What can we learn from Asia in science and math education?

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Make American Education Great Again

Problem Statement	Objective	Proposed Solutions
According to International Assessment, US is behind in literacy, math, and science compared with their international counterparts at different grade/age levels.	The need for improvement in education is high when we need a better equipped workforce to face the challenge of the 21st Century globalization.	-Hire foreign teachers and adopt foreign curriculum -Schedule periodical revisions in math/science curriculum -Require expertise in teaching -Train learners to fail well

Top Performers of Grade 4 Math in 2015 TIMSS

Top Performers of Grade 8 Math in 2015 TIMSS

Top Performers of Grade 4 Sci in 2015 TIMSS

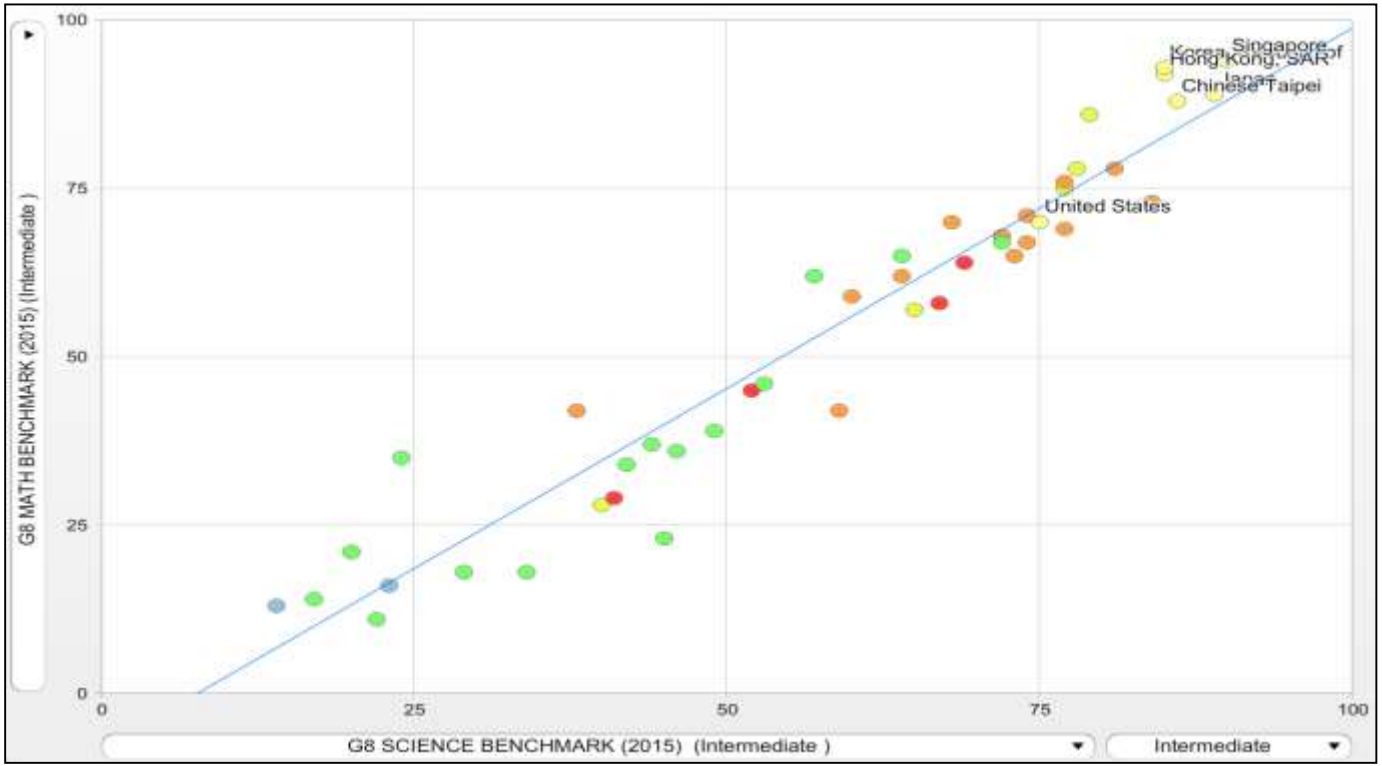
Top Performers of Grade 8 Sci in 2015 TIMSS

Counter-argument

- Bracey (2009): ‘‘Using test scores to compare education systems is a mistake…using average scores to compare countries is a worse mistake’’ (p. 450).
- Salzman and Lowell (2008) argued that average test scores are mostly irrelevant as a measure of economic potential. Rather, high-performing students are more crucial for producing leading-edge technology.

