WP series: Mathematics Stagnation Nation series: for the USA (Part 5)

The quasi-universal math stagnations in developed countries are real and won't go away as the conventional EDU reforms are mostly futile: how to transcend them with MMU1 or at least 1/3 of its full version over the next 2-4 years (draft 2)

By Dongchan Lee (Date: February 8, 2017)

Abstract

In this short, visual data rich paper, we will demonstrate the following: 1) the math EDU stagnations in almost all OECD nations (especially in the Western countries) are here to stay and they will not go away according to the data from PISA, TIMSS internationally and NAEP for the USA; 2) as the Math growth is critical for the modern economic growths and yet the EDU establishments are highly inefficient and adhere to the traditional alternatives instead of embracing more unconventional approaches, we provide a wide variety of the reality-biting results; 3) throughout the paper in this series, we used the yellow arrows as the expected math growth estimations against the past historic math growth data from the international and national math tests to demonstrate to the readers as to what they are missing by simply looking at the other directions when the answer is here already; 4) our mantra: to end math poverty means to end poverty itself. As such, we focus primarily on the math poorest 25 percentile of students especially (as about 20-35 percentiles of the math poverty population, especially in the grades 3-5 seem to have very negative impacts on the population for the rest of their lives; 5) we propose the worst case plan 4th of MMU1, which in itself is revolutionary and will achieve what the average USA cities or states have achieved past 20 years in just 2 years.

Author: Dongchan Lee

Email: dongchanlee11@uchicago.edu

Website: www.uslgoglobal.com

Lee's other Working Papers will be released at …. ☺

Key words: Math stagnations, math crisis, USL, MMU1, math education innovation. Education reforms

Table of Contents

Sources of data:

The entire data for the charts here are from 1) PISA (OECD) website; 2) TIMSS website; 3) NAEP website (National Report Cards) and they were all accessed between December 2016 and January 2017.

Critical Note: Throughout in this observational report with timelines from the NAEP math scores, all the data were gathered from NAEP's The National Report Card data. As such, all the data 1990-1996 had "Accommodations Not Permitted" while the data from 2000 on, I used the data with the Accommodations Permitted.

Introduction

I think 2015 was a very important year (which means 2017) because both PISA, TIMSS, and NAEP (for the USA) took place in 2015 and their results were finally released at the end of 2016. So in 2017, I hope that there are some courageous actions based on visions, not the perpetual and fruitless conflicts and struggling which are common in the Education reforms, especially for math worldwide. Over the past a decade or more, each cycle of TIMSS, PISA, and NAEP have drawn clearer pictures about the potentials of the math stagnations. As far as I can see, although no other author has raised

this issue at the level of global phenomena to this day although many are aware of the math stagnations at the state or national levels. The 15-20 plus years of data of TIMSS, PISA, and NAEP point to the clear pictures as I presented here that the math stagnations are here to stay for most of the developed countries and to deny is not only unwise, but this will have very grave economic consequences in near future.

As I have demonstrated earlier about the math education crises worldwide, focusing especially on the English-speaking and Latin American countries, there are sufficient evidences by now for the math stagnations. We all have choices of pretending that our math keeps on growing forever as we are all innovative and powerful. Or we acknowledge the fundamental nature of the stagnations and put heavy efforts to overcome from the most innovative directions instead of the traditional or tech-based math education innovations.

Let me first draw you to the following seemingly universally acceptable facts as the stepping stone for this paper.

1. **Math growth stagnations are real** at least for almost all non-Eastern Asian developed countries (especially all English-speaking countries). Furthermore, they are here to stay and won't go away at least according to the 15-20-25 years of data from the PISA, TIMSS, and NAEP (National Report Cards) of the USA. You can see the visual data of the math EDU stagnations in the international, national, states and city levels as Lee presents here. We can wish it goes away and hope for the best, but the global reality of data says otherwise. We all need to wake up instead of denying the reality. When we grow older, we shouldn't pretend we are all Peter Pan and we will keep on growing. No.
2. The world, national, and local leaders are all aware that **the STEM subjects heavily depend on the 'Math Prosperity'** (as Lee calls it as opposed to 'Math Poverty'). The trouble is almost the entire western world has reached the math education saturations over the past 10-20 years or more. In the case of the USA, over the past 10 years or so – as I provided NAEP evidences below – and this is not going to go away.
3. The traditional math education is **too time-consuming and heavily costing**, and to raise the national average (especially internationally) proves to be very difficult to almost all of the western OECD nations according to PISA and TIMSS.
4. **The seemingly universal shortage of the STEM and math teachers**, including almost all USA states, New Zealand, Australia, etc., and this doesn't have an easy short solutions either.
5. **Math causes too much math anxiety and traumas almost universally,** which I don't need to explain as this is a common understanding and the majority of the population seems very vulnerable, including the students from the top math edu nations.
6. **Technology will not save math stagnations alone:** in spite of the heavy investments on the new apps and the tech-based math education, exemplified by Khan Academy, gamifications, and numerous apps especially in most of the developed OECD nations, the vast majority of these developed countries' math averages have gotten worse and worse, not just stagnating past 5-10 years in spite of utilizing technologies. What does this mean? When it comes to math boosts, the bottom line is that they are not sustainable and haven't changed. The fancy toys are for cheap joys, not for the fundamental learning beyond some superficial entertainments in education.

So instead of all the fruitless mambos and jumbos, the author (Lee) proposes firstly to run MMU pilot studies based on his previous pilot successes in Mexico and Guatemala. MMU1 is to very

rapidly boost the 25 percentile of math students (equivalent to about the average of the worst half math students) to the 75th percentile (equivalent to about the best half math student participants): to run some really data-driven, factually most efficient math education instead of all the useless pedagogy, theories of psychology, etc.

Firstly, the massive negative impacts that we all need to be aware of, whether you are commissioners, district superintendents, or school superintendents and principals, as well as the media people.

1. **Math stagnations are here to stay no matter what you try:** no matter what your government or DOE will try, the math average will barely go up as they have stabilized or often even got worse according to the entire levels of the respected math assessments: 1) internationally as all English-speaking and almost all OECD nations have become (according to PISA 2000-2015 Math, TIMSS 1995-2015 math), 2) nationally, statewide for 90-95% of all USA states (according to NAEP math 1992-2015), 3) large school district-wide (according to about 90% of all the TUDA of NAEP participating 22 cities or districts), and 4) as the Common Core math has been based and measured against the NAEP and the NAEP 2015 math showed even the marked falling off for the first time since over 20 years of operations.
2. **The math stagnations are in for almost 1 decade already (for about 90% of the 50 USA states).** For the PISA math, the national average has been worse for most of the developed countries.
3. **Math Poverty dragging down the growth socially and economically** (typically for about the math worst 15-35 percentiles of the students), be it from Low Performance of PISA or similarly for TIMSS or Below Basic of NAEP (National Report Cards) or just the lowest 20-40 percentiles of any of these tests, have the very tight and strongest correlations with the average math growths. In other words, the math average of your districts, cities, states and nation will not rise much without radically reducing the math poverty.
4. **Math growths from 1995-2005 or so in most USA states and cities (based on National Report Cards) may be much less than what people have thought.** In the past according to NAEP for 23 years, there have been much progresses if we don't take into account of the math average of the USA in TIMSS and PISA. If we take into account of the USA national math averages in TIMSS and PISA, then about more than half the math gains from NAEP's are illusions; in other words, in the international competitive perspectives, the statewide or citywide gains are at most half of what the US educators have believed because the 15-20 years averages of these show little growths in the internationally standardized tests.
5. **Math stagnations mean the math edu crisis, which means the future economic crisis:** this is because the 5-7% of the annual GDP or state GDP, etc., are used for the education hoping especially to boost the national, state or even district level average income per capita over the next half a century plus, but the chances are this is not going to happen because the stagnation in its long persistent and consistent manner means the entire EDU operations are just for the maintenance (as the majority of the OECD nations in PISA math have actually gotten worse past 15 years) and there will not be the surplus economic engines to contribute. [1] In the past, educators believed that adding more mean years of schooling can solve the problems and generate the economic growths. Not anymore.

