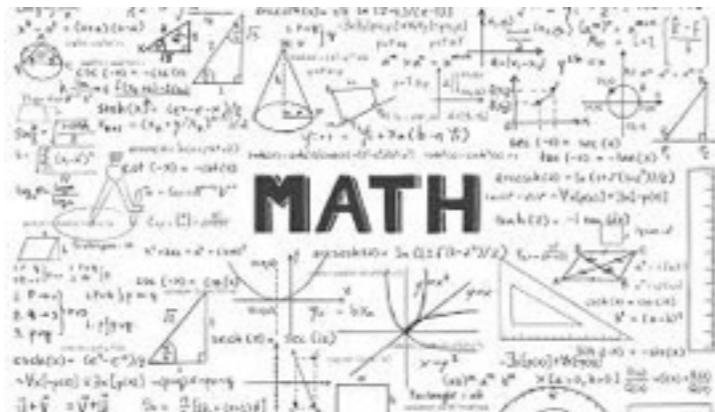


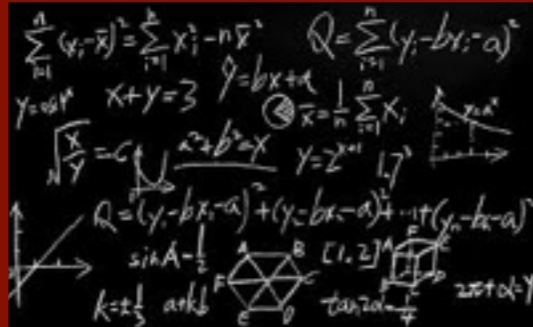
# INTERNATIONAL MATH PERFORMANCE

**“Inquiry” Mathematics Research Project**



**BY: ASHIANA SUNDERJI**

## WHY IS THIS RELEVANT TO US?



Handwritten mathematical formulas on a chalkboard, including:

- $\sum_{i=1}^n (y_i - \bar{y})^2 = \sum_{i=1}^n x_i^2 - n\bar{x}^2$
- $Q = \sum_{i=1}^n (y_i - bx - a)^2$
- $y = mx + c$
- $x + y = 3$
- $y = bx + a$
- $\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$
- $\sqrt{\frac{x}{y}} = c$
- $x^2 + b^2 = x$
- $y = 2^{x-1}$
- $R = (y - bx - a)^2 + (y - bx - a)^2 + \dots + (y - bx - a)^2$
- $\sin A = \frac{a}{c}$
- $k = \frac{2}{3}$
- $\arcsin \frac{1}{2}$
- $\tan^{-1} \frac{1}{4}$
- $2\sin(x-y)$

- **Math Students**
- **Analyze different methods so we can identify the teaching style that resonates with us.**
- **We ourselves participate in contests so it's interesting to see the results of the big contests written internationally.**



- **Socials/Historically:**
- **Learning the ways of other cultures to improve ourselves and have a more diverse approach to learning.**
- **How we have improved as a nation.**

## **HISTORICAL CONTEXT INTERNATIONAL ASSESSMENTS**



Programme for International Student Assessment

**PISA**

**PISA (Programme for International Student Assessment) looks at the performance in Science, Mathematics and Reading of 15 years olds every 3 years in 70 countries.**

## **TIMSS & PIRLS**

**TIMSS**

**(Trends in International Mathematics and Science Study) looks at the achievement both in mathematics and Science at equivalent to the grade 4, grade 8 and secondary 2 abilities. It runs every 4 years since 1995 and had over 600,000 students participate in 2015. In 2015 49 countries were tested at the grade 4 level.**

