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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)

By Dongchan Lee (Version 6 on February 3, 2017)

Highlight summary and solutions by Dongchan Lee with MMU1 for the developed or Latin countries.

1) There have been **ongoing math education collapses or stagnations** in most English-speaking and Latin American countries. (To see is to believe.) So I provided some data from PISA 2000-2015 and TIMSS 1995-2015 (as these two are basically the Olympics and the World Cup of the largest, international education assessments) as they are standardized & normalized.
2) According to these data of the past 20 years, which is more than enough to show the math EDU stagnations, **the chances for the rapid improvements for the next 10-20 years are extremely slim** no matter what the MOEs or DOEs of these countries try as these countries have spent normally 5-7% of GDP annually for education and still increasing the costs.
3) **In almost all English-speaking or Latin American countries, their gains have been lopsided for the Reading skills much higher than the Math skills**, especially compared to the EDU and economic power houses of 5-7 Eastern Asian countries. This has the significant economic impacts. This alone has ½-2/3 of the impacts of the EDU as a whole.
4) **Education costs lost for no progress for 15-20 years is on par with the national debt size:** 6% of GDP per year x 20 years ~ 120% of the annual real GDP cumulatively (for almost all the English-speaking nations, e.g. the U.S.A.) ~ is on par with the sovereign debts of these nations, and the lost costs will continue increasing over the next 10-20 years and beyond.
5) **Even in just 10-15 years alone,** after reducing math poverty in 2-4 years with MMU1, the surplus gains are larger than the entire annual national education cost (about 5-6% of GDP).
6) **Lee's mantra: to end the math poverty is to end the poverty:** in most OECD nations, math poverty is about 20-30% of the student population. In most Latin America, 50-90% of the student population have the math poverty.[1] They mean the lost economy of dozens of times of the current real GDP (per capita) of almost all OECD (more for Latin American countries).
7) **Lee's current proposals:** to run MMU1 pilots in each participating nations' main cities or states as pilot projects that consist of at least 4,000 student participations, exclusively online-based lectures and tests targeting for the math poorest 25% (for the OECDs) or 50% (for most of the Latin American countries) of the student populations. In each pilot studies, Lee will take the worst half of the math students and will raise them to the best half average in 1-2 weeks of the pilot studies for at least 4,000 student participations. Once the initial results are persuasive enough, then Lee and the governments may collaborate to scale this up starting with the grades 3-5 first in 2017 to radically, rapidly reduce the math poverty. The preliminary MMU1 pilots were done in Guatemala 2016 with the persuasive results.[2] The MMU1 series is meant to empower all, be it your cities, states, governments, or philanthropists, investors, or NGOs by ending math poverty and empower all very rapidly.

[1] Lee's current math poverty definition is about PISA math 420 equivalent or below.
[2] You can see the evidences at http://uslgoglobal.com/short-video-evidence-summaries-about-usl-mmu1-mini-mini-usl1/

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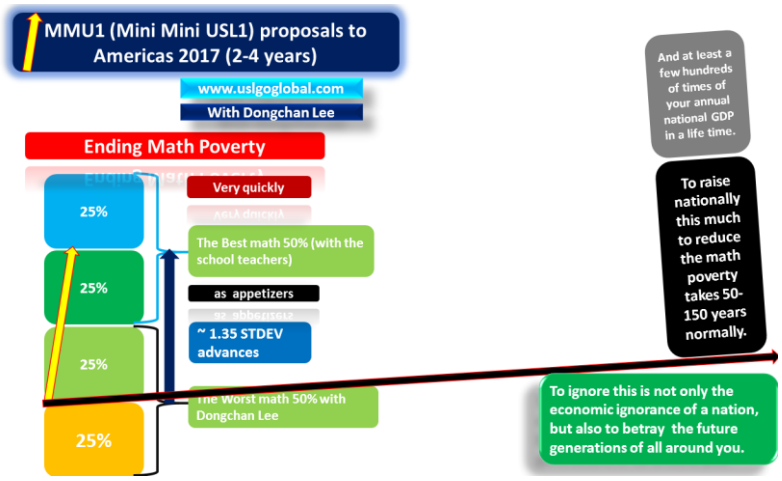
APPENDIX

What Lee has (or will be released online quickly) can be summarized as follows. All the PISA and TIMSS data came from the OECD PISA data and TIMSS website in December 2016.