[1] For this, please refer to the 7 page Executive Summary as to why MMU1.

7. **The trouble is the Departments or Ministries Of Education around the world seem very rigid guided by heavily layered bureaucracies to implement the MMU1 proposals** although they may all rapidly pay attentions to the new math EDU gadgets and technology-based education even though they have no real concrete, sustainable math boosts as the vast majority of the OECD nations with the heavy dependence on the technology-based math education have failed miserably as the PISA and TIMSS math data attest.
8. We hope that this crudely awakening paper on the math edu stagnation nations, states, and cities can wake up the high position people at the administrative or executive levels in education establishments and governments so that they start exploring the alternative actively without biases to their traditional modus operandi.

APPENDIX with the visual evidences: math stagnations are here to stay unless some radical solutions like MMU1 are embraced.

The math stagnations exclusively from the international math assessments' points of view (those of PISA 2000-2015 and TIMESS 1995-2015), focusing on the English-speaking countries

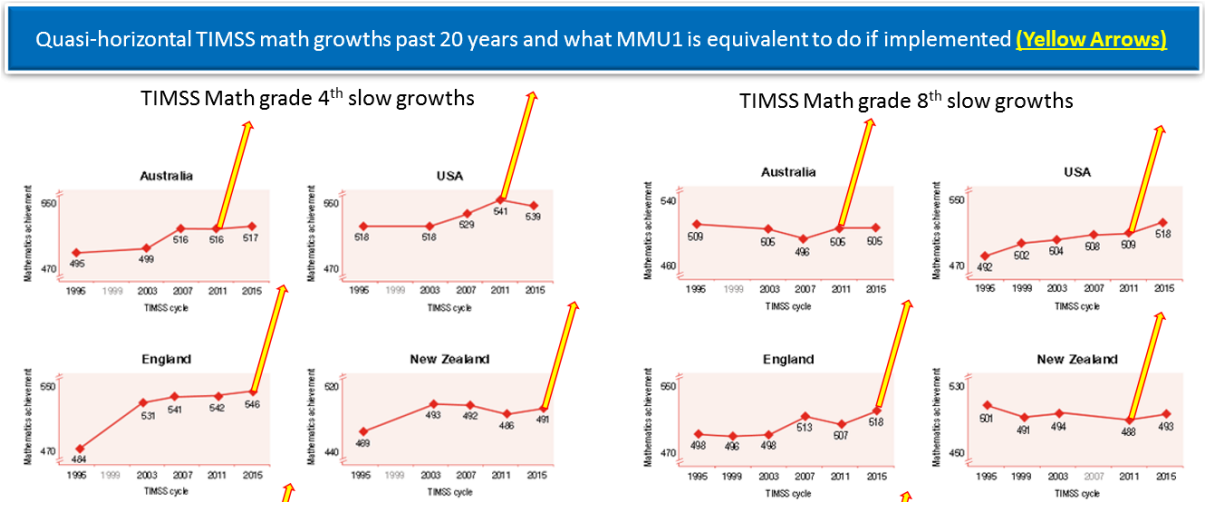
Throughout here, I included the yellow arrows (which signifies the principle of MMU1 to rapidly boost the math poverty of the 25 percentiles (from the math poverty half) to about 75 percentile (to the math richer half). If the rapid supports and collaborations, we can make this happen in 2-3 years for a district or city and 3-4 years for state or 4-5 years for a country.

The color schemes I will use:

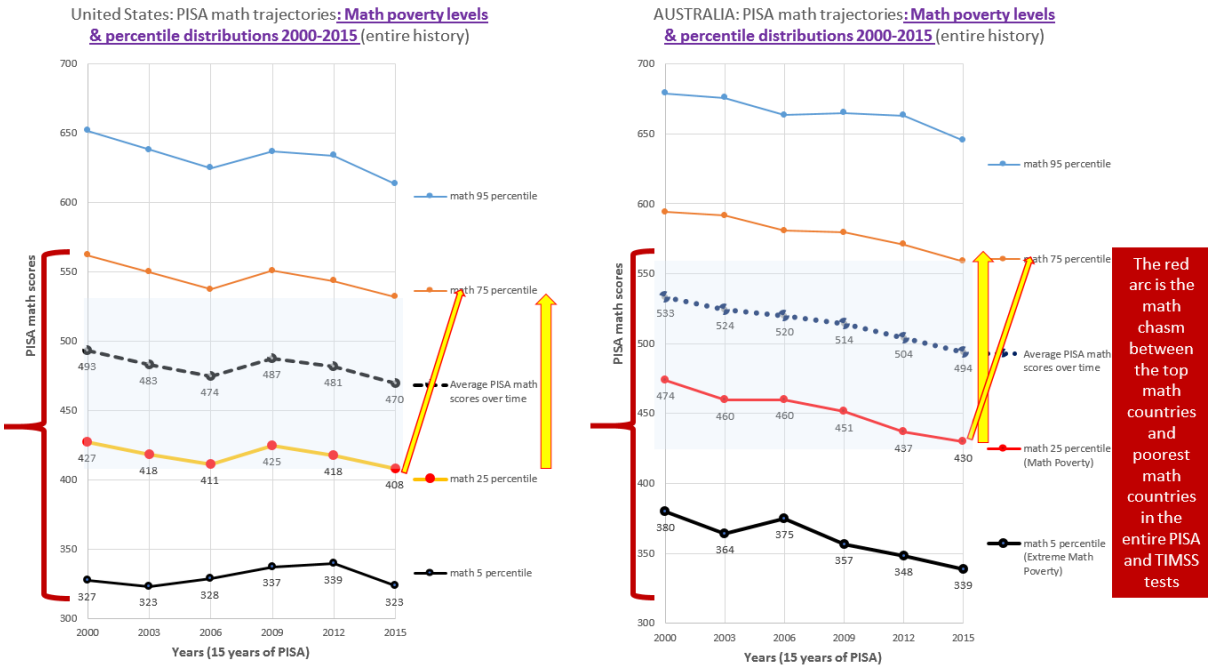
- **the yellow arrow** for the MMU1 (to boost the math share 25 percentile – or the average of the math poorest half of the student population – to about 75 percentile share (or the average of the math richest half of the student population).
- **The orange arrow**: for 1/3 of the MMU1 (to boost from about 25 percentile to about 43 percentile), which is roughly about the math gains of the USA national average in 1995-2015 (for 20 years) although the past 10 years had almost no gains in NAEP math.

