How TIMSS results are utilized in Hong Kong?

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Four points:

- How TIMSS results were reported in the press
- How TIMSS results were utilized by the Hong Kong Government
- How TIMSS results were informing curriculum change in mathematics and science
- How TIMSS results were impacting teaching and learning in Hong Kong

The values and goal of TIMSS 2007

"For policymakers, the TIMSS 2007 report contains a wealth of information about key instructional, curricular, and resource related variables that are fundamental in understanding the teaching and learning process. …. The information should be of great value in guiding educational decision making and practice in the areas of mathematics and science around the world." (p.2)

"The goal (of the study) is to provide comparative information about educational achievement across countries to improve teaching and learning in mathematics and science" (p.14)

TIMSS 2007 international report (Mullis, et al, 2008)

How TIMSS results were reported in the press

The Standard, 11 December 2004
"*Top boost for maths*"

"FRESH proof that Hong Kong students are brainy at both maths and science comes in a worldwide survey which puts the territory near the top in both subjects. The findings emerged from a survey of more than 360,000 fourth- and eighth- graders, the quadrennial Trends in International Mathematics and Science Study, or TIMSS, for 2003. Hong Kong students came second in the fourth-grade category. … The new study put Singapore students top in both maths and science. Asian countries or regions took six of the top 10 slots for eighth- grade maths. …."

“For fourth grade, for which students of 25 countries or territories were measured, Singapore led the ranking with an average score of 594 against a worldwide 495, followed by Hong Kong with 575. Japan was third with 565. Fourth-graders are generally aged about nine.

In science, Singapore dominated both age groups, followed by Taiwan, South Korea, Japan and Hong Kong, the survey showed. More non-Asian countries filled out the eighth-grade top 10 in science than in maths, including the United States, which was placed ninth, Australia and Sweden. England, Latvia and Russia cracked the top 10 in fourth-grade science. The US ranked sixth.

The complete rankings are available at the website www.timss.bc.edu.”

UK: *The Guardian*, 11 December 2008

"The Olympics of education: Fresh efforts to boost the UK in maths and science league tables will also help our economic health

This week the results were announced for the Olympics of education. As they have for many years now, Singapore, South Korea and Taiwan took home the medals. The contest was the quadrennial match of brainpower called the Trends in International Mathematics and Science Study, known fondly as the TIMSS ….."

Is TIMSS a competition, the "Olympics of education"?

Ranking of countries

- Participating countries change from one cycle to another
- So a rank in a certain cycle may not mean the same thing as a rank in another cycle
- Also, when comparing the relatively rankings between two countries, we should take the standard error of measurement into consideration
- E.g., compared to TIMSS 2003, grade 4 students in Hong Kong may be seen as having "moved up" in mathematics achievement from 2nd place to 1st place in 2007
- But if we take standard errors into consideration, the difference between the scores for Singapore and Hong Kong in 2007 is not statistically significant
- So we should not be too sensitive about fine changes in ranking from cycle to cycle

How the Hong Kong Government utilized TIMSS results

- TIMSS (and PIRLS and PISA) results have been used as evidence of the effectiveness of our education system, and as "proof" of the success of curriculum reform
- Seems to suggest that the high achievement is due to the curriculum reform
- Can the "instructional, curricular, and resource related variables" really explain student achievement, and hence the results be able to guide "educational decision making and practice in the areas of mathematics and science"?
- e.g., is it curriculum reform or class size that has caused high student achievement?