To end the math poverty is to end the poverty itself. Except the tiny minority with the abundant oil wealth, this is the fastest and the most efficient way to end the poverty quickly.

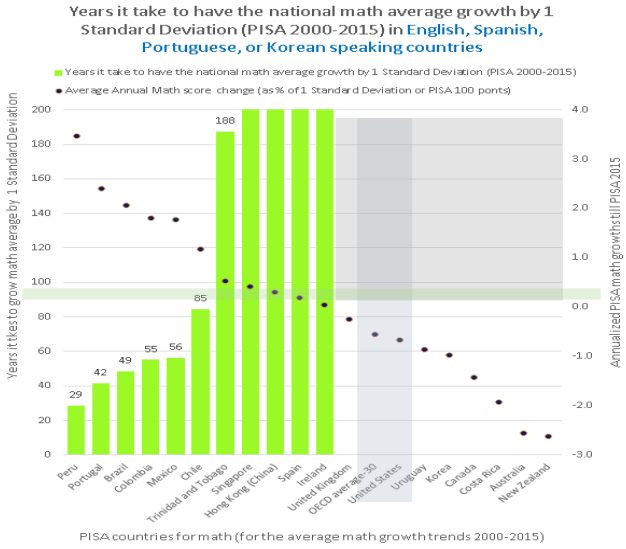


Point 1: Why to end the math poverty is to end the poverty itself?

Across the globe, the countries with the faster math growths tend to have much faster economic growths. Without math, the growths are largely illusions excpet for the very resource-rich handful of countries. Reading skills and literacy can't change much without math skill boosts.

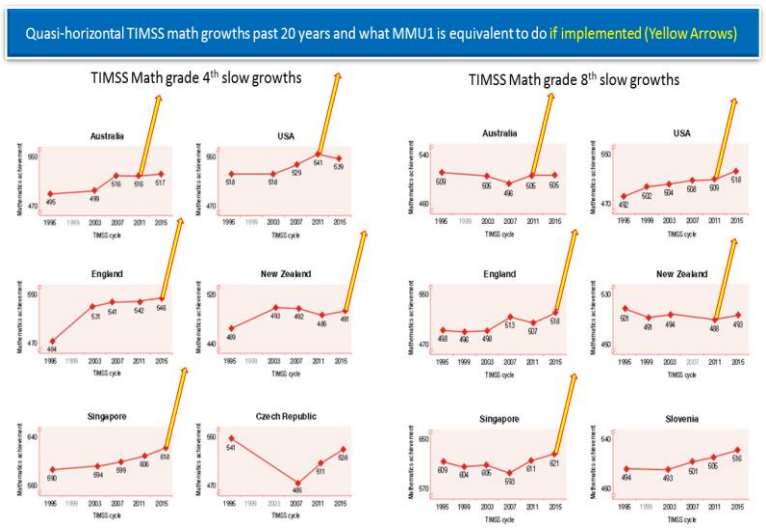
Point 2: It takes only too long to improve the national math average. Typically 30-100+ years to gain as we want: According to the past 15-20 years of history of math growths from PISA and TIMSS, how long will it take to improve the national math average by 0.5 Standard Deviation or 1 Standard Deviation? Typically half or entire 1-2 lives or beyond.

Here on the right chart, I share the years it takes to boost the national average of math by 1 Standard Deviation, which is roughly about 70-75% of the scaling up of the target of the MMU1 to give you the basic idea. For the majority here, it takes at least 100+ years.