The math stagnations from the English-speaking developed countries' point of view

1) Very little math growths of the national math average, especially for the past 10 years for both 4th and 8th grades **NOT just for the USA, but for all of the English-speaking countries**.



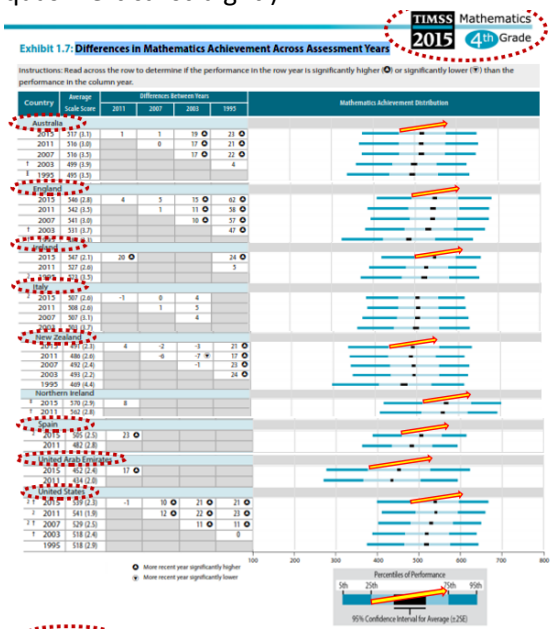
2) The math de-growths of almost all English-speaking countries (Not just the USA) in PISA math 2000-2015.[2]

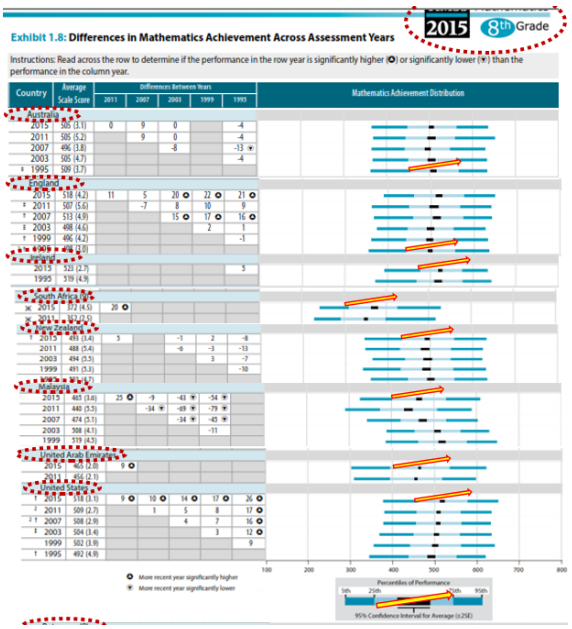


3) Math stagnations are here to stay and the tiny gains are illusions. Over the 2 decades (vertically), there are little changes as you can see in these percentile diagrams. The yellow arrows indicate the magnitude of math growths from the 25the percentile to the 75th percentile. Normally, this may take 50-100-200 years, but MMU1 can make this happen in 2-3 years for a district; in 3-4 years for a state; in 4-5 years for a country. (You can see the little changes in 20 years here. All

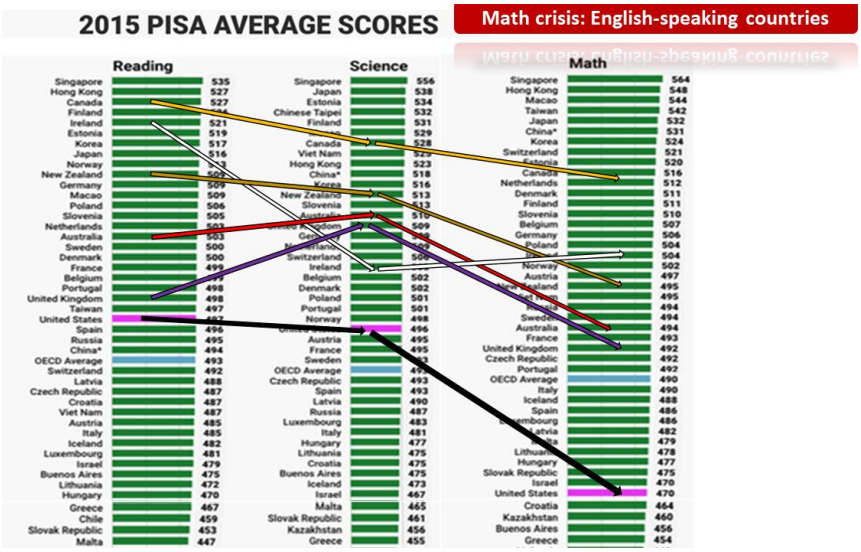
[2] For the entire English-speaking or Latin American countries' visual data, please refer to author's other paper.

quasi-vertical straight.)





4) In all English-speaking developed countries (Canada, Ireland, Australia, New Zealand, and the USA), Math is much worse than Reading according to PISA. Here from the PISA 2015.



5) All developed English-speaking countries and most of the Latin American countries have (much) stronger reading scores than math scores by large margins, especially for the USA , Chile, Brazil,

Costa Rica, and Colombia in the stark contrasts against the top math Eastern Asian countries.

PISA 2015: Math dominance vs. others' by regions: English or Spanish speaking countries vs. the North-Eastern Asia

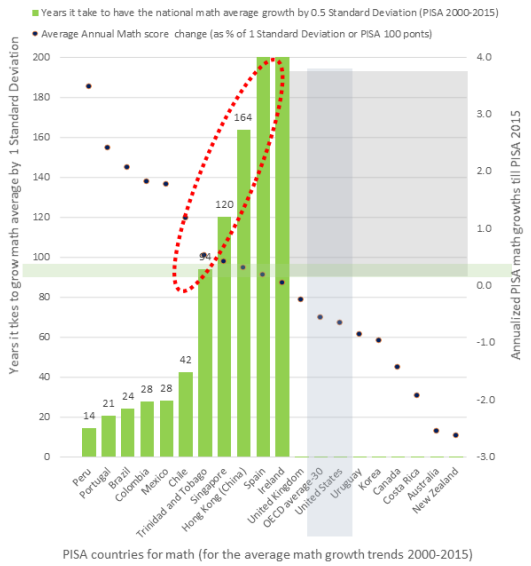
Mean score in PISA 2015	Math -Reading (PISA 2015)		Math - Science		Math - Science & reading average	
Chile		-36		-24		-30
Colombia		-35		-26		-31
Brazil		-30		-24		-27
Dominican Republic		-30		-4		-17
Costa Rica		-27		-19		-23
CABA (Argentina)		-19		-19		-19
Uruguay		-19		-17		-18
Mexico		-15		-8		-11
Peru		-11		-10		-11
Trinidad and Tobago		-10		-7		-9
United States		-27		-27		-27
Ireland		-17		1		-8
New Zealand		-14		-18		-16
Canada		-11		-12		-12
Australia		-9		-16		-13
United Kingdom		-5		-17		-11
Spain		-10		-7		-8
Portugal		-7		-9		-8
Korea		7		8		7
Japan		16		-6		5
Hong Kong (China)		21		25		23
Singapore		29		9		19
Macao (China)		35		15		25
B-S-J-G (China)		37		14		25
Chinese Taipei		45		10		28

Source: OECD, PISA 2015 Database, Tables I.2.4a, I.2.6, I.2.7, I.4.4a and I.5.4a.

