

4. Performance of Hong Kong Students in the Third International Mathematics and Science Study (TIMSS)

4.1 Introduction

The TIMSS students' instruments consist of mathematics (and science) tests as well as questionnaires that measure students' attitudes towards mathematics and mathematics learning. In this section, we report the performance of Hong Kong students in both the achievement tests and the questionnaires.

Before we do so, it may be of interest to point out some characteristics of the education system in Hong Kong as a background to understand the achievement and attitudes of Hong Kong students.

4.2 Some Characteristics of the Education System in Hong Kong

Hong Kong has the highest population density among the 41 TIMSS countries¹ (5691.35 per sq. km., compared with the minimum of 2.29 and the median of 95.28), and is also the system lowest in spending on basic education as measured by percentage of GNP (1.34%, compared with the maximum of 5.26% and the median of 3.57%). Compared to other TIMSS countries, Hong Kong has a very centralized education system. Mathematics teachers in Hong Kong are among the youngest and the least experienced, and Hong Kong ranks third among TIMSS countries with the largest class size (after Korea and Columbia).

As far as the school curriculum is concerned, the TIMSS results show that not too much time has been devoted to mathematics in Hong Kong compared to other parts of the world (see Figures 1 to 4). This may be a result of the relative emphasis (compared to other countries) on the second language (i.e. English) in the Hong Kong curriculum.

¹ some participants in TIMSS are education systems which are not countries (e.g. Hong Kong, French speaking Belgium), but for the ease of presentation in this paper, instead of saying "countries/systems" every time, the generic term "countries" will be used to refer to countries or systems.

Hours of Mathematics Instruction per Year (Grade 4)

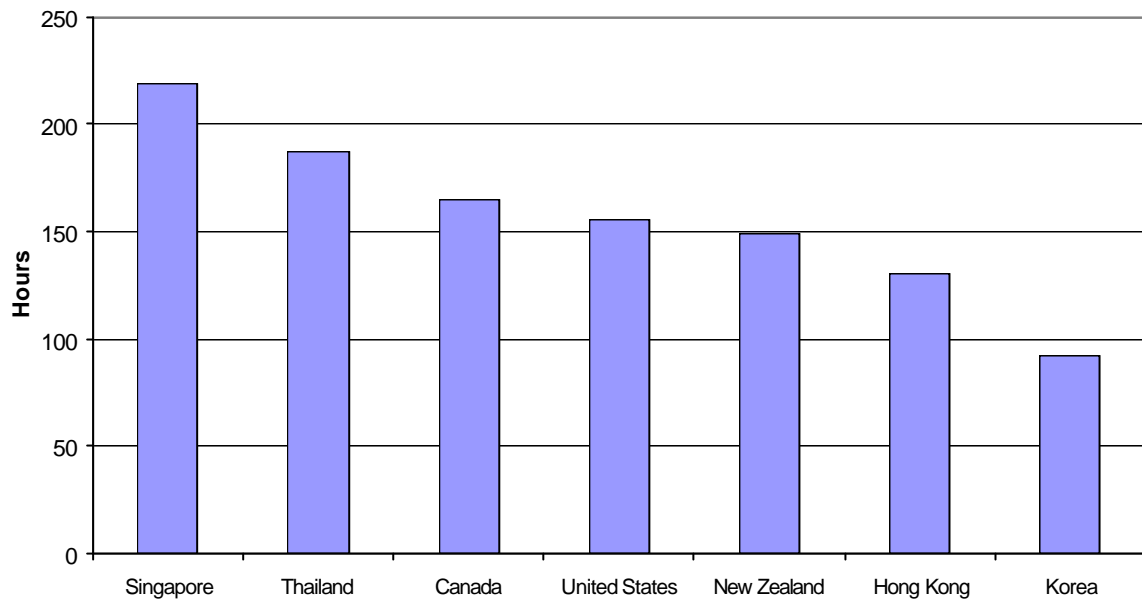


Figure 1

Hours of Mathematics Instruction per Year (Grade 8)