Point 3: To see is to believe: <u>the Math stagnations have continued over the past 1 generation</u>: PISA 2000-2015 and TIMSS 1995-2015 have revealed that there have been overall almost no progresses of the average Math for the vast majority of the OECD countries. **To see is to believe:** Math stagnations over 1 generation. The visual trajectory of the stagnations from all English-speaking and the Latin American countries.

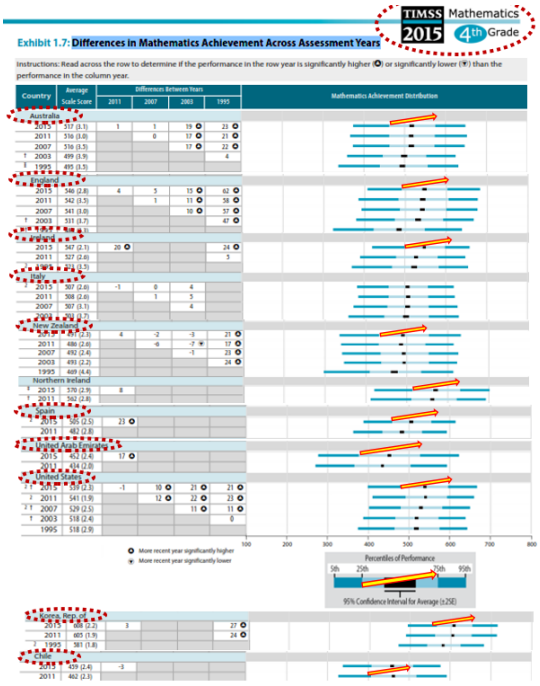
The yellow arrows are the magnitude of the MMU1's operations if fully implemented over the next 2-4 years as expected.

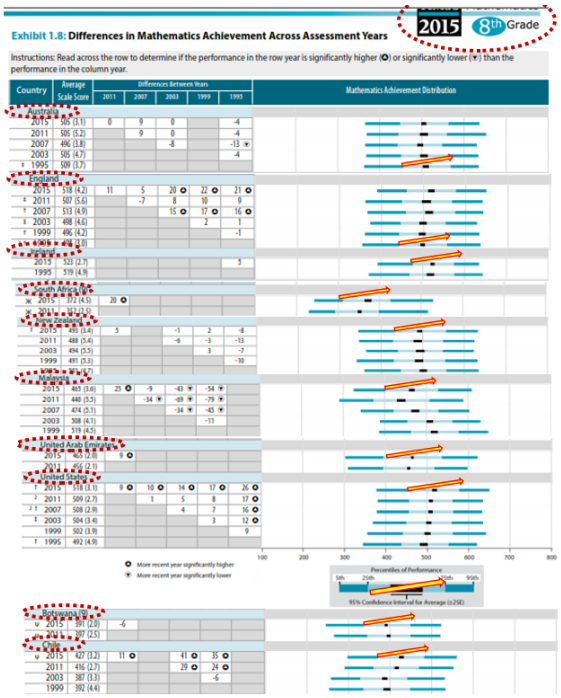


Point 4: Astronomical Economic costs

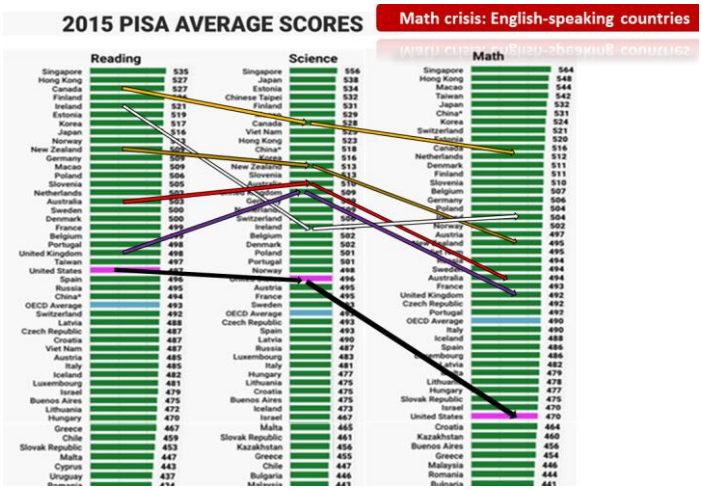
The yellow arrows are what the MMU1 impacts will be like at least for the math poorest 25 percentile of each country compared to the past 15-20 years of little or no progresses in most developed nations (where math progresses are almost flat for 20 years) as you can see in the charts. The 25th percentile to the 75th percentile can be clearly seen as chasms to all these countries in 20 years, which unlikely to be narrowed in the entire 21st century at the current rate in most of these nations according to the history.