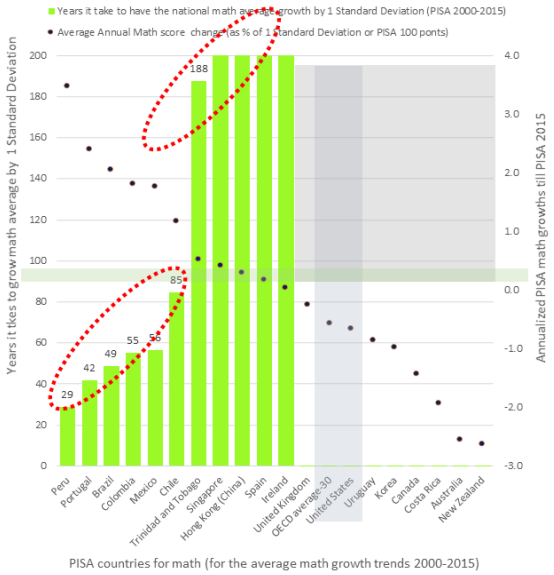
6) If the math stagnations are real, how long it takes even to reach 40-80% of what MMU1 aims to do (assuming the math growth patterns of PISA math 2000-2015)? Here is my answer. In virtually all developed OECD level nations, this will take 100-200 plus years according to history.

These show how many generations are needed to even boost the national math by 40-80% of what MMU1 can do.

Years it take to have the national math average growth by 0.5 Standard Deviation (PISA 2000-2015) **in English, Spanish, Portuguese, or Korean speaking countries**

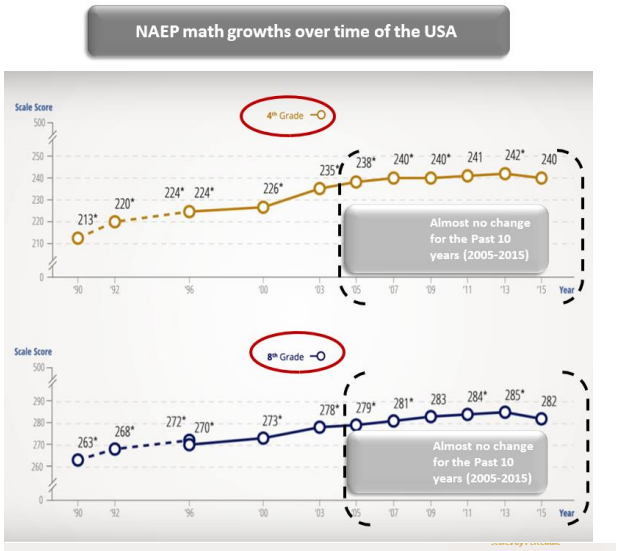


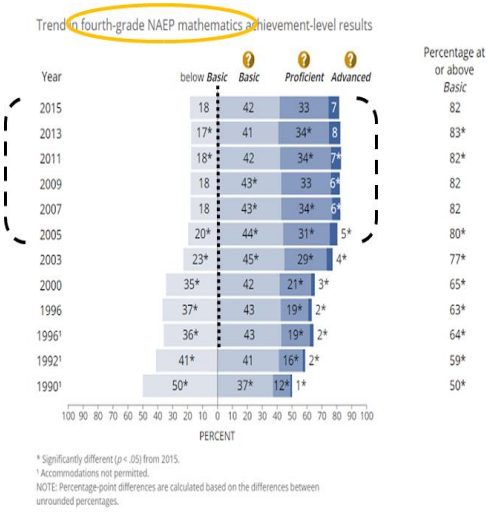
Years it take to have the national math average growth by 1 Standard Deviation (PISA 2000-2015) in English, Spanish, Portuguese, or Korean speaking countries



The math stagnations exclusively from the USA states' points of view

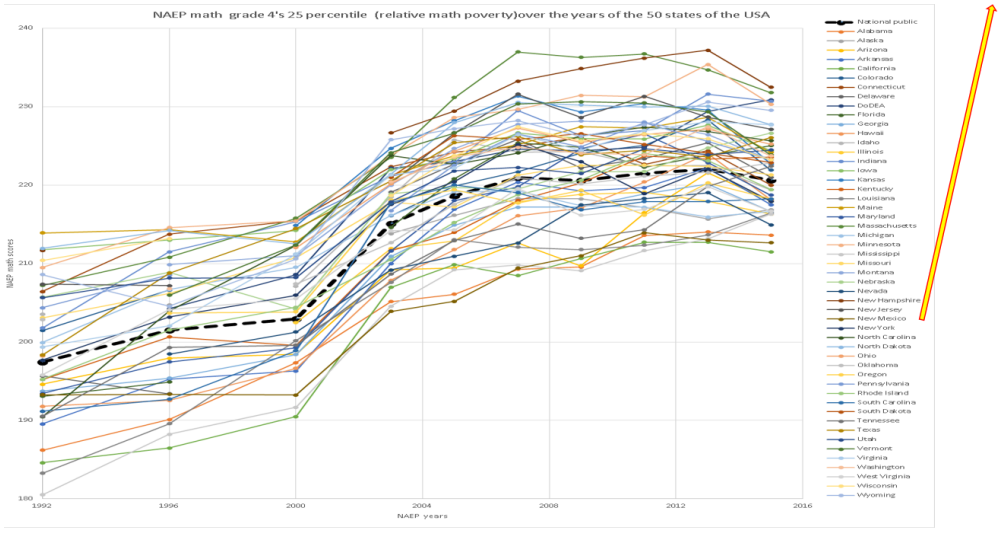
1) So, internationally, the entire English-speaking countries are in the math EDU stagnations or regressing. How about only national data of the USA, forgetting about the depressing international comparisons of growths? The national level stagnations over a decade is very clear. 2015 had the first ever dip in math scores of the both grades 4 and 8 for the first time in 25 years since its National Report Card (NAEP) operations in 1990.





Math grade 4's 25 percentile stagnation. We can pretend that the stagnations are not real, but all the technology-based math buzz did not change a bit past 10 years while internet, tabletsand apps reached every student.