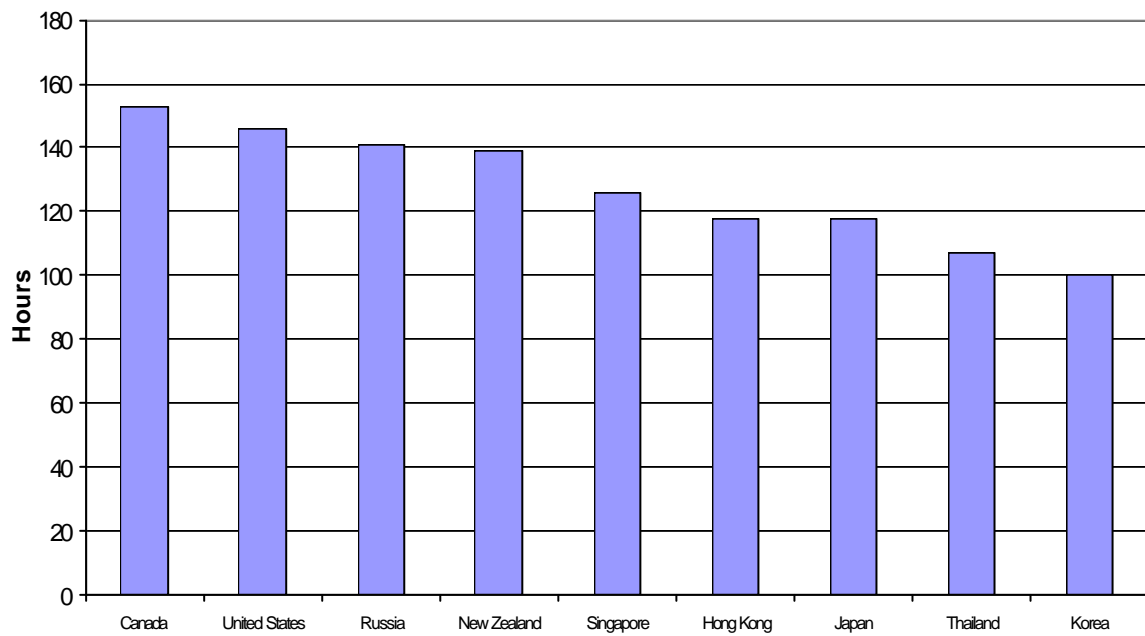


Figure 2

Percentage of Instructional Time Devoted to Mathematics (Grade 4)

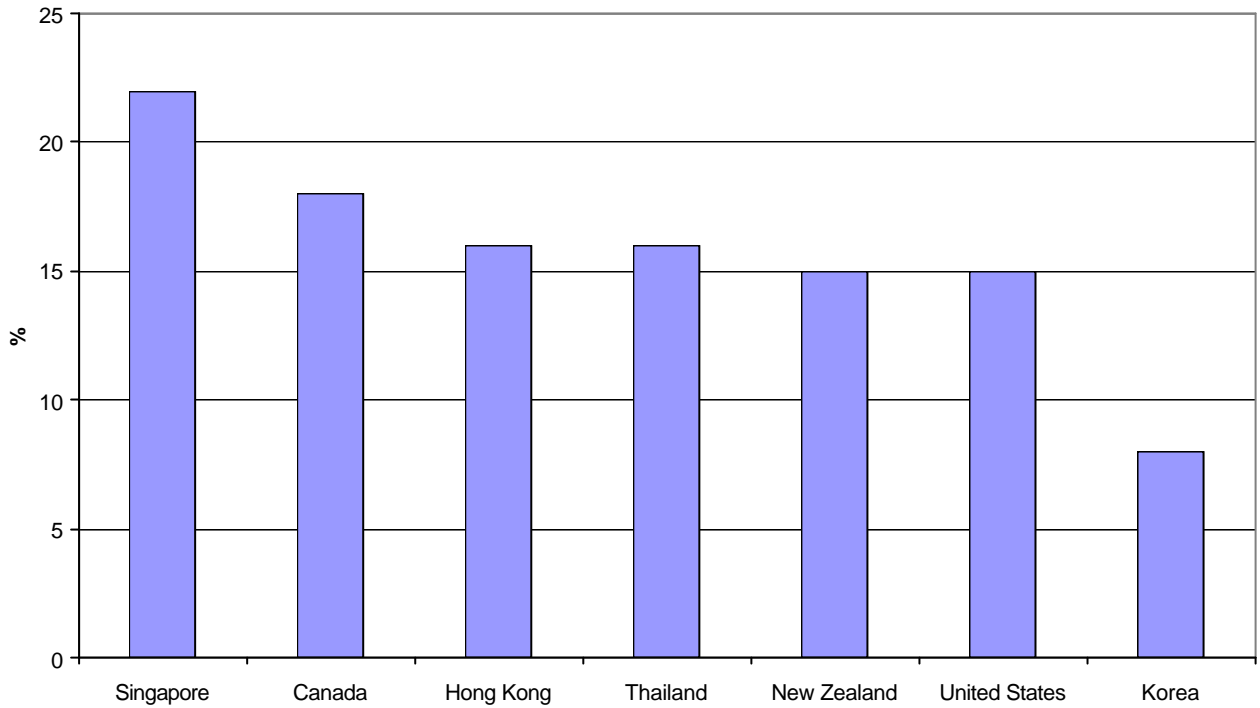


Figure 3

Percentage of Instructional Time Devoted to Mathematics (Grade 8)