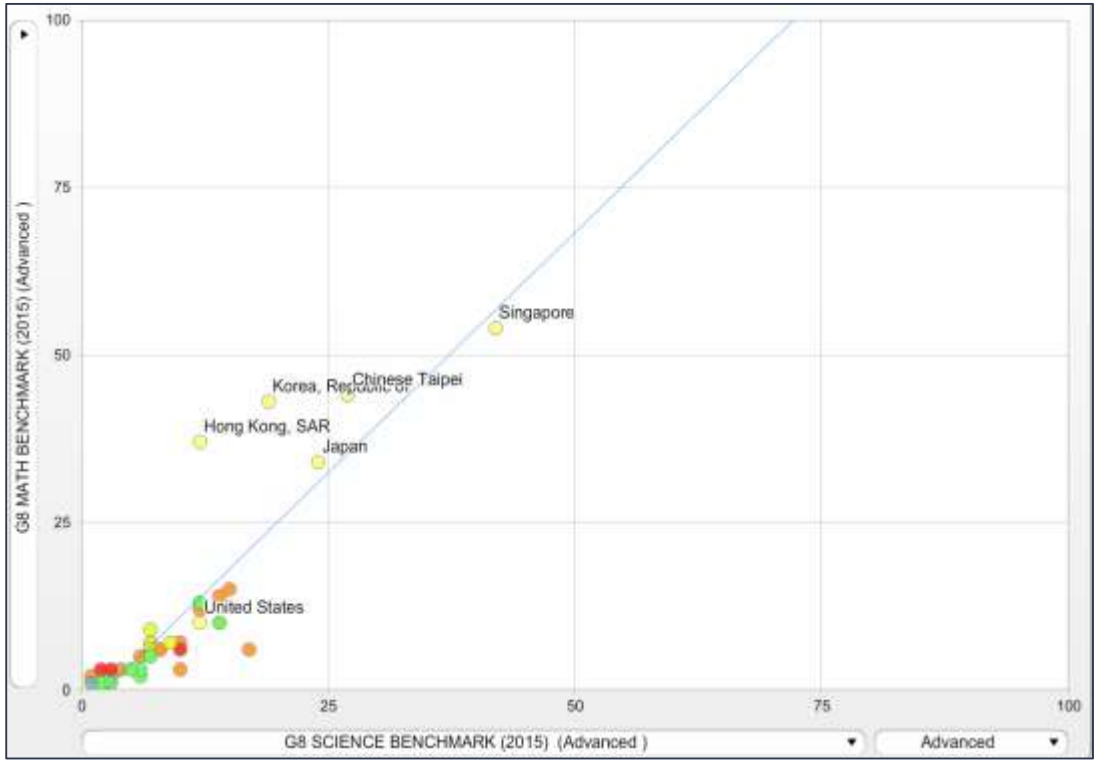
TIMSS 2015: Science and Math Benchmark

If we skip the average and look at better students, we can see a wide performance gap between US and East Asia among intermediate performers.



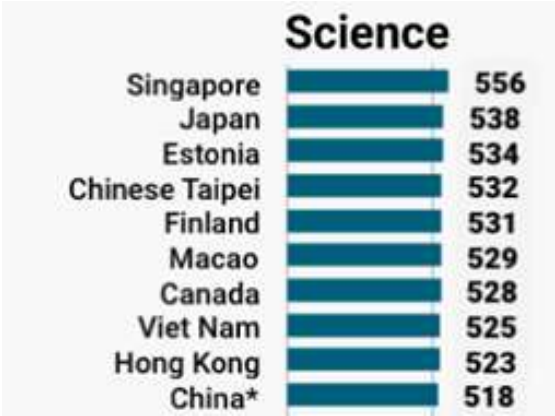
TIMSS 2015: Science and Math Benchmark

If we look at the best, we can see an even wider performance gap between US and East Asia among intermediate performers.