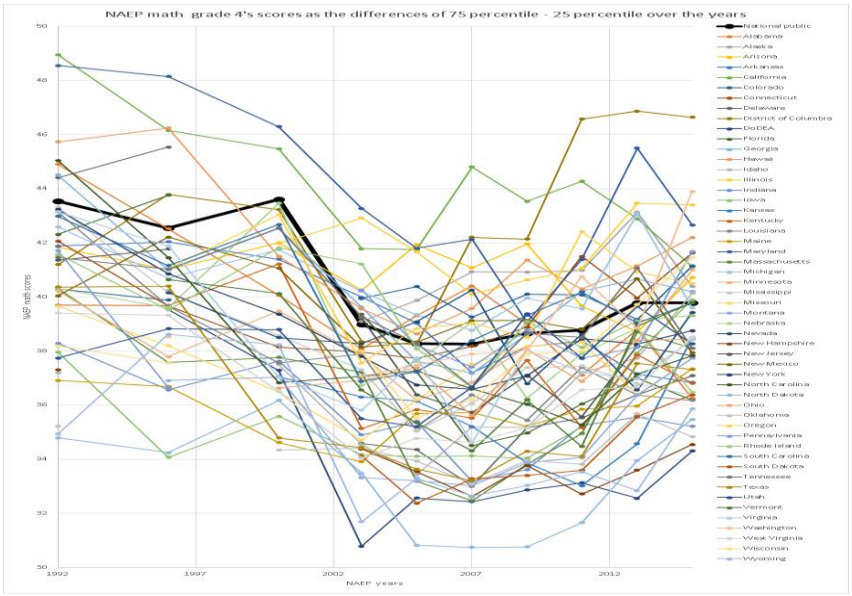
2) Math growth saturations across the entire USA states are real over the past about 10 years. The proof? NAEP data (National Report Cards) data vs. the yellow arrow indications for the math poverty measure using the math 25 percentile of the NAEP math grade 4.



This report was generated using the NAEP State Comparisons Tool.http://nces.ed.gov/nationsreportcard/statecomparisons/
Average Mathematics scale score sorted by all students, grade 4 public schools: By jurisdiction

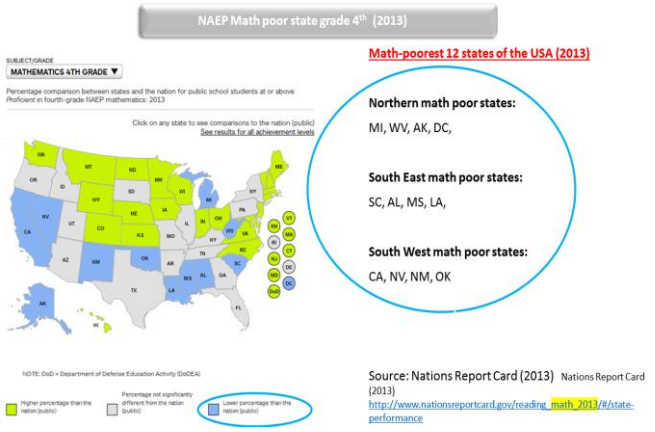
3) For NAEP math, why I use about 40 pointsin math for the percentile difference between 25th and 75th is given here based on the time series pattern of over the past 15 years or so although was larger earlier to around 44 points. Over the past 1 or 2 decades, the rule of thumb distance between the math score percentiles between the 25th to 75th percentiles in NAEP math grades 4 or 8 is roughly 40 points in Math in NAEP math data. So I used that as

an anchor too make the arrow plots against the traditional math growths in NAEP math.

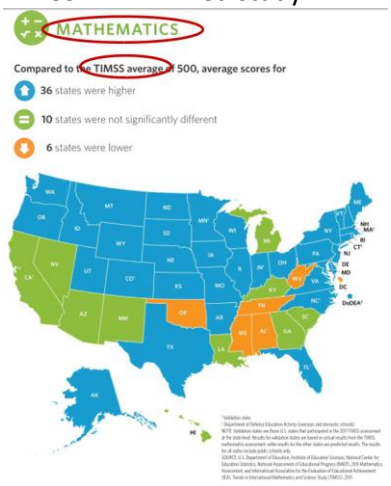


4) So what are the math poorest and math poorer states?

According to NAEP math grade 4 for 2013

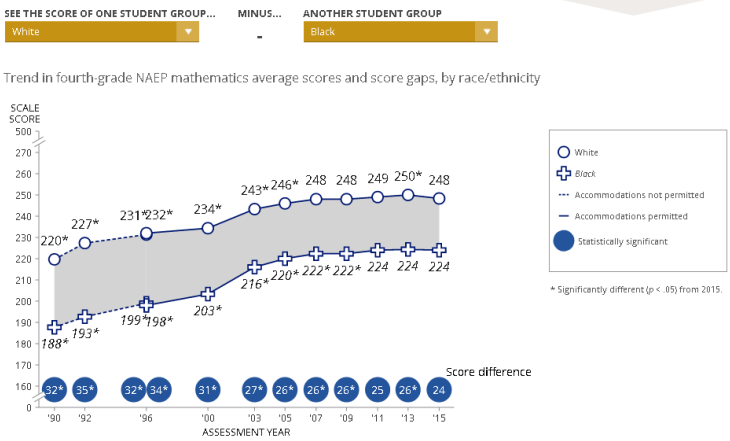


TIMSS-NAEP linked study



including those in the Departments of Education at any level, the implications of MMU1 or even the plan 4th of MMU (1/3 of MMU1 capacity) should be absolutely clear to the readers.

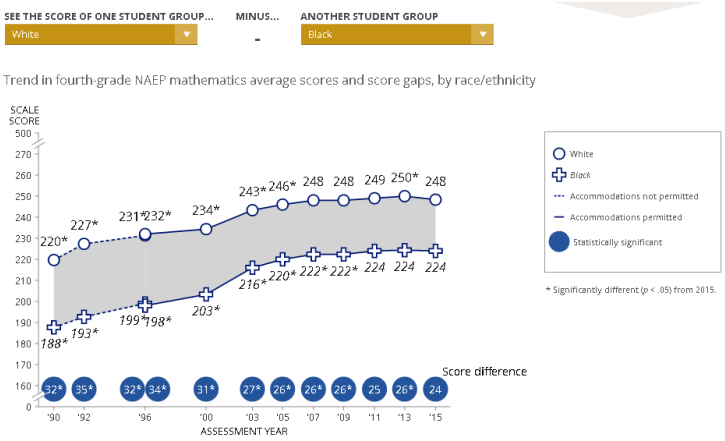
5) **To reduce the racial gaps in math has been wishful thinking and the reality bites**..



I don't know if you can pretend that the ideology of the reducing the ethnic gaps have been successful if you see actually see the data from NAEP.

25 years for little change.

You can either believe that the new technology gadgets will change this for nothing again or support the real and

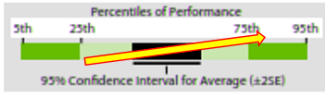
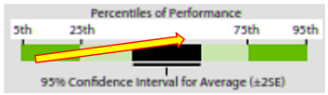
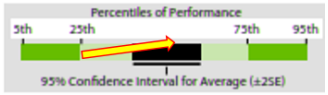
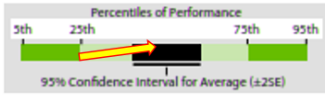


concrete innovations to radically reduce the gaps in 2-4 years no 50-100 years.

Radical Solution with MMU1 (or at least 1/3 of the version of MMU1 called Plan 4) to reform in just 2-4 years: so how do we overcome the massive loss of time, sweats and tears and economic loss?

