want top grades in most or all of my courses.	☐1	☐2	☐3	☐4
ST119Q02NA	I want to be able to select from among the best opportunities available when I graduate.	☐1	☐2	☐3	☐4
ST119Q03NA	I want to be the best, whatever I do.	☐1	☐2	☐3	☐4
ST119Q04NA	I see myself as an ambitious person.	☐1	☐2	☐3	☐4
ST119Q05NA	I want to be one of the best students in my class.	☐1	☐2	☐3	☐4

We defined a cutoff of 8 points in the aggregated score, which ensures that only the following students are classified as having a strong motivation calibration:

- Students who strongly agree that <NAME 3> is motivated, and whose agreement on <NAME 1>'s motivation does not exceed their agreement on <NAME 2>'s motivation
- –OR— Students who agree that <NAME 3>'s is motivated; agree that <NAME 2> is motivated, and strongly disagree that <NAME 1> is motivated
- –OR— Students who agree that <NAME 3> is motivated; strongly agree that <NAME 2> is motivated, and disagree or strongly disagree that <Name 1> is motivated

Sense of belonging:

We grouped the index BELONG (based on ST034) as follows:

- Low belonging: BELONG < 0
- High belonging: BELONG >=0

Motivation:

We grouped the index MOTIVAT (based on ST119) as follows:

- Low belonging: MOTIVAT < 0
- High belonging: MOTIVAT >=0

Test anxiety:

We grouped the index ANXTEST (based on ST118) as follows:

- Low belonging: ANXTEST < 0
- High belonging: ANXTEST >=0

Instrumental motivation:

We grouped the index INSTSCIE (based on ST113) as follows:

- **Low instrumental motivation: INSTSCIE < 0**
- **High instrumental motivation: INSTSCIE >=0**

Growth vs. fixed mindset:

To assess the impact of a growth versus fixed mindset, we used selected 2012 PISA survey question ST43 and ST91 from the student survey.

We created an index by adding the response values for each of the four sub-questions related to growth versus fixed mindsets, after reversing the sequence of response values for the last question to account for the negative framing of the prompt.

The resulting index takes values from 4 to 16, with lower scores representing a growth mindset and higher scores representing a fixed mindset. Looking at the distribution of students globally, we devised the following definitions.

- **Strong growth mindset: students with a score of 4 or 5 reflect a growth mindset on at least three of the sub-questions, and are directionally aligned on the remaining question. These represent 23 percent of the global population.**

- **Neutral or weak growth mindset: students with a score of 6 to 9 reflect a neutral or weak growth mindset and represent 69 percent of the global population.**

ST118 **To what extent do you disagree or agree with the following statements about yourself?** (Please select one response in each row.)

		Strongly disagree	Disagree	Strongly Agree	Agree
ST118Q01NA	I often worry that it will be difficult for me taking a test.	☐1	☐2	☐3	☐4
ST118Q02NA	I worry that I will get poor <grades> at school.	☐1	☐2	☐3	☐4
ST118Q03NA	Even if I am well prepared for a test I feel very anxious.	☐1	☐2	☐3	☐4
ST118Q04NA	I get very tense when I study for a test.	☐1	☐2	☐3	☐4
ST118Q05NA	I get nervous when I don't know how to solve a task at school.	☐1	☐2	☐3	☐4

ST113 **How much do you agree with the statements below?** (Please select one response in each row.)

		Strongly disagree	Disagree	Strongly Agree	Agree
ST113Q01TA	Making an effort in my <school science> subject(s) is worth it because this will help me in the work I want to do later on.	☐1	☐2	☐3	☐4
ST113Q02TA	What I learn in my <school science> subject(s) is important for me because I need this for what I want to do later on.	☐1	☐2	☐3	☐4
ST113Q03TA	Studying my <school science> subject(s) is worthwhile for me because what I learn will improve my career prospects.	☐1	☐2	☐3	☐4
ST113Q04TA	Many things I learn in my <school science> subject(s) will help me to get a job.	☐1	☐2	☐3	☐4

ST043 **Thinking about your math lessons: to what extent do you agree with the following statements?** (Please select one response in each row.)

		Strongly disagree	Disagree	Strongly Agree	Agree
(a)	If I put in enough effort I can succeed in mathematics	☐1	☐2	☐3	☐4
(b)	Whether or not I do well in maths is up to me	☐1	☐2	☐3	☐4
(c)	If I wanted to, I could do well in mathematics	☐1	☐2	☐3	☐4
(d)	I do badly in mathematics whether or not I study for my exams	☐1	☐2	☐3	☐4

SC004

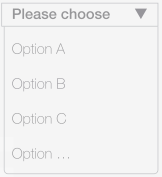
The goal of the following set of questions is to gather information about the student-computer ratio for students in the <national modal grade for 15-year-olds> at your school.
(Please enter a number for each response. Enter "0" [zero] if there are none.)