The astronomical economic costs of not gaining the national math average over the past 20 years. The longer term vs. the short term. (the first brute force approximation): its lost cost is at least 50-100 times larger than the worst financial crisis you have seen since the WW2 in our life time[3].) So in average, each year of the math growth stagnation means 3-5 times of the worst national financial crisis lost in a larger scale of our life time. And worth about 0.3-1 Quadrillion USD for each of EU or the USA in a life time cumulatively.[4] Or for the student loan debts in the USA, the costs of no math growths in 20 years is at least 30-50 times more than the current USA student loan debts of about $1.3 Trillion USD for just next 20 years, not even half a century.





Source: TIMSS 2016



For the entire English-speaking countries that participated in PISA, the math scores are consistently and persistently worse than those of Reading and Science. This rule applies similarly to the great majority of the entire Latin American countries. The modern economic growths depend on the math and science, not just the literacy by readings. When the math stagnates, the science cannot move forward. When the 20-50% or more of the student population suffers from the math poverty, the future is not going to change simply by better reading skills. No comprehensive proofs necessary to see this fact.

[3] This alludes to the Financial crisis 2008 caused by the Wall Street and motivated the Occupy Wall Street.
[4] Lee will release more detailed analyses on the current math EDU crisis impacts on economy soon.

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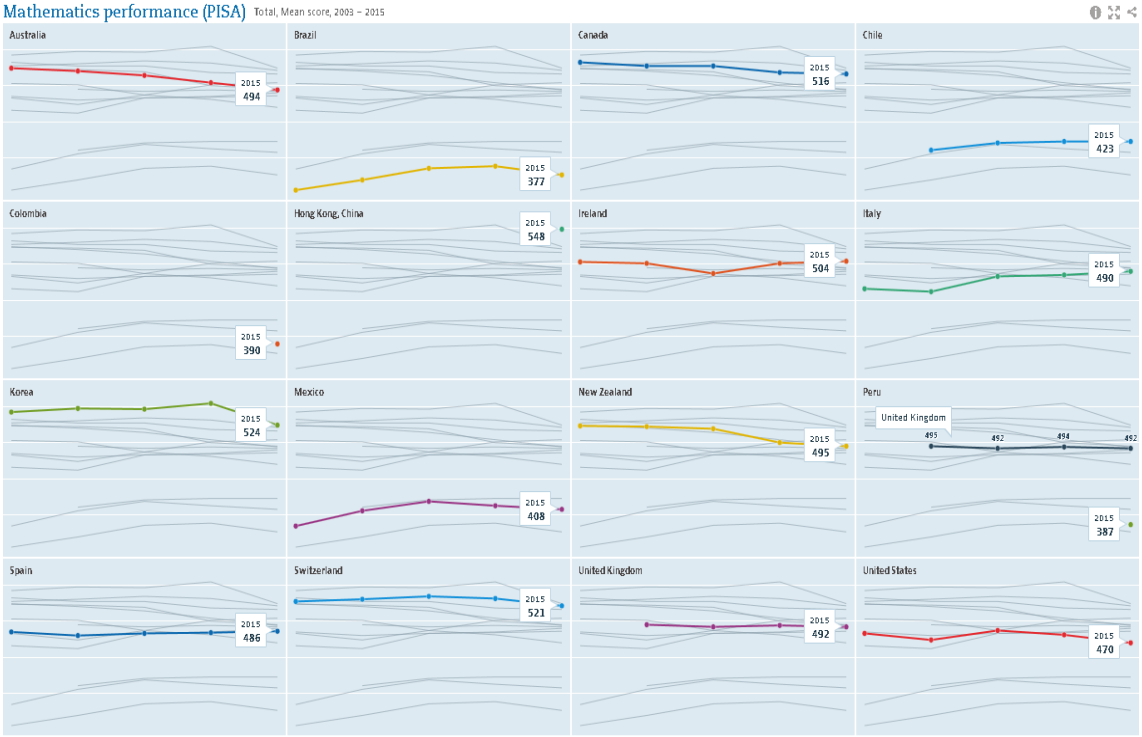
For the entire English-speaking or Latin American countries, their Reading is much better than Math in contrast to the Far Eastern Asian 7 countries (with exception of B-S-J-G provinces of China) where the math gains are much more predominant. Lee has demonstrated that this puts extra impacts on the economic growth disparities in these regions. In the English-speaking or Latina countries, the reading average is about 0.2-0.3 Standard Deviation better than their math in average and most of the nations couldn't even rise this much of the national math average past 15-20 years.