Exhibit 7.2 **Achievement and Class Size for Mathematics Instruction**

TIMSS2007 Mathematics 4th Grade

Table 4

Country		1–19 Students		20–32 Students		33 or More Students	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Algeria	r	11 (2.8)	388 (14.2)	60 (4.3)	378 (7.0)	29 (4.0)	383 (9.4)
Armenia	s	24 (3.3)	526 (14.1)	50 (3.8)	499 (7.3)	26 (3.6)	484 (6.0)
Australia		19 (3.0)	510 (9.0)	80 (3.0)	521 (4.3)	2 (1.2)	~ ~
Austria		37 (2.9)	506 (3.1)	63 (2.9)	505 (2.7)	0 (0.0)	~ ~
Chinese Taipei		3 (1.2)	548 (12.8)	45 (3.7)	570 (3.2)	51 (3.4)	583 (2.4)
Colombia		19 (3.3)	342 (13.7)	24 (4.7)	347 (14.0)	57 (4.4)	365 (8.1)
Czech Republic		31 (3.5)	482 (5.9)	69 (3.5)	489 (2.9)	0 (0.0)	~ ~
Denmark		34 (3.9)	529 (4.4)	66 (3.9)	521 (2.9)	0 (0.0)	~ ~
El Salvador		20 (2.7)	307 (10.7)	37 (4.1)	318 (9.1)	43 (3.8)	352 (4.2)
England		8 (1.9)	556 (9.6)	80 (3.0)	539 (3.2)	12 (2.4)	546 (9.0)
Georgia		37 (3.8)	454 (7.3)	50 (4.5)	428 (6.6)	13 (2.2)	454 (6.3)
Germany		21 (2.4)	512 (5.6)	79 (2.4)	528 (2.2)	0 (0.0)	~ ~
Hong Kong SAR		1 (0.7)	~ ~	25 (3.3)	588 (5.5)	74 (3.4)	616 (3.8)
Hungary		33 (3.7)	482 (6.5)	67 (3.7)	525 (4.7)	0 (0.0)	~ ~
Iran, Islamic Rep. of		25 (2.7)	381 (6.5)	59 (3.8)	406 (5.3)	16 (2.9)	421 (11.6)
Italy		44 (2.6)	506 (4.3)	56 (2.6)	507 (4.5)	0 (0.0)	~ ~
Japan		7 (1.5)	558 (8.5)	47 (2.9)	569 (3.4)	45 (3.2)	569 (2.9)
Kazakhstan		30 (4.5)	550 (20.2)	68 (4.6)	548 (5.5)	3 (1.2)	577 (29.4)
Kuwait	s	7 (2.8)	330 (18.1)	88 (3.4)	314 (5.0)	5 (1.9)	302 (11.9)
Latvia		44 (2.4)	525 (3.9)	49 (3.0)	550 (2.6)	6 (2.0)	551 (9.3)
Lithuania		37 (3.0)	511 (4.7)	63 (3.0)	541 (3.1)	0 (0.0)	~ ~
Morocco	r	17 (3.3)	352 (17.7)	42 (4.3)	343 (11.4)	41 (3.9)	338 (7.7)
Netherlands		27 (3.3)	531 (4.3)	71 (3.5)	535 (2.9)	2 (1.3)	~ ~
New Zealand	s	13 (2.1)	489 (8.7)	81 (2.4)	497 (3.0)	6 (1.7)	524 (11.7)
Norway		42 (3.3)	473 (4.4)	53 (3.6)	474 (3.5)	5 (1.9)	467 (10.6)
Qatar	r	8 (0.1)	301 (4.3)	75 (0.2)	296 (1.4)	17 (0.2)	316 (3.4)
Russian Federation		33 (2.7)	531 (10.5)	67 (2.7)	551 (3.8)	0 (0.3)	~ ~
Scotland	r	16 (2.8)	492 (9.4)	79 (3.0)	493 (3.1)	5 (1.6)	506 (14.0)
Singapore		0 (0.0)	~ ~	6 (1.3)	514 (13.5)	94 (1.3)	605 (3.5)
Slovak Republic		34 (2.5)	497 (6.6)	65 (2.6)	496 (5.7)	1 (0.6)	~ ~
Slovenia		46 (2.9)	497 (2.7)	53 (3.0)	506 (2.6)	1 (0.6)	~ ~
Sweden		36 (3.4)	505 (4.5)	60 (3.6)	504 (3.2)	4 (1.6)	512 (12.4)
Tunisia		20 (2.8)	303 (12.2)	69 (3.8)	334 (5.0)	11 (2.7)	354 (21.3)
Ukraine		30 (3.3)	445 (4.9)	65 (3.5)	480 (3.8)	5 (1.4)	472 (13.4)
United States		26 (2.6)	521 (4.1)	69 (2.8)	533 (3.3)	5 (1.3)	522 (8.0)
Yemen	r	9 (2.1)	262 (18.5)	17 (4.0)	227 (16.4)	74 (4.1)	219 (7.7)
International Avg.		24 (0.5)	462 (1.8)	58 (0.6)	471 (1.1)	18 (0.4)	460 (2.3)