The stagnations of the math growths of TIMSS grades 4 and 8 in all English speaking developed countries and some others in the next page. They are all vertical. The YELLOW ARROW is what MMU1 focuses on: to empower the math poorer 25 percentile to the 75 percentile very rapidly for the fully supporting, committed nations.

MMU1 pilots will be the mere appetizer versions to run in just 1-2 weeks.

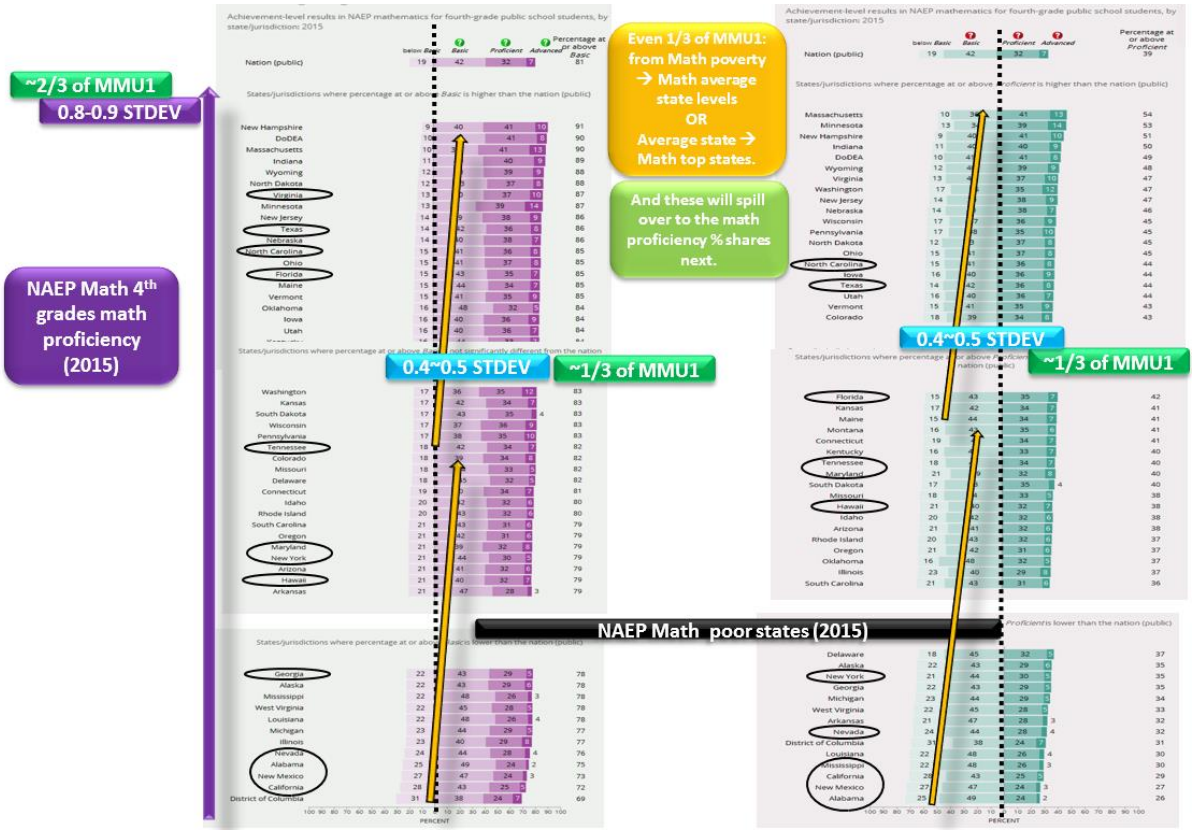
Priority plan1 (for districts): 25 percentile → 75 percentile	**For the first school districts & DOEs that support MMU1 goals strongly.**	
Priority plan 2 (to end math poverty): 10 percentile → 50 percentile	**For those who are only interested in ending bottom math groups.**	
Plan 3 (if less supportive, about half level of the plan 1): 25 percentile → 50 percentile	**For those who don't initially support MMU1 strongly (e.g DOEs and districts).**	
Plan 4 (if still less supportive, about 1/3 level of the plan 1): 25 percentile → 43 percentile	**Still more than what USA, Australia, New Zeland, and Canada gained in 20 years!**	

The worst case scenario for those who are skeptical about this approach as what MMU1 proposes is still massive although boring in the MMU1's point of view. As we will show in the next point, even the worst case scenario of Plan 4 is on par with what the USA national math for the grade 4 has achieved for the past 20 years (1995-2015) after the astronomical costs, sweats and tears as well as for most other developed English-speaking countries. You have to realize that even the difference between the best maths vs. the worst math states of the USA for the grade 4 math in Below Basic is only about 20-22% and by now all national Department Of Education administrators should know how hard it is to end this gap.

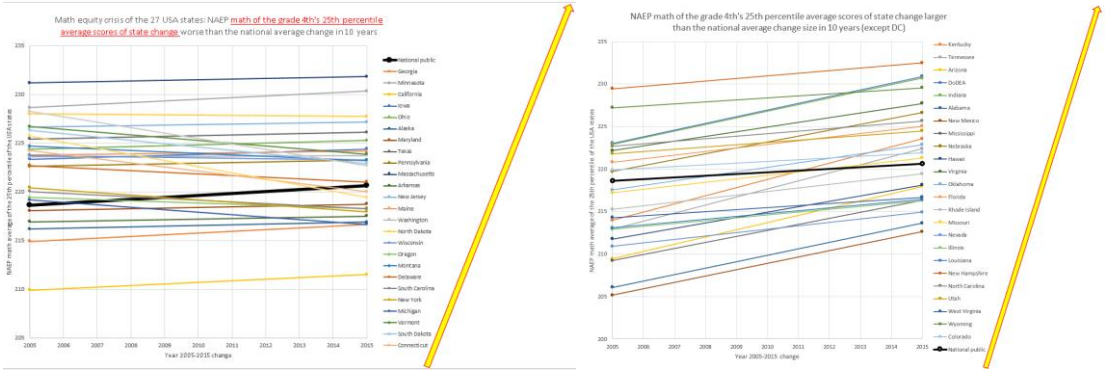
1) The champagne popping time for the math growth is basically over: worse still is that although about 1/3 of the capacity of MMU1 has been achieved by the USA math average for the grade 4 NAEP tests in 1995-2015, you have to realize that most of the gains were

obtained during the first a decade of this era, but for 2005-2015 (the second half) there have been almost no gains at all especially for the math richer half states of the USA. [3]

2) In the context of the National Report Cards (NAEP)'s math grade 4, the implications can be easily found here. In its standard, let's look at the Below Basic Math along the vertical dot lines. The top 10 math states (with about average 12% in Below Basic) vs. the mid-tier (about 19% in Below Basic) vs. the math bottom 10 states (about 25% in Below Basic). And the best of the USA vs. the worst of the USA state math Below Basic average difference is roughly by about 20% (NOT including Puerto Rico). So even the plan 4th of MMU1, which uses only about 1/3 of MMU1 capacity, can empower the math poorest states to the USA state average or the USA math average states to the math top USA states at least for the grade 3-5 levels for now.