## RANKING OF TOP 10 COUNTRIES IN 2015 - PISA

1. Singapore



564

2. Hong Kong



548

3. Macao



544

4. Chinese Taipei



542

5. Japan



532

6. BSJG (China)



531

7. Korea



524

8. Switzerland



521

9. Estonia



520

10. Canada



516

## DATA VALUES FOR ALL 70 COUNTRIES WHO PARTICIPATED IN PISA 2015

1. Singapore	564	21. New Zealand	495	41. Croatia	464	61. Columbia	390
2. Hong Kong	548	21. Vietnam	495	42. Argentina	456	62. Peru	387
3. Macao	544	23. Russia	494	43. Greece	454	63. Indonesia	386
4. Taiwan	542	23. Sweden	494	44. Romania	444	64. Jordan	380
5. Japan	532	23. Australia	494	45. Bulgaria	441	65. Brazil	377
6. BSJG	531	26. France	493	46. Cyprus	437	66. FYROM	371
7. South Korea	524	27. United Kingdom	492	47. United Arab Emirates	427	67. Tunisia	367
8. Switzerland	521	27. Czech Republic	492	48. Chile	423	68. Kosovo	362
9. Estonia	520	27. Portugal	492	49. Moldova	420	69. Algeria	360
10. Canada	516	30. Italy	490	49. Turkey	420	70. Dominican Republic	328
11. Netherlands	512	31. Iceland	488	51. Uruguay	418		
12. Denmark	511	32. Spain	486	51. Montenegro	418		
12. Finland	511	33. Luxembourg	486	53. Trinidad and Tobago	417		
14. Slovenia	510	34. Latvia	482	54. Thailand	415		
15. Belgium	507	35. Malta	479	55. Albania	413		
16. Germany	506	34. Lithuania	478	56. Mexico	408		
17. Poland	504	37. Hungary	477	57. Georgia	404		
17. Republic of Ireland	504	36. Slovak Republic	475	58. Qatar	402		
19. Norway	502	39. United States	470	59. Costa Rica	400		
20. Austria	497	39. Israel	470	60. Lebanon	396		