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

ss Size for Mathematics Instruction

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	19 (3.0)	510 (9.0)	80 (3.0)	521 (4.3)
	37 (2.9)	506 (3.1)	63 (2.9)	505 (2.7)
	3 (1.2)	548 (12.8)	45 (3.7)	570 (3.2)
	19 (3.3)	342 (13.7)	24 (4.7)	347 (14.0)
	31 (3.5)	482 (5.9)	69 (3.5)	489 (2.9)
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	8 (1.9)	556 (9.6)	80 (3.0)	539 (3.2)
	37 (3.8)	454 (7.3)	50 (4.5)	428 (6.6)
	21 (2.4)	512 (5.6)	79 (2.4)	528 (2.2)
	1 (0.7)	~ ~	25 (3.3)	588 (5.5)
	33 (3.7)	482 (6.5)	67 (3.7)	525 (4.7)
	25 (2.7)	381 (6.5)	59 (3.8)	406 (5.3)
	44 (2.6)	506 (4.3)	56 (2.6)	507 (4.5)
	7 (1.5)	558 (8.5)	47 (2.9)	569 (3.4)
	30 (4.5)	550 (20.2)	68 (4.6)	548 (5.5)

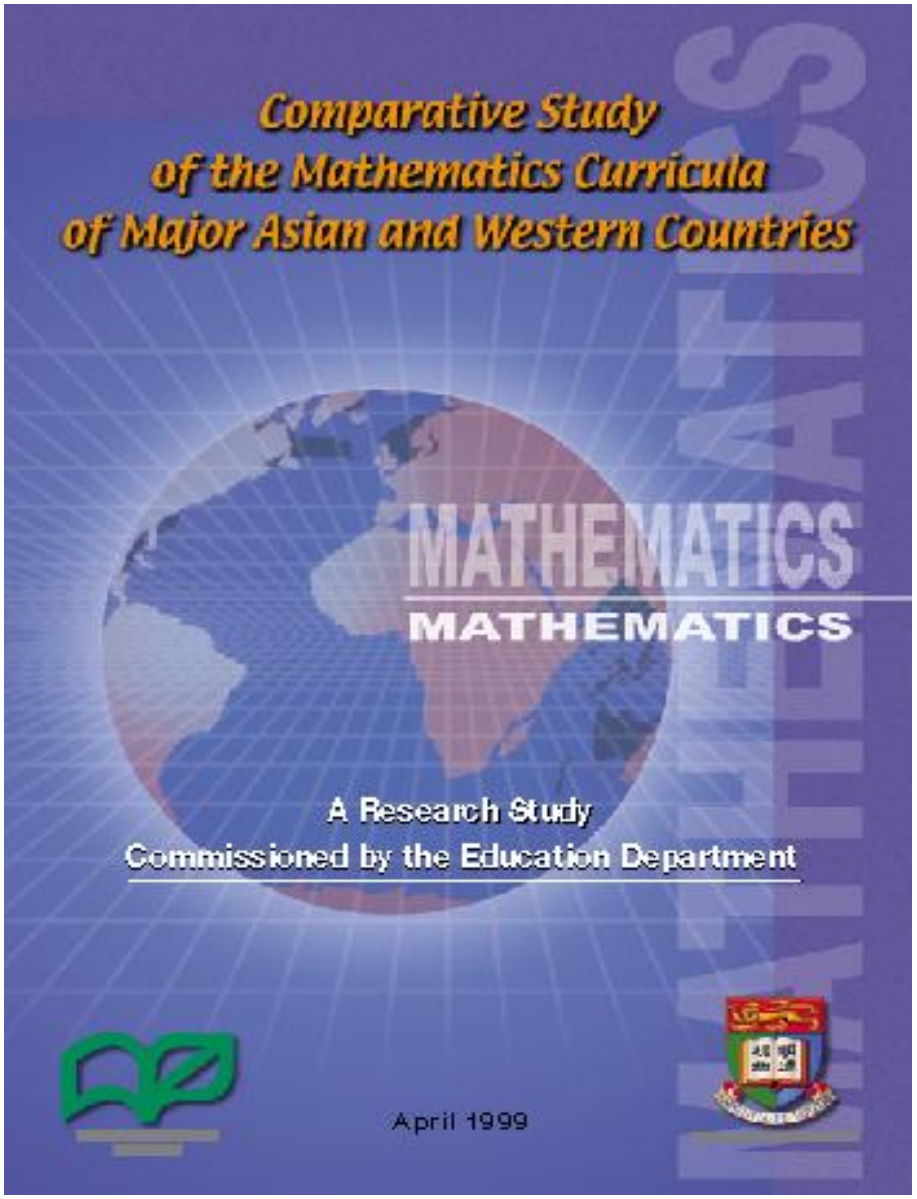
Class size and student achievement

- For many countries (e.g., Austria, Italy), class size does not make any difference to student achievement
- For some countries (e.g., Armenia, Kuwait), the smaller the class size, the higher the student achievement
- For the majority of the countries (e.g., Chinese Taipei, Colombia, New Zealand), the bigger the class size, the higher the student achievement
- All the high achieving countries (e.g., Singapore, Korea, Hong Kong) have large class sizes
- How do these results guide “educational decision making and practice”?
- Are we going to suggest increasing class size in order to raise the achievement of students??

Causal relations

- TIMSS is a survey, and not an experiment - we have to be cautious in drawing conclusions about causal relations
- In most instances, the best that we can conclude is that a certain variable (e.g., curriculum reform; class size) ***may*** have caused or impacted student achievement, based on the correlations between the measure of the variable and the achievement scores, since it is unlikely or illogical that achievement leads to changes in that variable