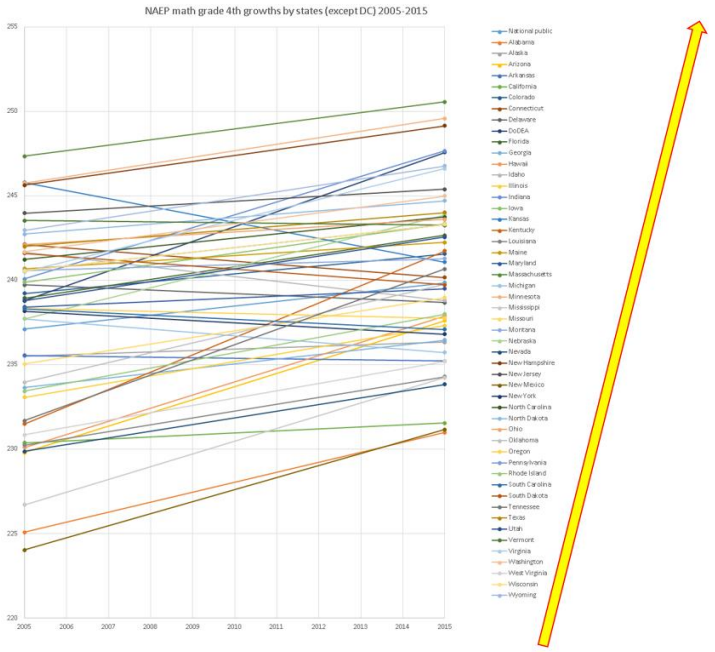


3) For the USA state math stagnations vs. MMU1 projections…

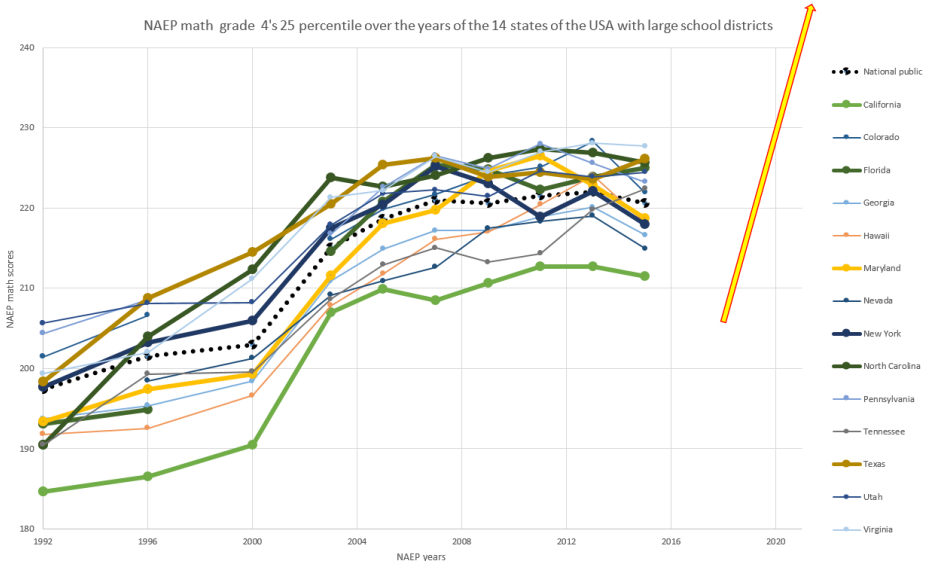


[3] I provide the ample evidences in other papers.

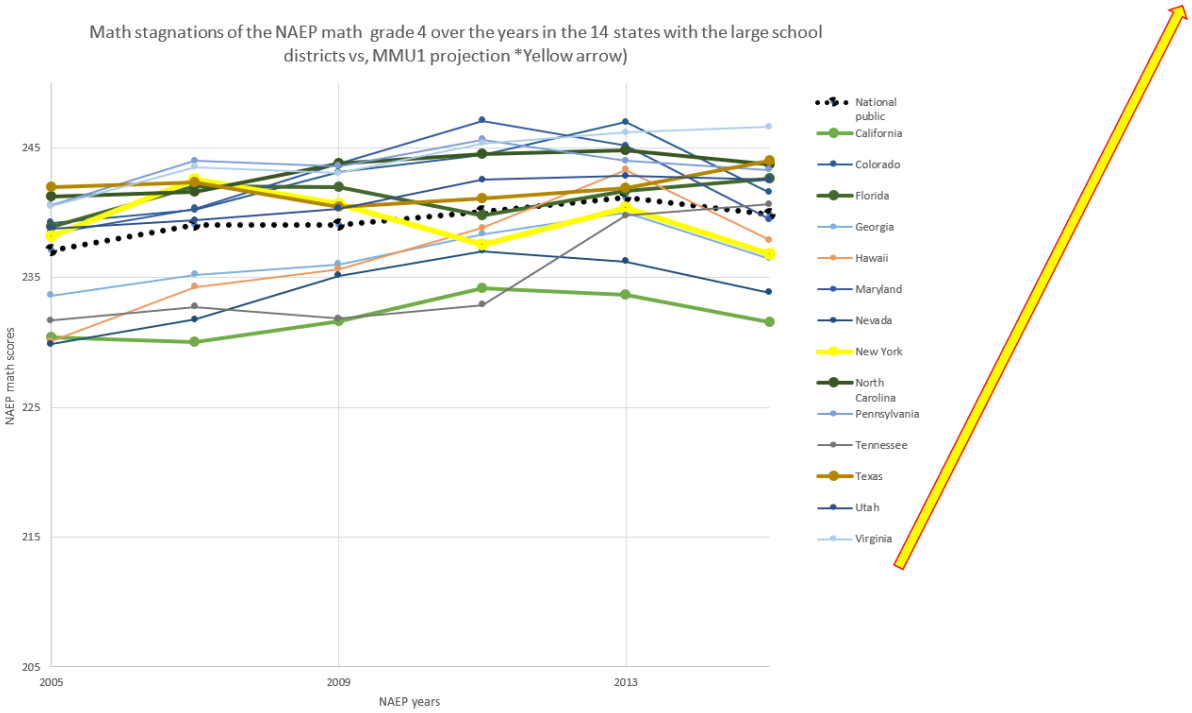
MMU1 vs. the entire USA states' math growths past 10 years till 2015



4) Math growth saturations for the past 23 years in the main USA states vs. MMU1 projection



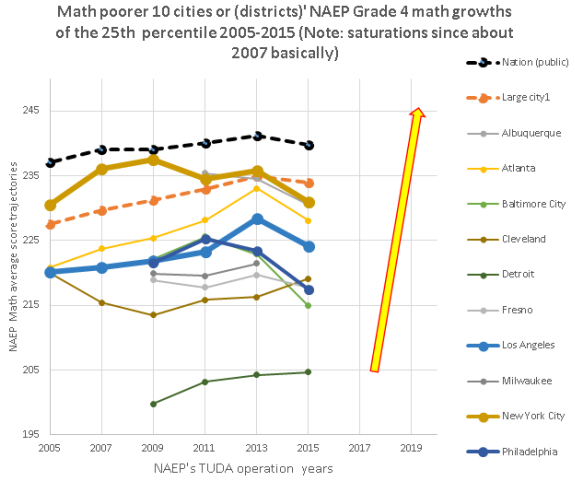
5) The math EDU grade 4 stagnations for the larger states with larger school districts over the past 10 years (2005-2015) vs. the MMU1 projection if implemented fully over 4 years.