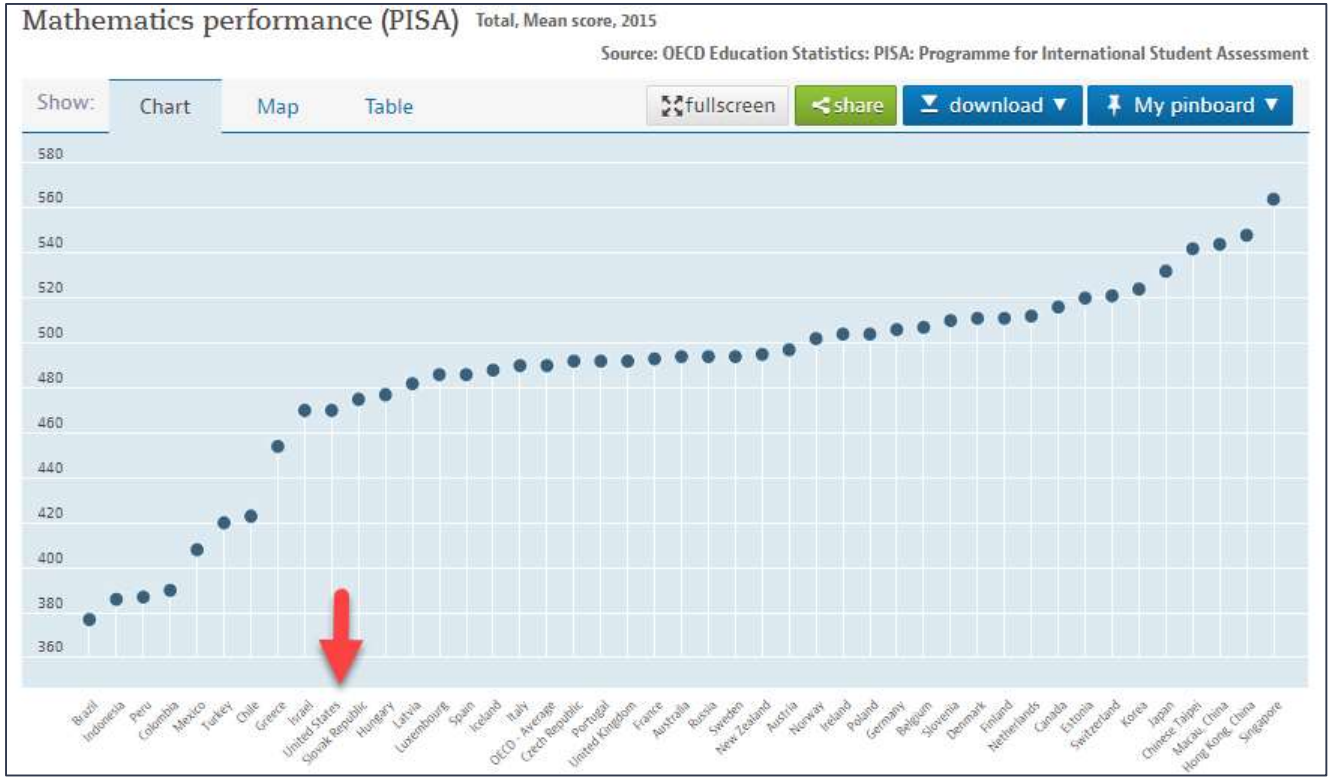


US Performance in PISA

The US performance ranking is low in many PISA tests. In 2015 the U.S. ranked 38th out of 71 countries in math and 24th in science.