**MEAN: 461.61**

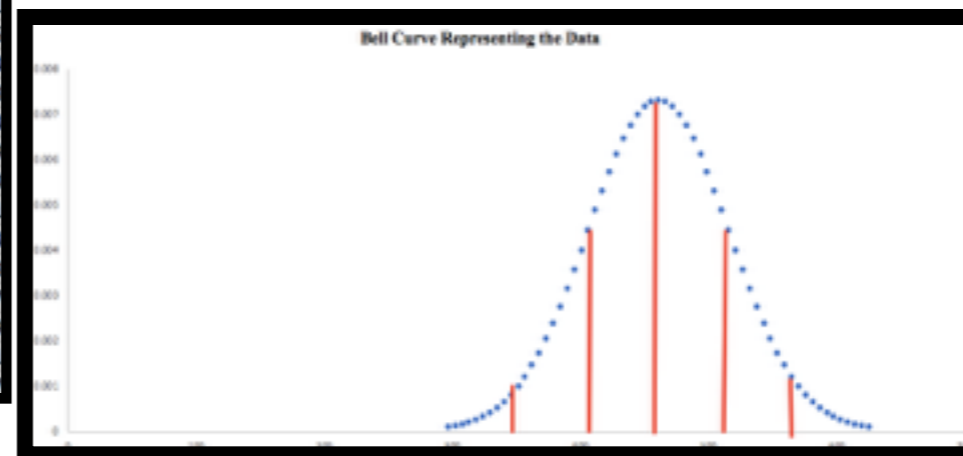
**STANDARD  
DEVIATION: 54.73**

# BELL CURVE

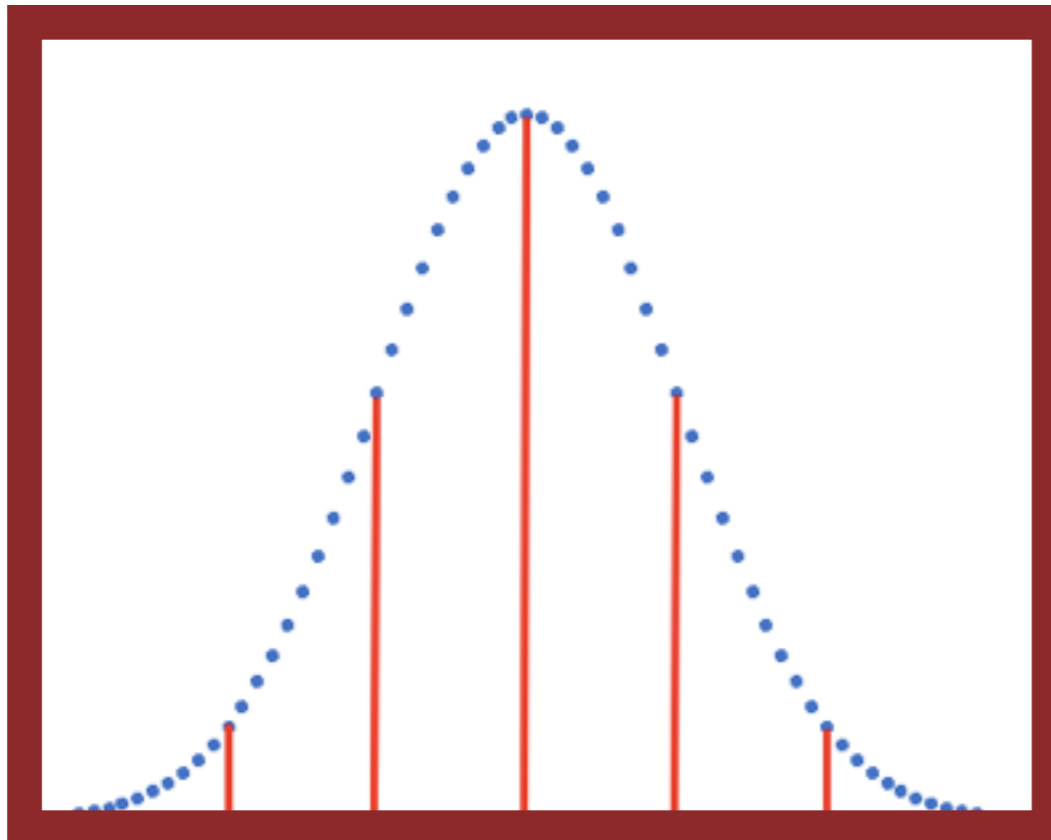
Standard Deviation	Your data	
-3	297.436626	8.09827E-05
-2.9	302.909215	0.00010877
-2.8	308.381804	0.000144638
-2.7	313.854392	0.000190421
-2.6	319.326981	0.0002482
-2.5	324.799569	0.000320293
-2.4	330.272158	0.000409213
-2.3	335.744747	0.000517617
-2.2	341.217335	0.000648223
-2.1	346.689924	0.000803707
-2	352.162513	0.000986571
-1.9	357.635101	0.00119899
-1.8	363.10769	0.001442647
-1.7	368.580279	0.001718548
-1.6	374.052867	0.002026844
-1.5	379.525456	0.002366661
-1.4	384.998045	0.002735953
-1.3	390.470633	0.003131399
-1.2	395.943222	0.00354834
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-0.6	428.778754	0.006088976

-0.5	434.251342	0.00643329
-0.4	439.723931	0.006729359
-0.3	445.19652	0.006969057
-0.2	450.669108	0.007145479
-0.1	456.141697	0.007253469
0	461.614286	0.007289828
0.1	467.086874	0.007253469
0.2	472.559463	0.007145479
0.3	478.032052	0.006969057
0.4	483.50464	0.006729359
0.5	488.977229	0.00643329
0.6	494.449818	0.006088976
0.7	499.922406	0.005705781
0.8	505.394995	0.005293501
0.9	510.867584	0.004862146
1	516.340172	0.004421504
1.1	521.812761	0.003980788
1.2	527.285349	0.00354834
1.3	532.757938	0.003131399
1.4	538.230527	0.002735953
1.5	543.703115	0.002366661
1.6	549.175704	0.002026844
1.7	554.648293	0.001718548
1.8	560.120881	0.001442647
1.9	565.59347	0.00119899
2	571.066059	0.000986571
2.1	576.538647	0.000803707

2.2	582.011236	0.000648223
2.3	587.483825	0.000517617
2.4	592.956413	0.000409213
2.5	598.429002	0.000320293
2.6	603.901591	0.0002482
2.7	609.374179	0.000190421
2.8	614.846768	0.000144638
2.9	620.319357	0.00010877
3	625.791945	8.09827E-05