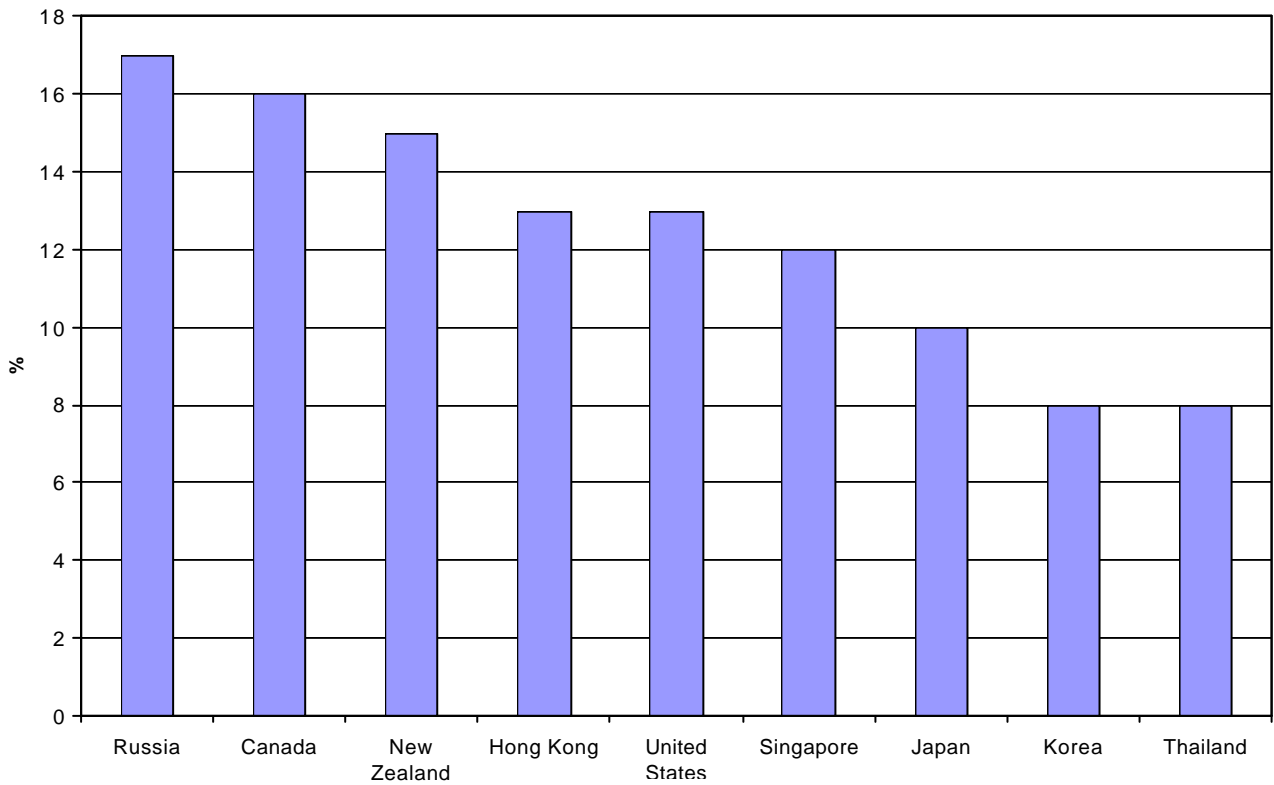


Figure 4

4.3 The Achievement of Hong Kong Students Compared with Their Counterparts in the Rest of the TIMSS Countries

TIMSS is not a mathematics contest, but it would be illuminating to plot participating countries' positions against the scores they obtain so as to compare the achievement of Hong Kong with the rest of the TIMSS countries. From Figures 5 and 6, it is clear that Hong Kong outperformed many other countries in mathematics achievement in both grades four and eight, and it seems that the superiority of the Hong Kong students becomes more marked when they proceed from grade four to grade eight. At the same time, it should be pointed out that Hong Kong performed not as well as our major economic competitors in the Region (Singapore, Japan and Korea), and so there is certainly no place for complacency.

Hong Kong students came fourth both in the 26 countries in Grade Four and the 41 countries in Grade Eight. Another way of describing the superior performance of the Hong Kong students is that 18 % of the Grade Four and 27% of the Grade Eight Hong Kong students are among the top 10% of the highest achieving students internationally. This contrasts sharply with some low-performing countries where very few or none of the students are among the top 10%. For example, there are 5 and 7 countries in Grades Four and Eight respectively for which there are only 1% or less of the students among the top 10%.

4.4 The Affective Aspects

Other than achievement, we are obviously interested in students' attitudes towards mathematics and learning in general. Looking at the affective aspect provides a parameter other than the TIMSS test results in measuring the success of a country in mathematics education, for test results should be considered as only one aspect of achievement. Are Hong Kong students responding as favourably in the TIMSS questionnaire on the affective aspects of mathematics? For example, do Hong Kong students like mathematics? Are they confident in doing mathematics? Also, in appraising the accomplishment of the Hong Kong students, one has to ask what price they are paying in attaining this result. Are the superior test results achieved at the expense of other aspects of development of the child? Are children in Hong Kong, for example, spending less time in sports and in having fun? These are some of the issues that will be explored in rest of this section based on the TIMSS questionnaire results.