- But there may be a third "hidden" variable which influences both the variable and achievement, causing the variable and achievement to be correlated with each other
- And there are so many possible variables that may have influenced both the variable and achievement!
- Does big class size (or curriculum reform) lead to high achievement, or are there variables which lead to both large class size (or curriculum reform) and high achievement?

How TIMSS affects curriculum change



- Mathematics 2001 curriculum change
- Partly based on a study done utilizing TIMSS results
- Not to “over-learn” from “Western” countries

Science curriculum

- Mismatch between HK Science curriculum (Secondary 1-3) and the 2003 TIMSS assessed curriculum - should we introduce/re-introduce the missing topics (such as 'Atomic theory / Subatomic particles' and 'Element / Mixture / Compound')?
- "our curriculum (and hence teaching) emphasizes structural details of the sense organs (i.e. eyes and ears) and pays insufficient attention to the advantages of having two eyes and two ears in relation to the survival of an organism as a whole. This has resulted in very distorted learning; students can remember the names of the detailed structures of the eyeball and their functions but are unable to explain the advantage of having two eyes. … our curriculum has put too much emphasis on the learning of details and has overlooked the learning of principles. We might not have become aware of these shortcomings in our curriculum if we have not participated in the TIMSS studies" (Yung, 2010, p.118)

How TIMSS results affect classroom teaching: Teacher Workshops

e.g.: Item on Photosynthesis (Content / Concept assessed: Conditions necessary for photosynthesis)

Relevant Science (S1-3) topic(s): Living things and air (Unit 7)

“The Question (1995)

Which BEST explain why green marine algae are most often restricted to the top 100 metres of the ocean?