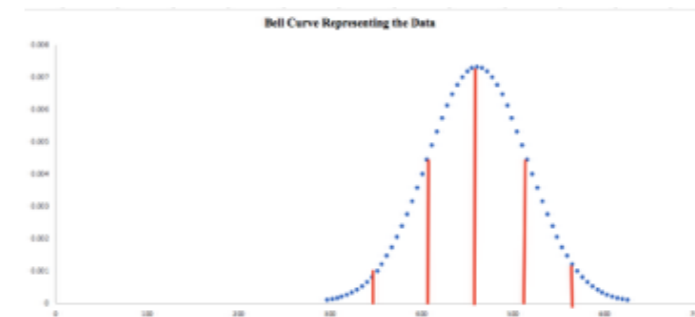


## BELL CURVE



**WAS THE DATA CONSISTENT? IS THERE BIAS?**

**I LOOKED FOR THIS DATA FROM 3 DIFFERENT SITES AND THE NUMBERS WERE THE EXACT SAME.**

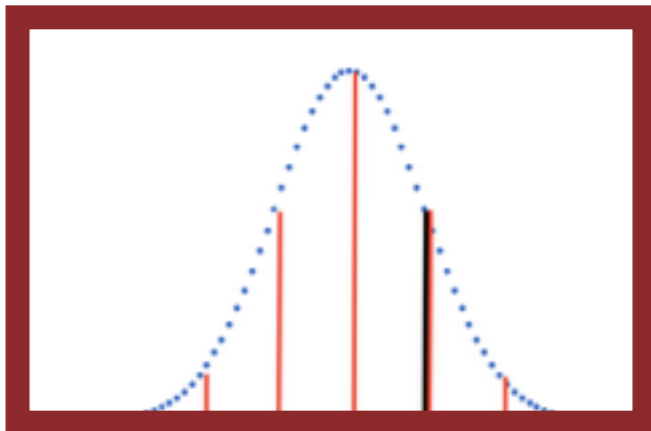


**MEAN: 461.61**

**STANDARD DEVIATION: 54.73**

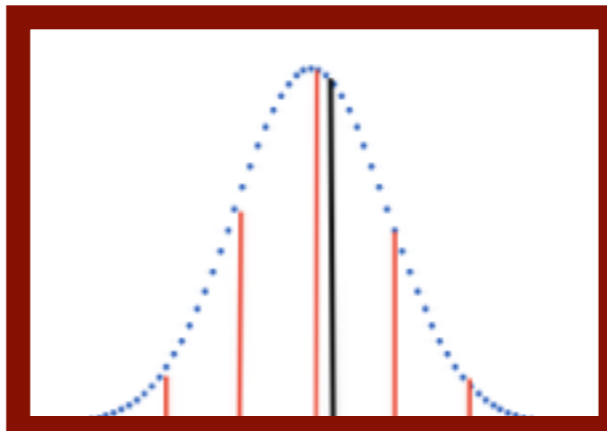
## Z-SCORES OF SPECIFIC COUNTRIES

10. CANADA



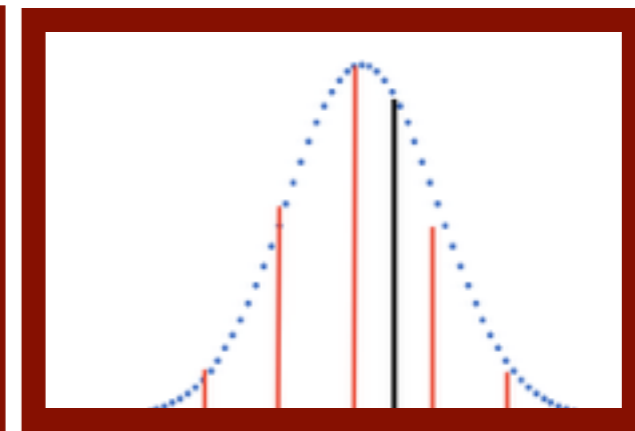
Z-SCORE: 0.99

39. USA



Z-SCORE: 0.15

27. UK

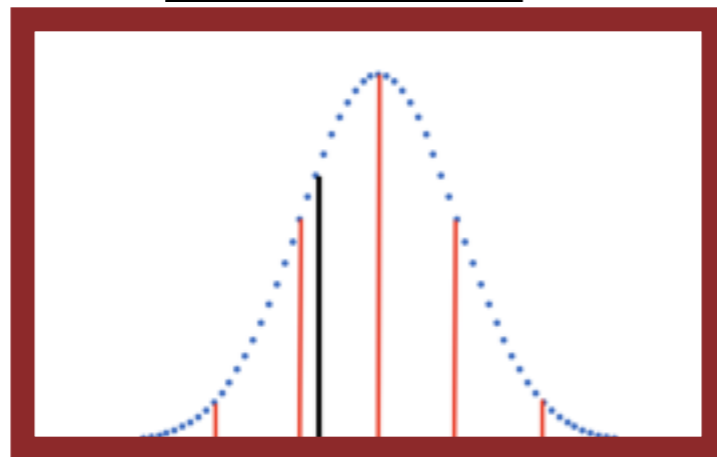


Z-SCORE: 0.56



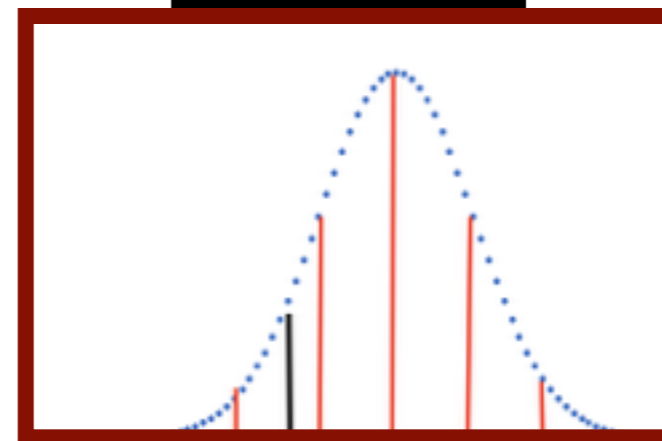
## Z-SCORES OF SPECIFIC COUNTRIES

56. MEXICO



Z-SCORE: -0.80

62. PERU



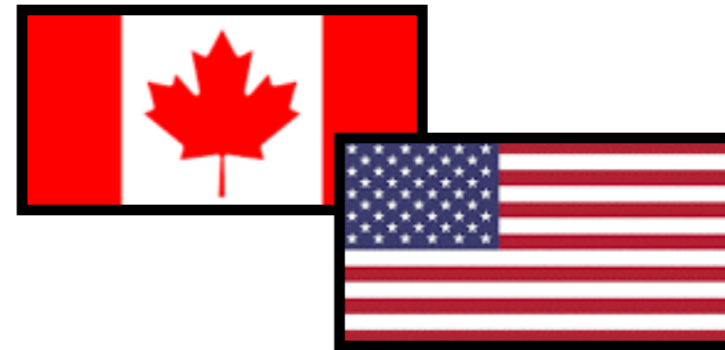
Z-SCORE: -1.36

## **CONFIDENCE LEVELS**

**- I USED 100% OF THE POPULATION SO MY CONFIDENCE LEVEL IS 100%.  
The larger the sample size the smaller the confidence interval.**

## **HOW MUCH HIGHER DID CANADA PLACE THAN THE US?**

**Canada was in the top 14.29%, and in comparison to the US 41.43% higher internationally in mathematics. According to the PISA.**



## **WHAT PERCENTAGE OF COUNTRIES SCORED ABOVE 400 ON THE PISA?**

**84.29% of countries scored above 400 on the PISA.