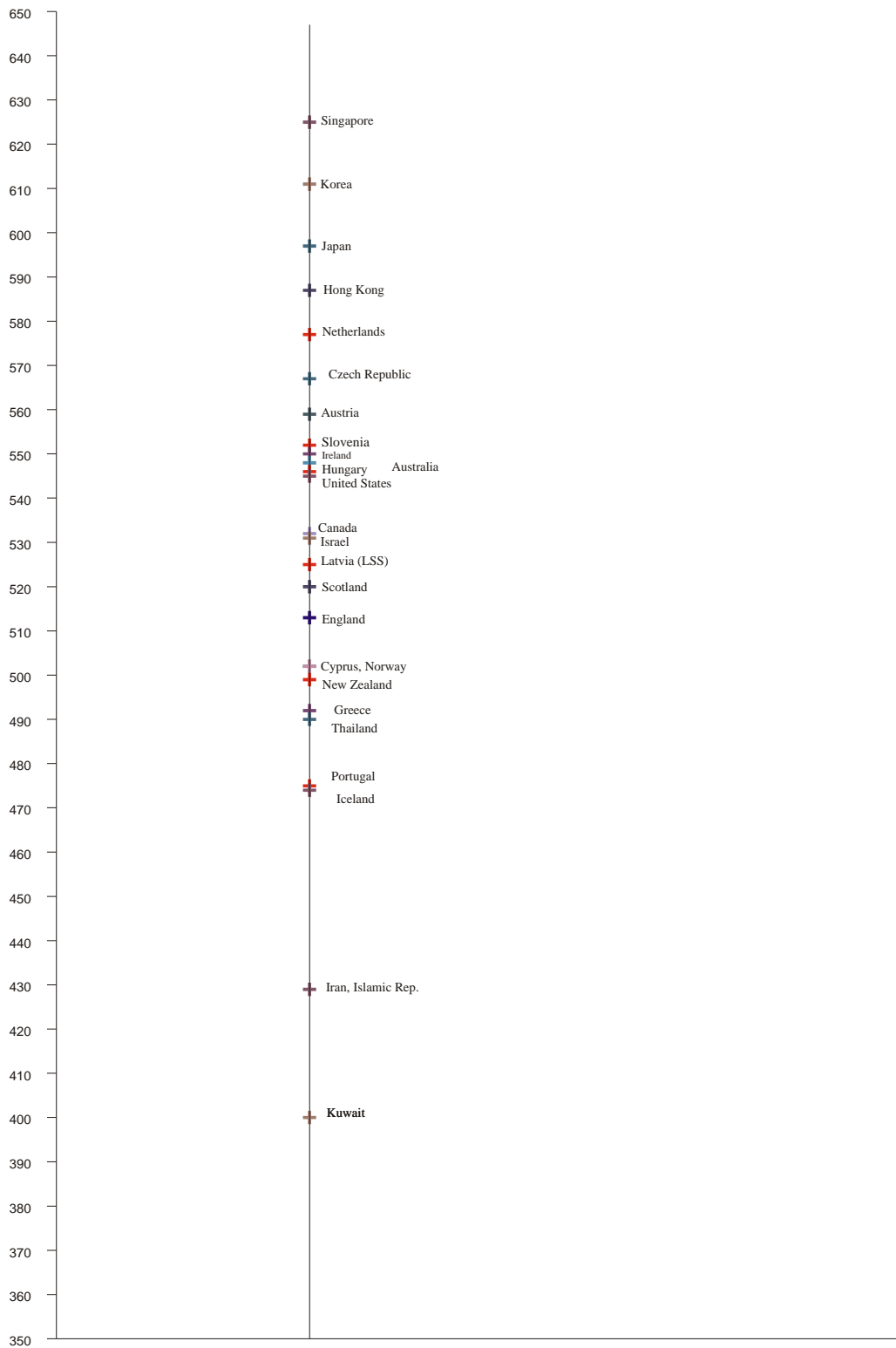


Figure 5: Mathematics Achievement in TIMSS Countries (Fourth Grade)