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.

Selected 16 country samples of PISA math 2003-2015 math growth stagnations or collapse trajectories



Source: OECD (2017) [5]

Point 5: rule of thumb estimations of the economic loss due to almost no math growths over 20 years (based on the regression charts below): Without using any fancy economic analysis, for roughly the same mean years of schooling, the right ends are 10-20 times richer than the left end (especially in the orange colored Western nations). This is for the actual quality of education; especially in mathematics the largest gaps arise. Although this illustration is just cross sectional in 2009, let's suppose it takes 40 years to get there to be 100% richer per capita. Overall average may be 50% richer (assuming linear growth) over the next 40 years, which means that 50% richer annually x 40 years ~ 20x of your current income per capita is lost. Or even for 20 years, the economic loss ~ 50% x 20 years ~ 10x of the surplus of the current income per capita. This 10x is larger than the typical, entire national debts of EU and the USA by about 10 times. **To be blunt for the Ministries or Departments of Education around the globe**, even with the most modest 10x of the annual income per capita (or similarly entire economy of your nation) estimations, **this is at least 5 times (and very possibly 10 times) larger than the entire education cost of your nation of the future 40 years**. For the USA, this is at least 200 times larger than the entire student loan debt as of 2014. Therefore, to ignore this as a reality may have dire consequences. Although this is correlation analysis, not the rigorous causality, at least you can see the scope of huge impacts lurking there. This is only to make people change the status quo.

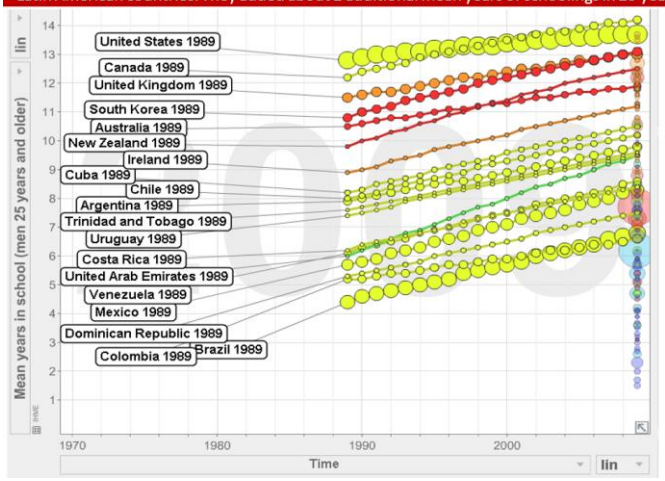
[5] OECD (2017), Mathematics performance (PISA) (indicator). doi: 10.1787/04711c74-en (Accessed on 06 January 2017)

Firstly, let's see how many additional mean years of schoolings have been added for the past about 20 years.