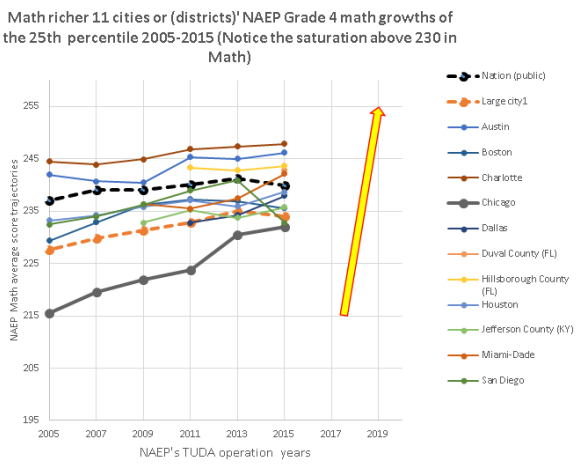


For more math stagnation visual data from the individual states of the USA from the NAEP data, you may find in Lee, Dongchan. 2017. Math Stagnations in Most of the Usa States According to the Naep Math 2000-2015 http://vixra.org/abs/1701.0692

The math stagnations exclusively from the USA cities' or districts' points of view

What can MMU1 at the city or school district levels? Please pay attention to the slope of MMU1's yellow arrows. MMU1 implementations for the cities or districts will be only 2-3 years or so. So the yellow arrows' slopes are 1.5-2 times steeper than the cases for the statewide implementations.





For the individual math growth time series of the individual cities or districts, you can see at Lee, Dongchan. 2017. Math Stagnations in the Mega Cities and School Districts of the Usa According to Tuda of Naep http://vixra.org/abs/1701.0693

For more cities or districts of the USA

What does this author want to make happen and what can you do?

As this initiation of MMU1 is not something conventional or light, we need to pay special attentions.

1) To invite Dongchan Lee to your districts, cities, states, or countries to run MMU1 pilots without relying the typical hyper-bureaucracies as this is not one of the typical gadget projects. This one is to shake up the entire math education practices around the world. So why not taking responsibility and taking your versions of committed actions instead of pointing to other bureaucracies or systems?
2) If the regulations of your country, state, city or districts prevent you from taking immediate actions to support this cause, you can contribute in innumerable forms: to mention about MMU1 proposal to various leaders of the EDU, ONG, government, media or otherwise.
3) We need the MMU1 pilot study happen in the developed countries cities or states this year (preferably in spring). As such, we need as much publicities, allies, and supporters as possible.

Conclusion

We hope that this paper summaries the key information that the Education authorities become aware and take the ethical and efficient actions to collaborate with the MMU1 to bring the radical changes in the math education in their districts, cities, states, and nations from 2017 on.

References

National or state or city or district level math assessment timelines

1) U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), various years, 1992–2015 Mathematics Assessments.
2) the NAEP math grade 4: https://www.nationsreportcard.gov/reading_math_2015/#mathematics/district/trends/XQ?grade=4
3) the NAEP math grade 8: https://www.nationsreportcard.gov/reading_math_2015/#mathematics/district/trends/XQ?grade=8

International level math assessment timelines

1) PISA, OECD (accessed on January 5th, 2017) https://data.oecd.org/pisa/mathematics-performance-pisa.htm
2) TIMSS mathematics results (accessed on January 5th, 2017) http://timss2015.org/timss-2015/mathematics/student-achievement/trends-in-mathematics-achievement/

WP (Working Paper) series of "Math Stagnation Nations" series by Lee

1) Lee, Dongchan. 2017 February. WP series of "Mathematics Stagnation Nations" for the USA, Australia, New Zealand, UK, and Ireland and most Latin American countries (Part 1). "Math stagnation nations of all 5 developed, English-speaking countries according to PISA and TIMSS for the past 15-20 years of the math growth history: what this means for education and economy"
2) Lee, Dongchan. 2017 February. WP series of "Mathematics Stagnation Nations" for the USA (Part 2). "NAEP (National Report Cards) Math Grade 4 & 8 stagnations 1992-2015 of the 50 states of the United States: national, regional, and the past growth compared to the projected MMU1 impacts on math growths if fully implemented in 3-4 years" (http://vixra.org/pdf/1702.0101v1.pdf for the version 1)
3) Lee, Dongchan. 2017 February. WP series of "Mathematics Stagnation Nations" for the USA (Part 3). The collective Math stagnations of the grades 4th and 8th in the big cities (or the School Districts based on TUDA of NAEP) of the USA over the 1 decade: their confirmations, time lags, math poverty shares, and the roles of the Common Core math (http://vixra.org/abs/1702.0101)
4) Lee, Dongchan. 2017 February. WP series of "Mathematics Stagnation Nations" for the USA (Part 4). Math Education Stagnations in the USA played more roles than the Common Core Math Standards impacts for the stagnations on the NAEP math 2015, but the Math dipping were most likely due to CCSS Math (http://vixra.org/abs/1702.0097)
5) Lee, Dongchan. 2017 February. WP series of "Mathematics Stagnation Nations" for the USA (Part 5). The quasi-universal math stagnations in almost all developed countries are real and won't go away. How to transcend them with MMU1 or at least 1/3 of its full version in just 2-4 years

Some preparation materials for the WP (Working Paper) series of "Math Stagnation Nations" series by Dongchan Lee

1) Lee, Dongchan. 2017 February. "What Pisa & Timss 2015 Show: the global Math Edu Crisis and Its Economic Impacts" http://vixra.org/abs/1701.0485
2) Lee, Dongchan. 2017 February. Math Stagnations in the Mega Cities and School Districts of the Usa According to Tuda of Naep http://vixra.org/abs/1701.0693
3) Lee, Dongchan. 2017 February. Math Stagnations in Most of the USA States According to the NAEP Math 2000-2015 http://vixra.org/abs/1701.0692
4) Lee, Dongchan. 2017 February. 8 point executive summary: math stagnations and the Economic impacts of MMU1: To end the math poverty multiple times faster with MMU1 than without it (then to achieve the POST-2015 goals of the UN multiple time faster than without MMU1) (http://rxiv.org/abs/1702.0056)
5) Lee, Dongchan. 2017 January. "What PISA 2015 and TIMSS 2015 show: global math EDU crisis and its economic impacts" (http://vixra.org/abs/1701.0485)

Some Youtube versions by Dongchan Lee

1) Lee, Dongchan. 2017. "Math edu crisis in most of the USA states and what MMU1 can do" https://www.youtube.com/watch?v=qiZW2GnNLXQ
2) Lee, Dongchan. 2017. "Math EDU crisis in most of the USA states Part 2 and what MMU1 can do" https://www.youtube.com/watch?v=vB7LcMLVWs4

Lee's online repository to get updates about the WP series on "Math Stagnation Nations"
http://uslgoglobal.com/wp-math-stagnation/