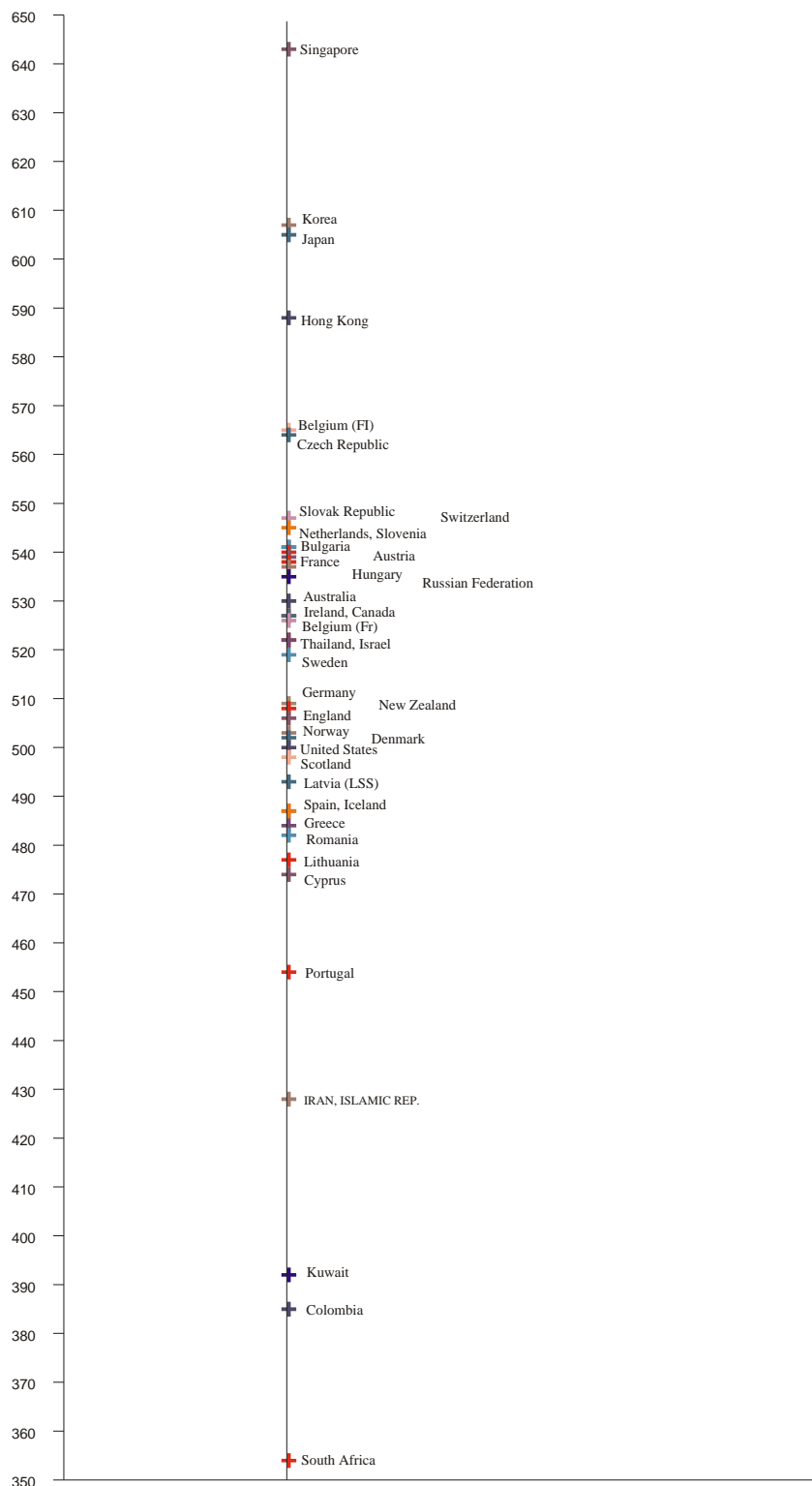


Figure 6: Mathematics Achievement in TIMSS Countries (Eighth Grade)

4.4.1 The Importance of Mathematics

Students in Hong Kong, like their counter-parts in the rest of the TIMSS countries, find mathematics important. 96% of the Hong Kong students in both grades 4 and 8 think that it is important to do well in mathematics (see Figures 7 and 8).

4.4.2 Interest in Mathematics

The literature shows a high correlation between students' interest in mathematics and their achievement. Given the high achievement of the Hong Kong students, one would expect them to have a positive attitude towards mathematics. But the TIMSS results do not coincide with this expectation. Students in Hong Kong are not among those countries whose students like mathematics most (see Figures 9 and 10).

4.4.3 Attribution of Success and Failure and the Role of Memorization

Contrary to common belief that students in East Asian countries attribute success more to hard work than to natural talent or ability, and that they attach a lot of importance to memorization (see Section 2.3), the TIMSS results do not totally support these stereotypes. Although 95% of the students in Hong Kong agreed that it takes a lot of hard work to do well in mathematics (which is among the highest in the TIMSS countries), this view is shared by most students worldwide as well (more than 70% of students in any one of the countries agreed with this statement, and 90% or more of the students in more than half of the countries agreed with this statement, see Figures 11 and 12). The percentages of students who agreed that natural talent or ability were important to do well in mathematics are more varied worldwide (Figures 13 and 14), but Hong Kong is not among those with low percentages of agreement (in fact it is slightly on the high side internationally). The only clear pattern is that Hong Kong primary school students in general do not believe in luck having anything to do with high achievement (Figure 15).

It may be worth pointing out that in contrast to the students' views, teachers in Hong Kong tend not to believe in natural talent. This is true for both Primary and Secondary school teachers².

As for the importance of memorization, again there is wide variation worldwide, but Hong Kong students are not among those who consider memorization very important (Figures 17 and 18).

² See Mullis, I.V.S. *et al* (1997), *Mathematics Achievement in the Primary School Years*, p.150, Figure 5.1; and Beaton, A.E. *et al* (1996), *Mathematics Achievement in the Middle School Years*, p.140, Figure 5.1.

Students' Report on Whether It Is Important to Do Well in Mathematics (Grade 4)

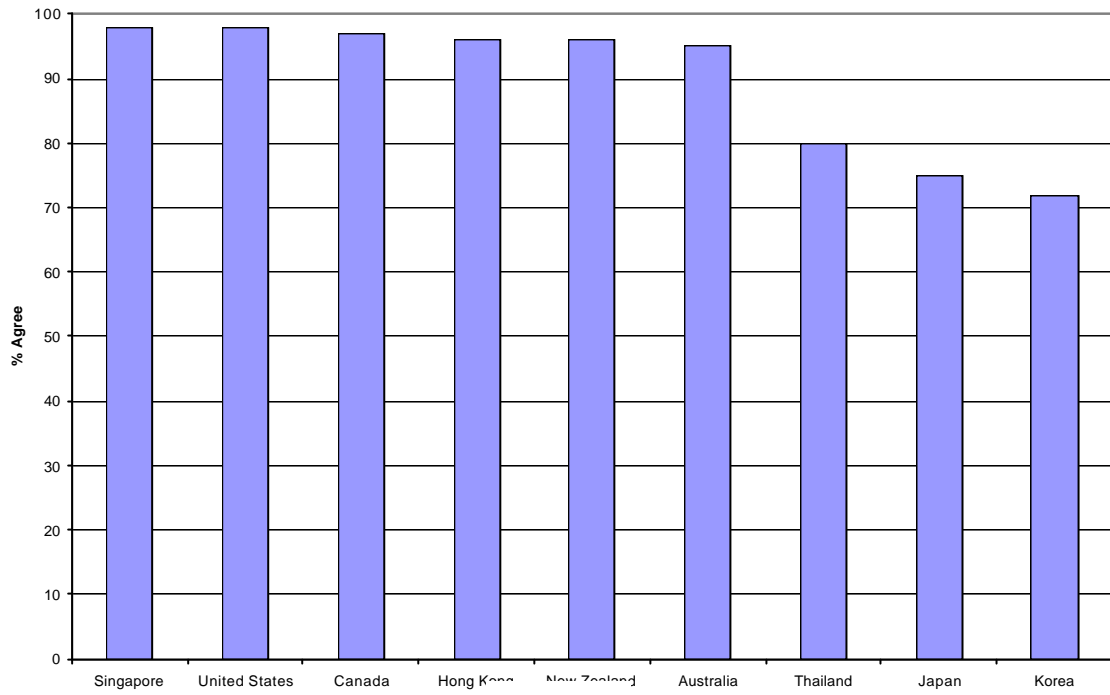


Figure 7

Students' Report on Whether It Is Important to Do Well in Mathematics (Grade 8)