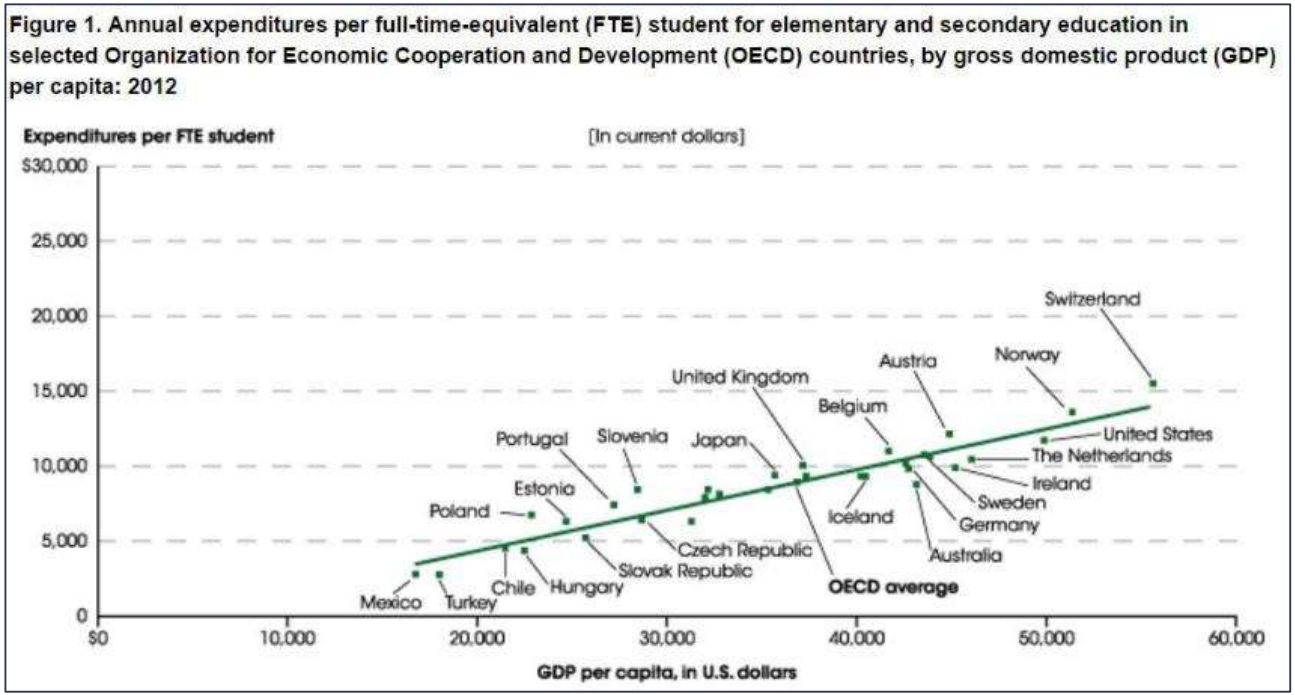


The top performers of PISA are Asian countries and regions (see figure above)