**

**Singapore with a high of 564 all the way to Costa Rica with 400.**

## **CONFIDENCE LEVELS**

**WHAT PERCENTAGE OF COUNTRIES RANGED FROM A SCORE OF 450 TO A SCORE OF 550? (The full range was 328 - 564: making it a range of 263.**

**More then half scored between only 100 points (450 and 550) A whole 60%!**



**From Hong Kong to Greece.**

## **PISA - Canadian Observations**

## **By province**

- **Highest Results: British Columbia and Quebec, followed by Alberta and Ontario in the 89 percentile.**
- **Followed by Nova Scotia and Prince Edward Island in the 78 percentile.**
- **Followed by New Brunswick in the 67 percentile.**
- **Followed by Manitoba in the 61 percentile**
- **Then Newfoundland and Labrador in the 56 percentile.**
- **Finally Saskatchewan below the average in the 44-50 percentile.**



- ★ **Note that the numbers being given for the percentiles are just approximates based on the colours shown in the following map**
- ★ **Maps demonstrating the provinces performance in comparison with the average Maps retrieved from <https://www.compareyourcountry.org/pisa>**

**TIMSS**

In TIMSS the top 5 countries for the past 20 years have been Singapore, Hong Kong SAR, Korea, Chinese Taipei and Japan.