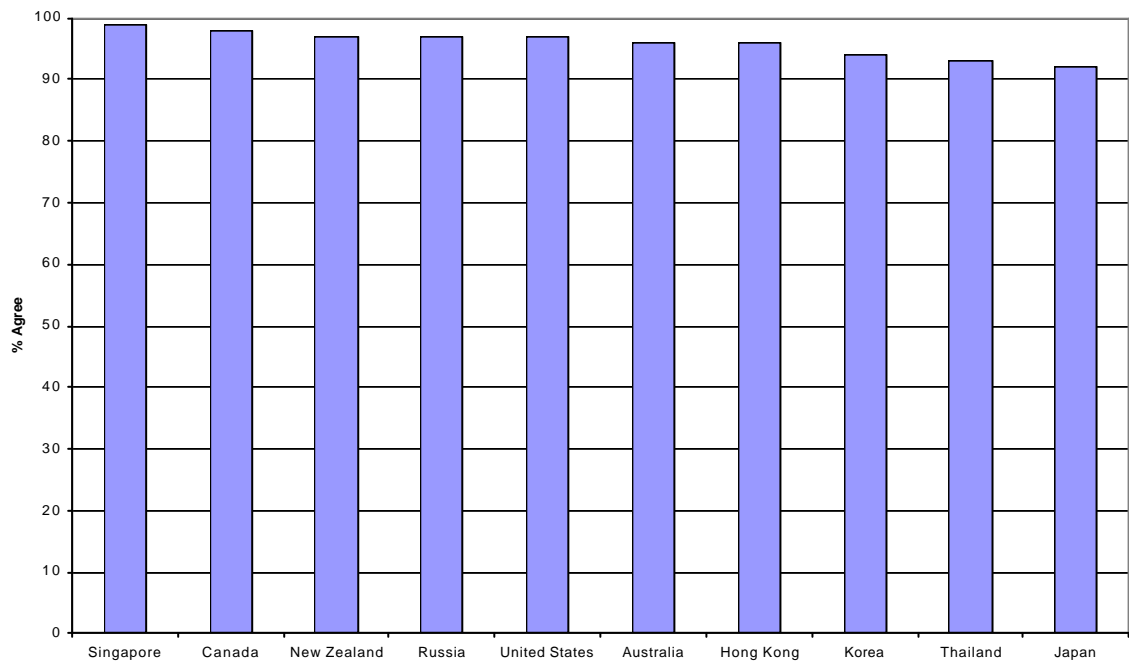


Figure 8

Students' Report on Liking Mathematics (Grade 4)

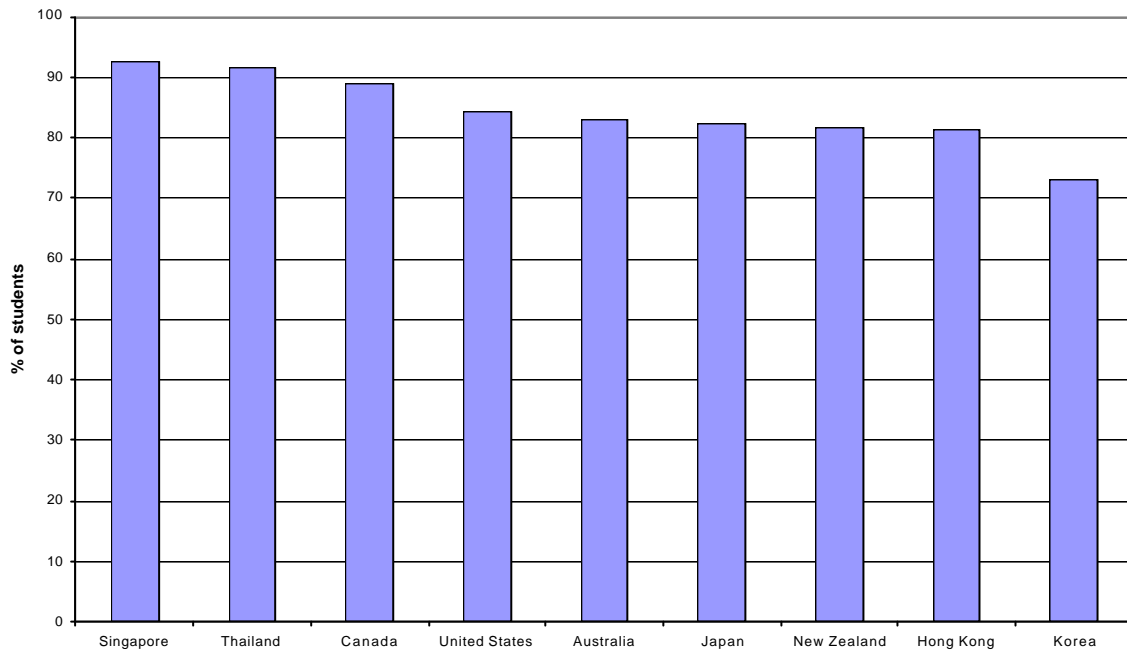


Figure 9

Students' Report on Liking Mathematics (Grade 8)