https://data.oecd.org/pisa/mathematics-performance-pisa.htm#indicator-chart

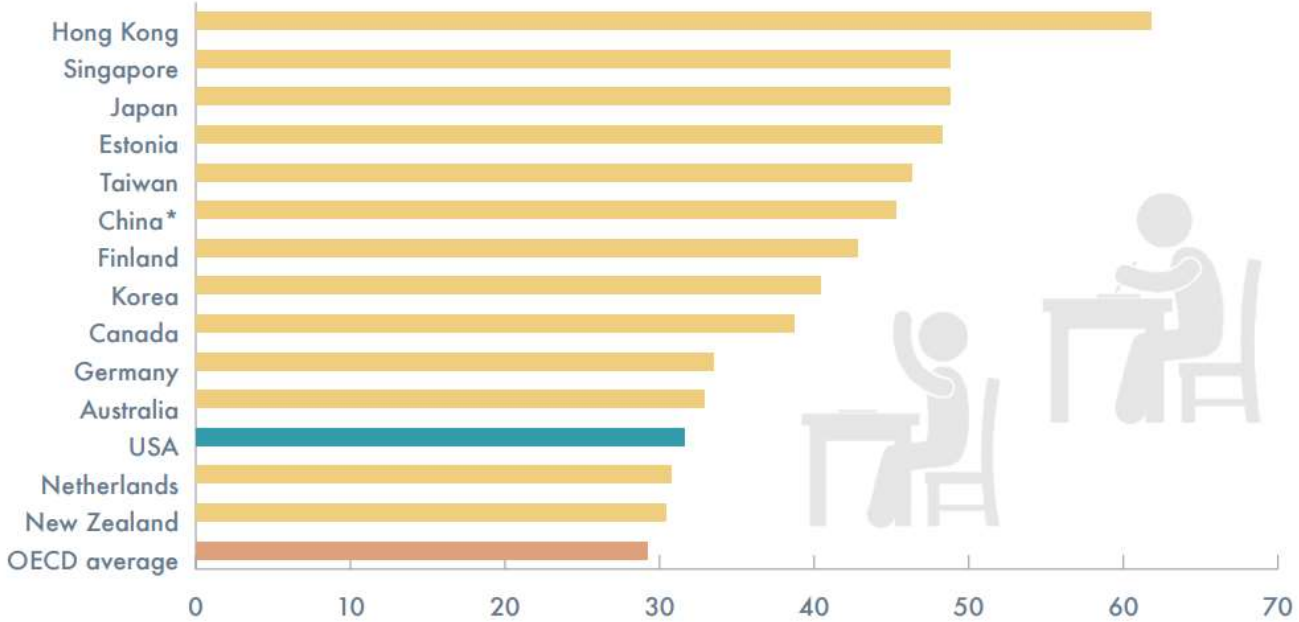
Spending in Education



Disadvantaged Students

Percentage of Resilient Students on PISA 2015, by Country

Resilient students are those in the most disadvantaged quartile of students in their country, who nevertheless score in the top quarter on the PISA assessments of student achievement.