		Number
SC004Q01TA	At your school, what is the total number of students in the <national modal grade for 15-year-olds>?	
SC004Q02TA	Approximately, how many computers are available for these students for educational purposes?	
SC004Q03TA	Approximately, how many of these computers are connected to the Internet/ World Wide Web?	
SC004Q04NA	Approximately, how many of these computers are portable (e.g. laptop, tablet)?	
SC004Q05NA	Approximately how many interactive whiteboards are available in the school altogether?	
SC004Q06NA	Approximately how many data projectors are available in the school altogether?	
SC004Q07NA	Approximately how many computers with internet connection are available for teachers in your school?	

ST125

How old were you when you started <ISCED 0>?
(Please choose from the drop-down menu to answer the question.)

Years



Drop-down menu, offering answers "1 year or younger", 2 years, 3 years, 4 years, 5 years, "6 years or older", "I did not attend <ISCED 0>", "I do not remember".

- **Fixed mindset: students with a score of 10 to 16 have an average response of 2.5 or more on the four questions, meaning that they tend to be misaligned with the principles of a growth mindset. They represent 8 percent of the global population.**

We compared students with a fixed mindset to students with a strong growth mindset in our analysis. In addition, we found that incremental gains were seen at each stage from fixed to neutral and from weak growth to strong growth.

Teaching practices:

To assess teaching practices, the PISA survey asked a series of questions about teacher-directed instruction (ST103) and inquiry-based instruction (ST098). This question does not allow us to assess the intensity of the teaching practices in a given class, but only the frequency with which they occur.

Students responded on a frequency scale that was slightly different for each set of questions:

Teacher-directed learning (ST103)
1 = Never or almost never
2 = Some lessons
3 = Many lessons
4 = Every lesson or almost every lesson

Inquiry-based learning (ST098)
1 = In all lessons
2 = In most lessons
3 = In some lessons
4 = Never or hardly ever

We consolidated each student's responses into averages on a scale from 1 to 4—one average for teacher-directed instruction and another for inquiry-based instruction (with the numbers reversed to be comparable). These averages form the basis for our analysis of teaching practices.

The OECD also created a numerical index of teacher-directed (TDTEACH) and inquiry-based learning (IBTEACH), which is calibrated such that the OECD average is 0 and the standard deviation is 1. When we ran regressions on the TDTEACH and IBTEACH variables, our results were consistent with theirs. However, we chose to present the data using our own indices because we believed these gave a clearer picture what was happening in the classroom.

ICT at school:

to create a like-for-like comparison of the impact of ICT hardware, we used the survey questions asked of school principals from SC004 and normalized the results by classroom size and student-to-teacher ratio. This allowed us to evaluate the effect adding one projector, student computer, or teacher computer to an average class size of 36 students.

Early childhood:

To understand the impact of early-childhood education (ECE) we used the student survey question ST125. We excluded from the analysis students who could not remember when they started ECE. With the remaining students, we counted them as having attended ECE if they started at five years or younger. Students who started at six years or older or who responded "no early-childhood education" we counted as not having attended ECE. Note we did not use the simpler question ST124 ("Did you attend early-childhood education," as only 15 percent of students globally answered this question (versus 82 percent who answered ST125). We also cross-checked results against similar questions in the parent survey for the subset of countries that took the parent survey; the results were consistent ■

1 These five stages inform McKinsey's Universal Scale of education system performance, which takes available assessments like PISA, TIMSS, TERCE, or local tests. We normalized the data, creating new units that are equivalent to 2000 PISA scores, and then broke down the results into five categories: poor, fair, good, great and excellent (see the analytical appendix for more, and also http://www.mckinsey.com/industries/social-sector/our-insights/how-the-worlds-most-improved-school-systems-keep-getting-better).

2 Argentina, Kazakhstan, and Malaysia were excluded from PISA 2015 report, but are included in our analyses. The PISA 2015 sample for Malaysia did not meet PISA response-rate standards, the PISA 2015 sample from Argentina did not cover the full target population, and the results from Kazakhstan are based only on multiple-choice items. Because our report analyzes achievement drivers at the student level based on examining individual items, and reports are generated at a regional basis rather than comparing the performance of individual countries, we have included these countries in our analysis. Albania was excluded from our analysis because, due to the ways in which the data were captured, it was not possible to match the data in the test with the data from the student questionnaire. As our report is entirely based on the drivers from the student questionnaire, we could not include Albania in our analysis.

3 The 2015 computer-based assessment was designed as a two-hour test comprising four 30-minute clusters. Students took two science clusters, plus two others across reading, math, and collaborative problem-solving.

4 The first-generation immigrant population grew at a rate of 299 percent while the native population grew at a rate of 11 percent.

5 Claro, S., Dweck, C. S. and Paunesku, D., "Growth mindset tempers the effects of poverty on academic achievement," proceedings of the National Academy of Sciences, 113(31), 8664-8668,www.pnas.org/cgi/doi:10.1073/pnas.1608207113.