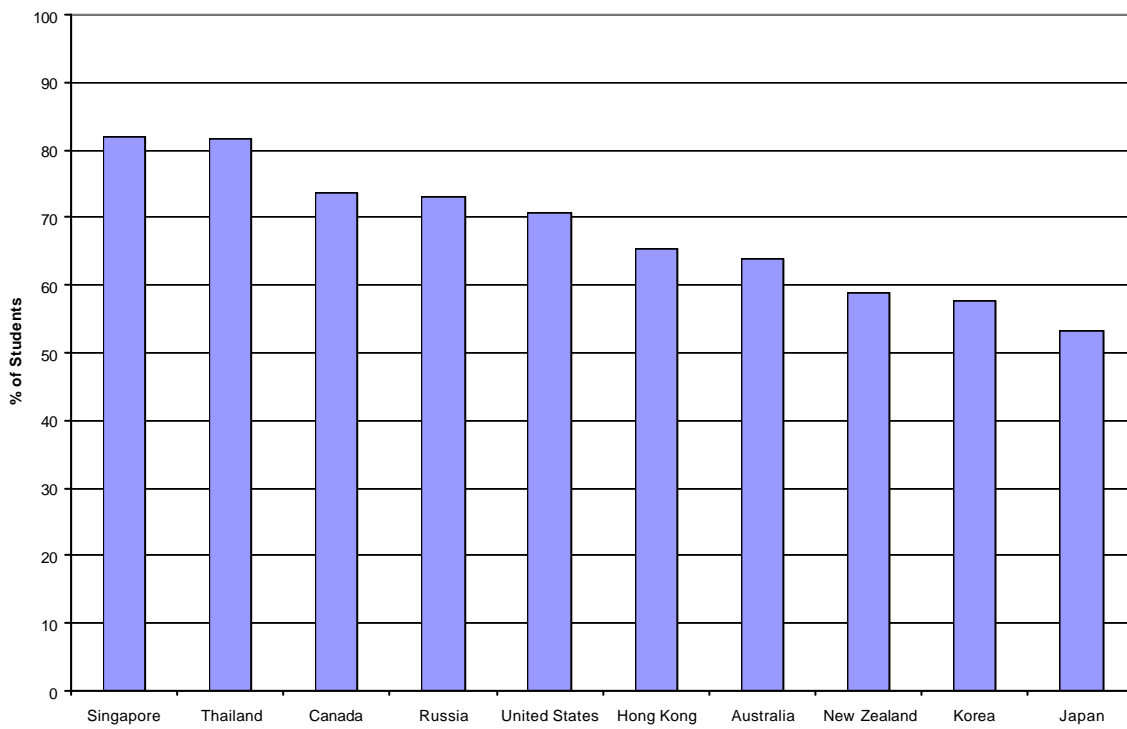


Figure 10

Attribution of Success to Hard Work (Grade 4)

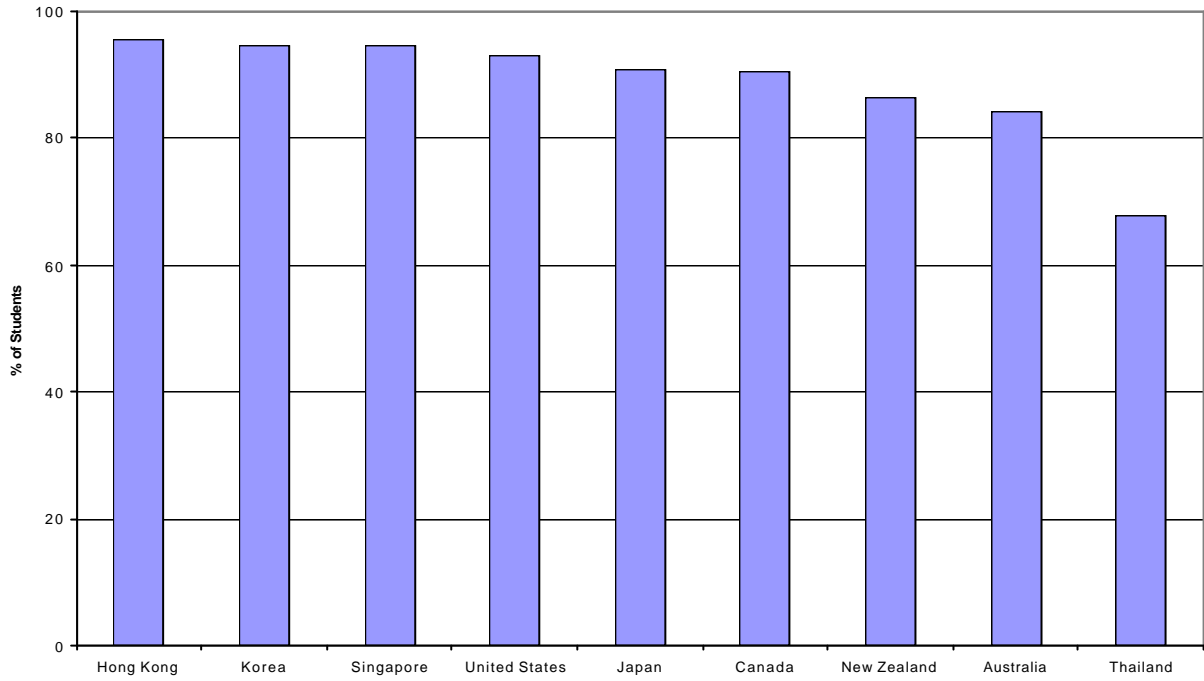


Figure 11

Attribution of Success to Hard Work (Grade 8)