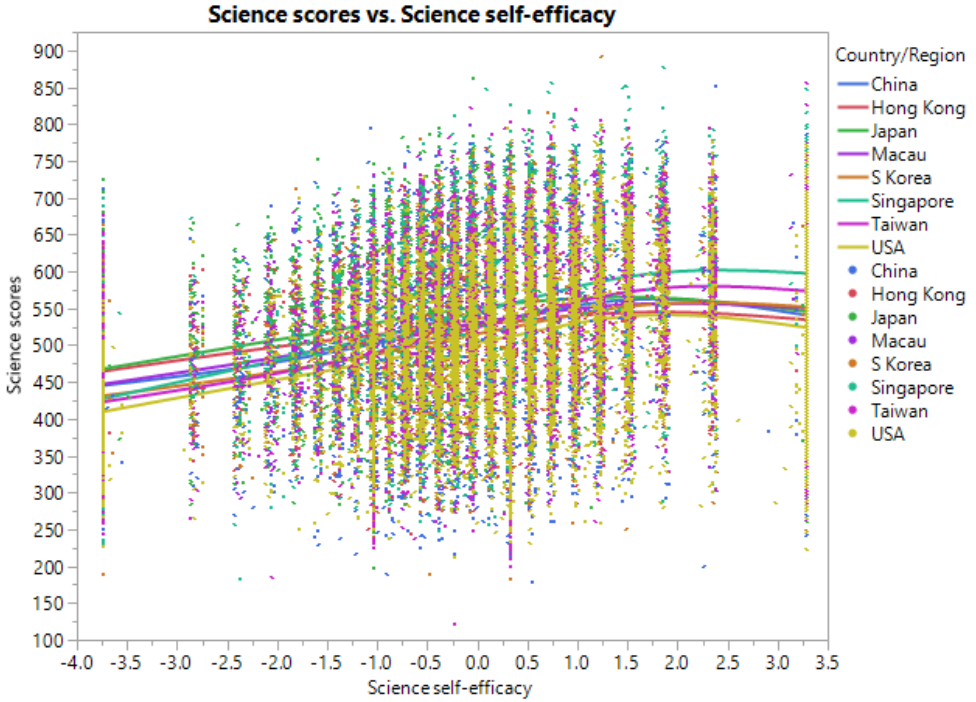


Source: OECD PISA 2015
*Includes Shanghai, Beijing, Jiangsu and Guandong

2015 PISA Results based on Random PVs

	Math PV		Science PV		Self-efficacy		Self-belief		Ambition	
Country/Region	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
China	541.74	100.84	528.34	98.56	0.06	1.17	0.19	0.87	2.98	0.73
Hong Kong	550.55	88.48	525.60	79.58	-0.07	1.22	0.21	0.95	2.80	0.80
Japan	533.30	88.18	539.03	93.28	-0.46	1.22	-0.51	1.02	2.64	0.82
Macau	543.98	79.03	528.59	81.84	-0.03	1.12	-0.50	0.81	2.63	0.81
S Korea	523.91	99.97	514.75	95.00	-0.02	1.23	0.34	0.98	2.84	0.75
Singapore	557.08	95.75	545.95	104.60	0.07	1.14	0.42	0.94	3.00	0.79
Taiwan	539.20	103.79	530.85	99.85	0.19	1.19	-0.01	0.89	2.92	0.76
USA	474.35	87.92	502.60	98.04	0.29	1.29	0.65	0.95	3.25	0.72

Too much self-efficacy can hurt performance



Bandura: “If people experience only easy successes they come to expect quick results and are easily discouraged by setbacks and failures. Resilient self-efficacy requires experience in overcoming obstacles through persevere effort. Resilience is also built by learning how to manage failure so that it is informative rather than demoralizing”

PIAAC

- Evaluate adults: Aged 16-25
- Three categories and 5 levels:
  - Numeracy
  - Technological proficiency
  - Literacy
- Thirty-six million American adults have low skills.
- 2016 PIAAC data indicated that American adults are far behind their international peers. In all three test categories US ranks among the bottom in numeracy and technological proficiency

PIAAC

- Numeracy:
  - 8% US adults achieve at Level 4/5,
  - OECD average: 13%
  - Japan and Finland: 19%
  - A third of adults in the U.S. scored below Level 2
- Problem solving in technology
  - About one-third (31%) of US adults score at least at Level 2
  - OECD average: 34%

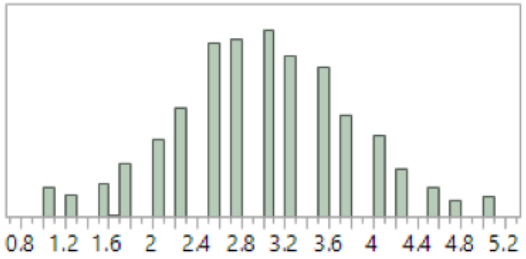
US Performance in PIAAC

Younger Singaporeans (aged 16-24) outperformed the older generation (aged 55-64) in literacy, but the trend is opposite in the US.
In the US, the younger generation fell behind, meaning that older Americans had better literacy skill than young adults.

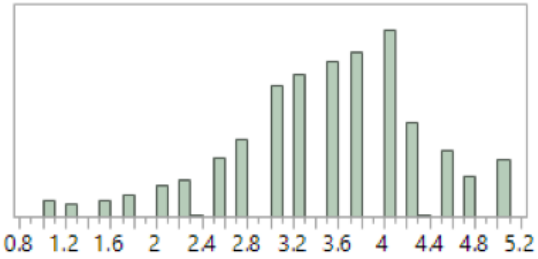
Many older Americans successfully reached Level 2 and 3 in problem-solving skill level, placing the US as the second to the highest performer for this skill.