**GRADE FOUR LEVEL- Ranking and Scores**



**1. Singapore  
618**



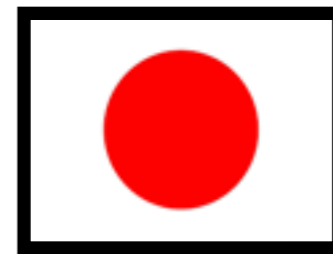
**2. Hong Kong  
615**



**3. Korea  
608**



**4. Chinese Taipei  
597**

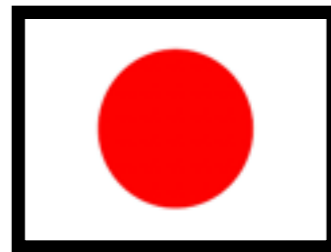


**5. Japan  
593**



**Canada was ranked 29th out of 49 scoring in the lower half.**

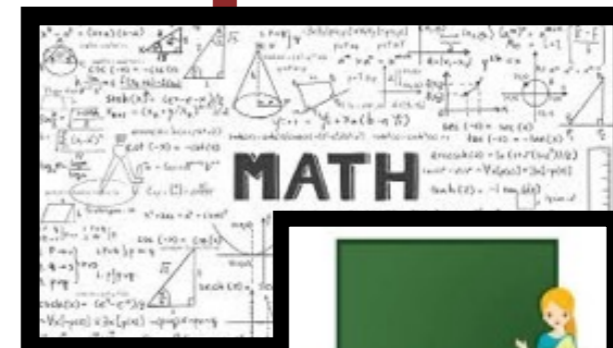
## TIMSS



**At the grade 8 level Canada scored 8th out of the 39 countries tested. The top 5 being the same 5 countries again just in a different order with Singapore still at the top with 621. These 5 countries have remained at the top for the past 20 years which is the longest amount of time that 5 countries have edged out the rest of the world.**

## **FACTORS EFFECTING RESULTS**

- **Financial stability of country**
- **Funding given to schools**
- **Resources**
- **Curriculum**
- **Environment/Atmosphere of schools**
- **Extra tutoring**
- **Determination/GRIT of students**
- **Teaching Methods**
- **Amount of students that wrote each test per country**



## **FACTORS THAT EFFECT SCORES:**

**The top 5 countries in mathematics are Singapore, Hong Kong, China, Japan and Korea. Singapore always at the top.**

## **Singapore Method**



**“Mathematics in Singapore is not about knowing everything. It’s about thinking like a mathematician” - Andreas Scheilcher the head of the OECD education assessment program.**

- Singapore focuses on teaching their students useful skills that are applicable to jobs that need to be filled.**
- Cover less material, but the material that they cover the cover in depth.**
- Hard work, ethics and persistence are rewarded over talent or natural abilities. GRIT**
- They work as a whole class so that weaknesses can be spotted more easily by the teacher.**
- Instead of concepts, they are given problems and must find their own approaches in solving them. This allows for more time on specific problems instead of jumping into new concepts each day.**
- Variation over repetition.**



## **BEST PRACTICES**

**The top 5 countries in mathematics are Singapore, Hong Kong, China, Japan and Korea. Singapore always at the top.**

## **China Methods**

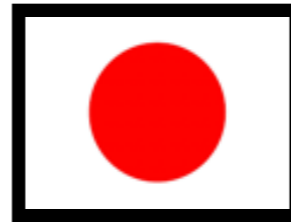


- **In China 15 year olds are studying at the equivalent of a second year A-level in the UK. They start their subjects earlier which puts them at an advantage.**
- **72% of class time is spent being taught by the teacher and the whole class is working at the same pace similar to Singapore.**
- **Every single school follows the same textbook published by the Shanghai education commission.**
- **85% of Shanghai students agreeing to the statement that they feel happy at school in the 2012 PISA survey. Cultural factors are roots to their success.**
- **Countries like Canada and Great-Britain have been trying to recruit teachers and tutors from China in order to gain the knowledge to begin to replicate the curriculum and methods. Similarly the east has also been trying to recruit from us.**