6 Credé, M., Harms, P. D., and Tynan, M. C., "Much ado about grit: A meta-analytic synthesis of the grit literature," Journal of Personality and Social Psychology. http://psycnet.apa.org/doiLanding?doi=10.1037%2Fpspp0000102; Morrison Gutman, L. and Schoon, I., The impact of non-cognitive skills on outcomes for young people, Education Endowment Foundation, 2013, https://educationendowmentfoundation.org.uk/public/files/Publications/EEF_Lit_Review_Non-CognitiveSkills.pdf.

7 To attain statistically meaningful results, we selected the top 100 variables using a feature-identification machine-learning algorithm. Recognizing that the regression wouldn't distinguish collinearity across variables, we mitigated by placing variables very likely to be collinear in the same category. We cannot control for collinearity between categories.

8 As a percentage of total predictive power of a regression model of top 100 features across all surveys.

9 Each category was made up of several subvariables. For example: Home environment: parent education and occupation, home possessions, language at home; Student behaviors: skipping school, activities before school, ICT use out of school; School factors: class size, school size, school resource level and funding, school autonomy; Teacher factors: teacher qualifications, teacher professional development, teaching practices.

10 The UAE, Qatar, and Tunisia answered mindset questions in 2015; the UAE, Qatar, Tunisia, and Jordan answered mindset questions in 2012.

11 See the Analytic Appendix for a detailed description of how we created the motivation calibration index.

12 PISA did not ask these growth-mindset questions in 2015.

13 This mindset may be subject to a feedback loop: students who study hard and perform well are inclined to believe that intelligence is not fixed. However, in 2016 Claro et al. found that a growth mindset correlated with high achievement even when controlling for students' self-assessments of their own abilities, indicating that it is a powerful driver of achievement even in students who are not intrinsically high achievers.

14 Paunesku, David, et al., "Mindset interventions are a scalable treatment for academic underachievement," Psychological Science, https://web.stanford.edu/~paunesku/articles/paunesku_2015.pdf.

15 Metacognition and self-regulation, Education Foundation Endowment Teaching & Learning Toolkit, August 2017, https://educationendowmentfoundation.org.uk/pdf/generate/?u=https://educationendowmentfoundation.org.uk/pdf/toolkit/?id=138&t=Teaching%20and%20Learning%20Toolkit&e=138&s=.

16 Alpen Capital, GCC Education Industry, May 2, 2016, https://slideblast.com/gcc-education-industry-may-2-2016-amazon-web-services_593a659f1723dde1fa8172a4.html.

17 Radan, Silvia, "Future of education: Technology in classrooms," Khaleej Times, April 6, 2016. http://www.khaleejtimes.com/nation/education/future-of-education-technology-in-the-classrooms.

18 Students, Computers and Learning: Making the Connection, OECD Publishing, 2015, http://www.oecd.org/publications/students-computers-and-learning-9789264239555-en.htm.

19 Only the UAE, Qatar, and Tunisia took the computer-based assessment which included these questions. Algeria, Jordan and Lebanon took the shorter paper-based survey.

20 Unless specified otherwise in the text, this section addresses all instructional hours, not only science. The OECD PISA's 2015 focus is science; we use the science score as a proxy for achievement throughout this report. We use this proxy in this section because we are addressing the question of how the school day length impacts achievement generally, but it should be noted that schools can provide more or less subject-specific instruction. This could be investigated as an option for improving results without changing overall school day length.

21 Phillips, Deborah A. and Shonkoff, Jack P., eds., From Neurons to Neighborhoods: the Science of Early Development, Board on Children, Youth, and Families: National Research Council and Institute of Medicine, National Academies Press, 2000.

22 Carneiro and Heckman, The Region, Minnesota Federal Reserve Bank, December 2003; Reynolds Arthur J. et al., Age 21 cost-benefit analysis of the Title 1 Chicago child-parent center program, Waisman Center – University of Wisconsin Madison, June 2001; Mann, E., Reynolds, A., Robertson, D., and Temple, J., Age 26 cost-benefit analysis of the Title I Chicago child-parent center program, HighScope: "Lifetime Effects: The High Scope Perry Preschool Study Through Age 40" (2005); The Carolina Abecedarian Project: website; Carneiro and Heckman 2003; Center for Public Education website; HeadStart fade out: https://ies.ed.gov/ncee/wwc/EvidenceSnapshot/636; https://www.acf.hhs.gov/opre/resource/head-start-impact-study-final-report-executive-summary)

23 Voices and views: Middle East and North Africa, "A new vision for early childhood education in the Middle East and North Africa," blog entry by Maja Capek and Samira Nakaein Towfighian, May 9, 2007, http://blogs.worldbank.org/arabvoices/new-vision-early-childhood-education-mena

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