A. They have no roots to anchor them to the ocean floor.

B. They can live only where there is light.

C. The pressure is too great for them to survive below 100 metres.

D. If the algae lived below 100 metres they would be eaten by animals.”

Result

Result HK (%)

A 12.6	**(B)** 49.3	**C** 29.8	**D** 7.7

% correct

HK Boys	**HK Girls**	**HK Overall**	**International**
53.9	44.2	49.3	52.8

Noteworthy Points on Students' Performance

The relatively poor performance of HK students (49%) compared with the International Average (53%) might be due to the following reasons:

1. ***Everyday life experience*** – HK students rarely come across algae except during field trips. Of all countries, Japan performed the best (77%). It might be because Japanese eat a lot of algae and hence know more about algae including their habitat.

2. ***Gender difference*** – HK boys (54%) performed better than girls (44%). It might be that boys tend to explore more on the beaches than girls do. For example, boys like to explore at the ends of beaches, searching in rock pools, turning over stones to look for organisms, etc. while girls tend to stay on the beaches. This lends support to the above argument that everyday life experiences matter.

3. ***Fragmented teaching*** – Algae are introduced to students in S1 during the topic on Classification, which focuses on external features rather than looking at the organism as a whole (including its mode of nutrition). In S2, terrestrial plants are often used by teachers in teaching photosynthesis. They often miss the chance to bring algae back into the picture. Actually, the more able students may be challenged to find out why there are different kinds of algae (namely, green, brown and red) found at different depths of the sea, and how this distribution is related to photosynthesis.

4. ***Higher order thinking skills*** – Students could not systematically analyze the complex information contained in the question. They did not know how to apply learned knowledge to answer the question. In particular, students could not apply the concept that light is essential for photosynthesis and that *light intensity decreases as depth of water increases*.

Implications / Suggestions for Improvement

1. In planning their lessons, teachers should take into consideration students' everyday life experiences, including any gender differences. Dried green algae, being a favourite food of students can be used by the teacher as a starting point to talk a little more about how algae adapt to their mode of life. This can be supplemented by, for example, showing video clips and discussing why algae found at different depths of water are of different colours.

2. Teachers should help students to link their present learning with their prior knowledge, consolidate and extend it further. This helps them to form a holistic picture of what they are learning in relation to what they have learned.

3. To clarify the relationship between light intensity and depth of water, teachers can recall students' memory of watching any documentary video of deep sea exploration (or actually showing them the video), and ask them why the explorers have to bring along illuminating devices. Then ask students what would happen to the plants if there is no/little light down there. Students need to understand that even though plants can stand the high pressure at great depth, there is no/or little light to allow for photosynthesis.

Conclusion

- Much (too much!) attention has been paid on ranking of countries in TIMSS, often without due consideration of contextual factors (e.g., cultural values) that may have affected the performance of students in different countries
- Without due consideration of cultural and other contextual differences, drawing lessons on educational policies or passing judgement on student performance in different countries is very misleading, and may even be damaging
- Education is a complex endeavour – we cannot expect the TIMSS results to produce answers for all our national problems in education

- IEA was set up as a consortium of researchers from different countries
- As researchers we are interested in seeking the truth through conducting IEA studies, for the purpose of improving educational practices in different countries
- A lot of resources and manpower have been spent on TIMSS to generate a rich dataset, and TIMSS is not meant for just fulfilling the agenda of politicians through selective reporting of the results
- TIMSS is meant for individual countries to find out the truth about their mathematics and science education and seek improvement in their educational practices
- In so doing, we need to be careful about what conclusions can and cannot be drawn from the data because of the nature of the study

Thank you very much for your attention!

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