## **BEST PRACTICES**

**The top 5 countries in mathematics are Singapore, Hong Kong, China, Japan and Korea. Singapore always at the top.**

## **Japan Methods**



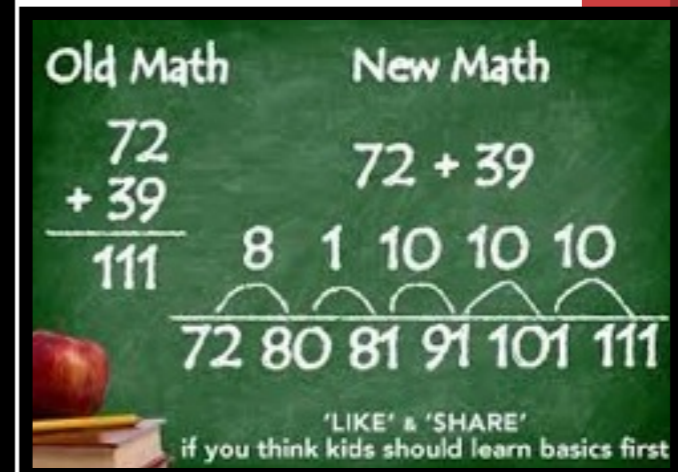
- In Japan, the method is similar to Singapore where they give the students a problem that relates to the lesson and give them the opportunity to guess and check their approaches.**
- In order for a problem to be used in must have the following elements; the possibility of having an estimate, different methods to get to the solution, the need for the involvement of everyone in the class and must have examples of mistakes that can be made along the way.**
- They must show work to demonstrate their thinking.**
- “Open Lessons” are a common practice, it is when a group of teachers get together to plan a lesson and then one teacher teaches it while the rest watch. They then discuss what worked and what didn’t to better their abilities.**

**Changes being made to improve Canada?**

**What is discovery math?**

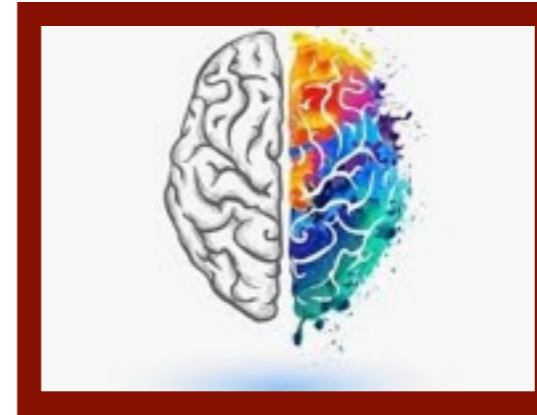
**The Discover method reinforces concepts and applied learning before teaching the procedures. It demands critical thinking and problems solving.**

- **Many provinces have been implementing the Discover method in their new curriculums. It's attempt was to engage students but has ended up not being as constructive as traditional methods.**
- **If we look back at some of the countries who are in the best practices of mathematics (Korea, Japan), they have found that combining the right amount of engagement with reinforcing fundamentals and memorization works better than the Discover Method.**
- **The Discovery Method forces kids to "discover" concepts versus being taught them, which works in some contexts, however in order for it to be an effective learning method, students need to have a good fundamental understanding already.**



## **OTHER BRANCHES OF STUDY?**

- **Psychology:**
- **Since we are all different yet we are all held to the same standard, it is important to take note of methods that are going to be effective for the type of learners that we are.**
- **Behavioral psychology trains humans to react a certain way to different situations, training our brains to connect aspects that aren't usually connected to promote a desired reaction.**
- **We could use behavioral psychology in forming the curriculum so that students connect situations where they would generally feel discouraged with the urge to better their skills - making a negative into a positive.**



## **IN CONCLUSION...**

- **Singapore is at the top: Canadas new learning methods are very individualistic and fit to the specific learner, which is very different from Singapore where they learn together for the majority of the lesson so that the teacher has a good understanding of where everyone is**
- **Critical thinking can be an asset in the workforce, however the individualistic aspect takes away from the collaboration needed in the workforce.**

**WE CAN LEARN SO MUCH BY COMING ACROSS THE RANKINGS OF A MATH CONTEST. JUST, BY WONDERING HOW WE CAN REACH THE TOP AND WHY THE RANKINGS ARE THE WAY THEY ARE!**

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