As you can see from the right chart, the average additional mean years of schooling in most of the English-speaking or Latin American countries **over the past 20 years (1989-2009), have been roughly 2 additional years of schooling**.

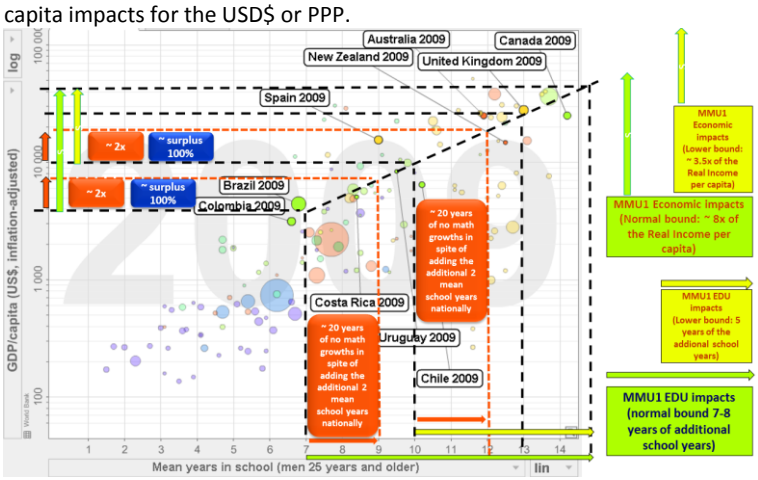
Note that in the vast majority of the nations, this is the case and the increase has been more or less linear except the top developed nations where the additions have slowed down tiny bit.

The 20 years of the mean years (1989-2009) of schooling in the English-speaking and most of the Latin American countries. They added about 2 additional mean years of schoolings in 20 years

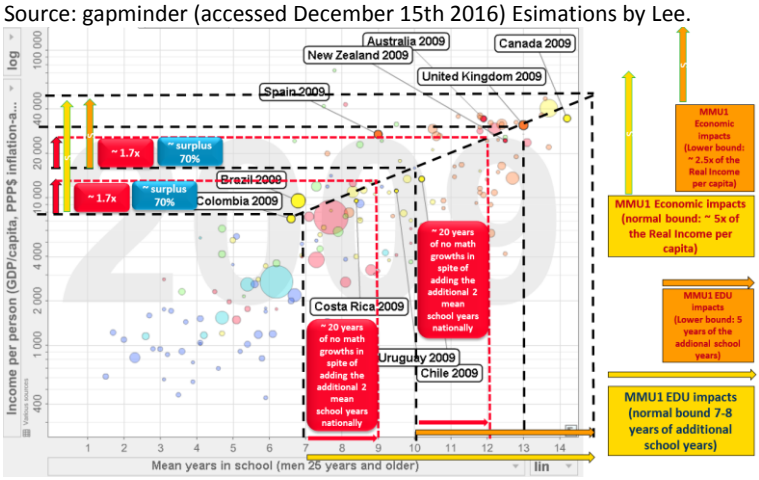


Source: gapminder (accessed December 15th 2016)

Bulk figure simpleton-minded estimations: Lee's rough rule of thumb regression based on Gapminder's visual data. The lost 20 years of mean years of schooling (with quasi-zero math skill growths) and their real GDP per capita impacts for the USD$ or PPP.



Source: gapminder (accessed December 15th 2016) Esimations by Lee.