Yet, the problem-solving skill of young Americans was among the bottom

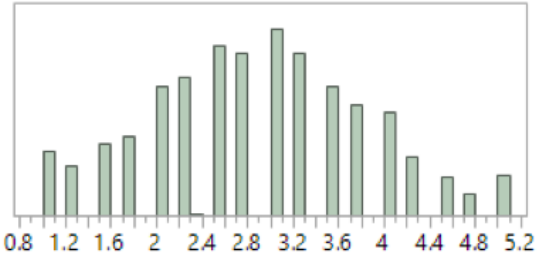
PIAAC Survey: Ready to Learn scores



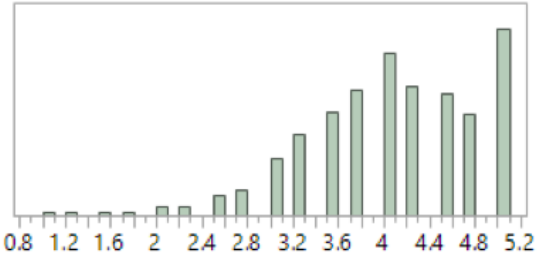
Distribution of RTL of Japan



Distribution of RTL of Singapore



Distribution of RTL of South Korea.



Distribution of RTL of USA.

PIAAC

CNN Commentator Zakaria responded to PIAAC:

–develop skills and knowledge at young ages

–peak in proficiency at 30 decline afterwards.

If people start out with poor foundation, those disadvantages will persist throughout their lives.

Counter-argument: USSR is gone!

Ravitch said, “The Soviet Union launched its Sputnik satellite in 1957. We did not respond by raising our test scores on international assessments… something is wrong with those international assessments, if our allegedly terrible public schools continue to produce the greatest workers, thinkers, leaders, and innovators that created the greatest economy in the world. The Soviet Union is gone, but we are still here!”

2011 Foreign Student Enrollment in US Grad School

Field	Percent of International Students	# of Full-time International Graduate Students	# of Full-time U.S. Graduate Students
Electrical Engineering	71.4	21,933	8,802
Computer Science	64.5	19,605	10,802
Industrial Engineering	60.6	4,998	3,253
Economics	55.3	7,823	6,335
Materials Engineering	53.8	3,163	2,714
Chemical Engineering	52.8	4,036	3,603
Mechanical Engineering	50.7	8,150	7,934
Mathematics & Statistics	45.6	8,354	9,949
Civil Engineering	45.6	6,554	7,809
Physics	43.6	5,844	7,569
Other Engineering	42.3	7,682	10,499
Chemistry	40.2	8,200	12,203

Many scientists and engineers in the US are foreign-born

H-1B: Foreign citizens make up nearly three-quarters of Silicon Valley tech workforce, report says

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Nobel Prize Winners

- Between 1950 and 2005, 27 of the 87 American Nobel Prize winners were born outside the US (Vilcek & Cronstein, 2006).
- Counting from 1990, about half of the US Nobel laureates in the scientific and technical disciplines were foreign-born.

Let’s Dive in with the Solutions!

If the UK Can, Why Can’t We?

- In England, UK schools invite teachers from Shanghai , adopting their teaching methods. Chinese textbooks were translated to English textbooks.
- We should invite foreign teachers to teach in U.S. high schools and grade schools.
- We should send our own teachers overseas to receive training in education.

Learn from the Best: Singapore

1. Periodic revisions of math/science curriculum to ensure focused learning along with a relevant economy (nationally & internationally)
2. Emphasis on teachers' key role: Teachers in Singapore are entitled 100 hours of funded training and core-upgrading courses each year

Productive failure

- "Learning resilience is fundamental to a successful career as a scientist."
- Our system does not train young people how to fail "well."

Productive failure

- Hong Kong educators has been systematically exposing students to manageable challenge and raising their self-awareness of misconception.
- The instructor asks the learners to solve an ill-defined problem with ill-structured or missing information while withholding guideline and feedback.
- The instructor sets them up to “fail.”

Summary and Conclusion

- Multiple reliable and valid assessments show that the US is behind in math and science education. Top performers of international assessments are Asians.
- Many scientist, engineers, and programmers in the US are foreign-born.
- England had started learning from Shanghai.
- We can learn from Asia, too e.g.
- Stay current (Singapore)
- Emphasize teacher quality (Singapore)
- Productive failure (Hong Kong)