Source: gapminder (accessed December 15th 2016)
Estimations by Lee for the English-speaking and Latin American countries.

the economic cost of the lost 20 years of little or no growths in national math average for the OECD (developed) or Latin American countries

CASE 1: 2 additional school years are correlated to roughly doubling real GDP per capita (after inflations). The average of additional schooling is about 2 more schooling years for the OECD, LACs. As you can see clearly here, the corresponding real GDP per capita in the US$ is supposed to be about 2x (although this is for longer time frame not for the immediate growths). The EDU growths in many countries, however, haven't grown past 20 years, especially in math. Adding the bad hardware without good software has the astronomical cost of economy, **the loss of 100% surplus gains.**

CASE 2: The same thing applies for the real GDP per capita based on PPP. The difference is a bit less, but the fundamentals will not change much for most of the developed countries and the Latin American countries. **the loss of ~70% surplus gains.**

The surplus real GDP (per capita) of 70% compared to the ideal case if these nations had progressed with their national math average past 20 years have powerful impacts over the next 30-50 years. If we understand that about 5-6% of the GDP is annually used for the entire education, this difference is staggering for all the Ministries and Departments Of Education.

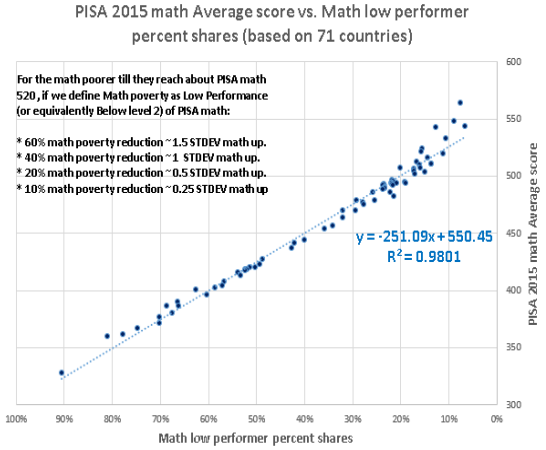
CASE 3 (roughly the worst case scenario): using the Hanushek & Woessmann style conservative estimations, **loss of 30-40% surplus.**

If we use the expected ~ 0.35 standard deviation of math not actually increasing over 20 years has the negative impacts of the real GDP per capita of 30-40% less in one's life time.

For the OECD nations, the usual rule of thumb by PISA is about 100 points of PISA is for 1 Standard deviation for 2-3 years of additional

schooling, but this becomes about than 3-4 additioanl schooling years for the LAC countries.

Point 6: Math poverty reduction rapidly by 22-30% in the OECD (or about 50% in most Latin American) countries (and the correlations are exceedingly high, of about 98% up to about PISA math 480 level) with MMU1 - which is roughly equivalent to MMU1 target objectives - has about 3-4 times larger than the 20 lost years of math education in most countries in terms of the socio-economic impacts in general in one's life time. This means about 7-8 times of the real income per capita (in PPP terms) increase.



Source: PISA 2015 math (and the author's regression)

For most of the countries below the OECD level countries, what MMU1 does (which boosts about 1.3-1.4 Standard Deviation of the math average) is roughly equivalent to reduce about 50% of the math poverty share of population.

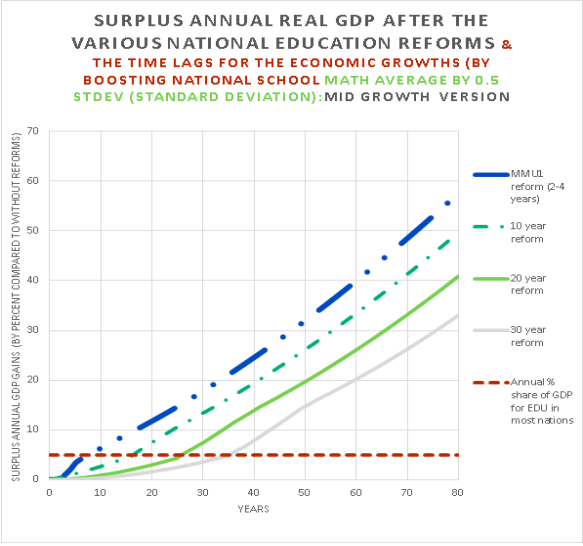
For most of the OECD level countries, of PISA math 470 and up or so, the math poverty reduction is about twice as hard and 1.3-1.4 STDEV boost (of what MMU1 does) is roughly **equivalent to about 22-30% of the math poverty reduction.**

MMU1 for 3Rs: Lee's proposal of radically rapidly reducing (3Rs) the math poverty across the MMU1 supporting nations, by raising the math poorest 25 percentile to the math 75th percentile (or the math richest 25%), its impacts on EDU, Economy (cumulative real GDP of nations and aggregates of nations), and prosperity will be 20-40-80-200-500+ times greater than the current annual economic size of most countries. MMU1 operations will depend on the levels of the commitments and supports for Lee from each country's government.

Point 7: short term surplus economic impacts in just 10-15 years is higher than the entire annual Education budget of 5% of GDP simply by rapidly boosting about 0.5 Standard Deviation with 2-4 year reforms or only about 35% of the MMU1 capacity. (An amazing news for the MOEs and DOEs), and the better case scenarios have more powerful growth scenarios.

If the full MMU1 is implemented, we can roughly estimate that the impacts will be 2.5-3 times larger than the short term projection mentioned here.

This is **roughly equivalent to the math reduction of about 10-15% in most of the OECD level countries.**



MMU1 proposals boost the growth estimations of Hanushek & Woessmann even in this mid-version scenario: instead of 40% to 60-80%.

Point 8: In the worst or least case scenario: assuming that these highlights don't ring a bell to you, we hope that at least this makes you consider the possibility that the lost 2 decades of math stagnations have far larger consequences not apparent to most leaders who subscribe to the normal paradigm of the Human Capital (as Mean school years) by simply facilitating what is obvious than what is the most critical. MMU1 may be the best antidote to overcome this. Furthermore, the full or even half of the MMU1 implementation will mean dozens of times larger cumulative GDP (per capita) over the next 40-50 years. A rule of thumb variations here given by

the author is reasonable because the cognitive skill impacts on the range of the mean years of schooling seem to range by 2-4 factors with the average about factor of 2 plus minus 1.[6]

1) Even the worst case scenario of only half of the full implementation of MMU1 is at least 20 times larger than the current real GDP per capita of the OECD level or Latin countries.
2) What does this mean to the EU or the total OECD countries? Over the next half a century, the rapidly implemented MMU! Impacts on the total OECD can be more than a Quadrillion USD, which is 100-200 times larger than the cost of Financial crisis 2008 (assuming the total OECD's GDP is about 50 Trillion USD around 2020), and at least $400 Trillion for the USA or EU (assuming their GDP by 2020 is about $20 Trillion USD for each).

Conclusion: to ignore this means not only allowing the economic crises of nations as these are far larger than all other financial crises we are aware of in the long run, but also the betrayals to the future generations of all around you: not just educationally, but also socio-economically.

1) **The immediate solution**s for the math stagnations across the OECD and Latin American nations: USL and start with MMU1 first and then we may expand depending on supports.
2) **(Technology-based education in the OECD countries haven't helped past 5-8 years and this tells us something although we all like the fancy toys for the joys.) → What to do now?**: invite Dongchan Lee to run the 100% internet-based MMU1 pilot studies with at least 4,000 students (1-4 school districts) with the supports of your city, state, or national MOEs or DOEs in spring 2017 as each lasts 1-2 weeks with about 1 month of the preparation time with the minimal costs considering at least 4k students involved. In each pilot study, Lee will take the worst half math students and raise them to about top half average. Once the initial results are encouraging, then we can quickly scale this up. Initial focuses will be the grade 3-5th. After this if the governmental supports and commitments are good, then we may expand to the grades 6th-8th, depending on the levels of supports and commitments for the cause.

Lee seeks to collaborate with and get supports from philanthropists, NGOs, governments, and investors around the world and start MMU1 pilots in your cities, states, and countries in this spring of 2017.

[6] Lee will explain why this is so in the upcoming papers.

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