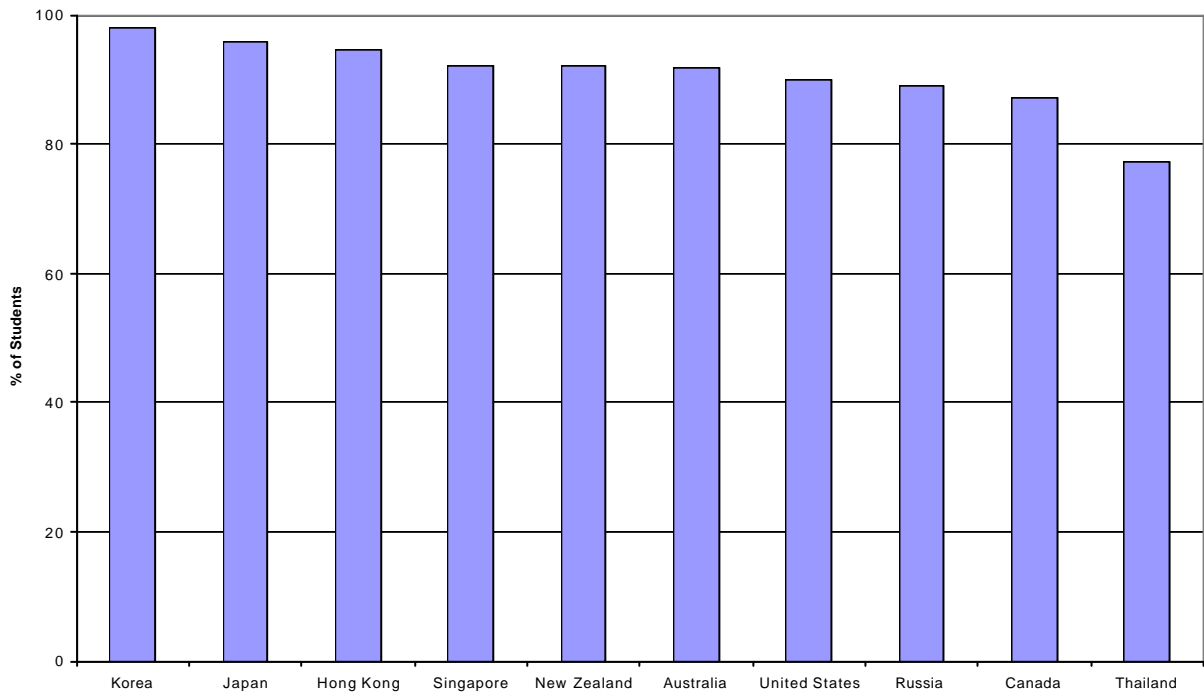


Figure 12

Attribution of Success to Natural Ability (Grade 4)

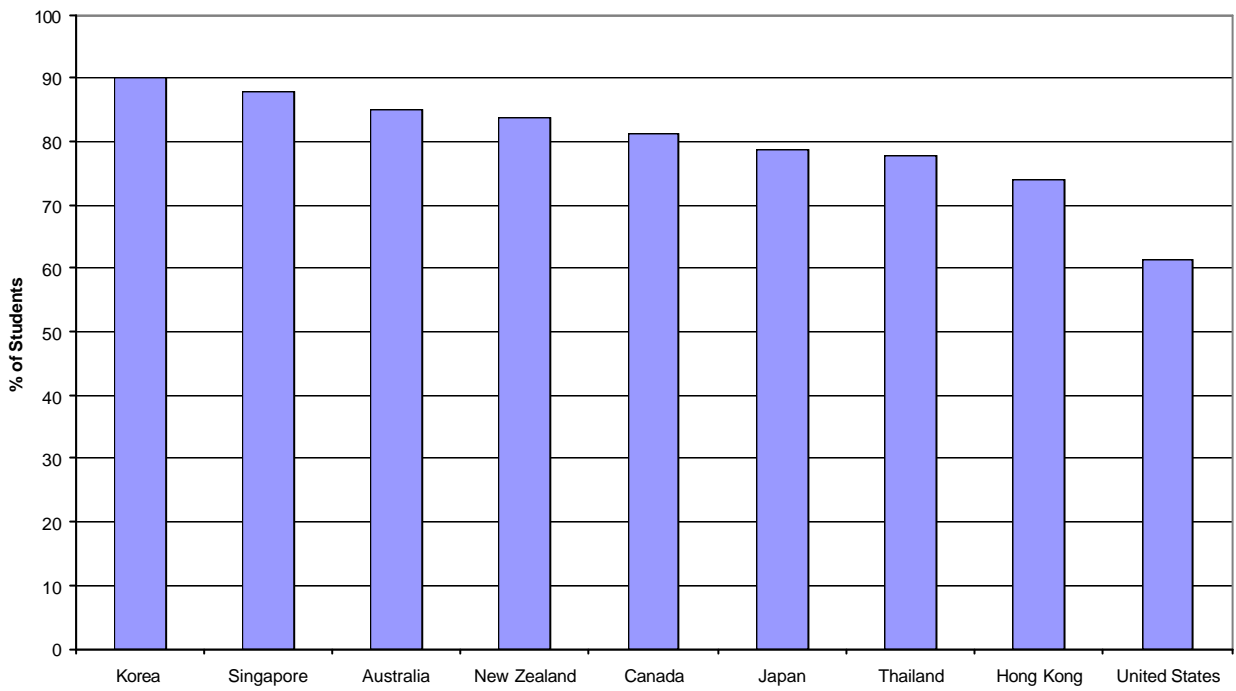


Figure 13

Attribution of Success to Natural Ability (Grade 8)

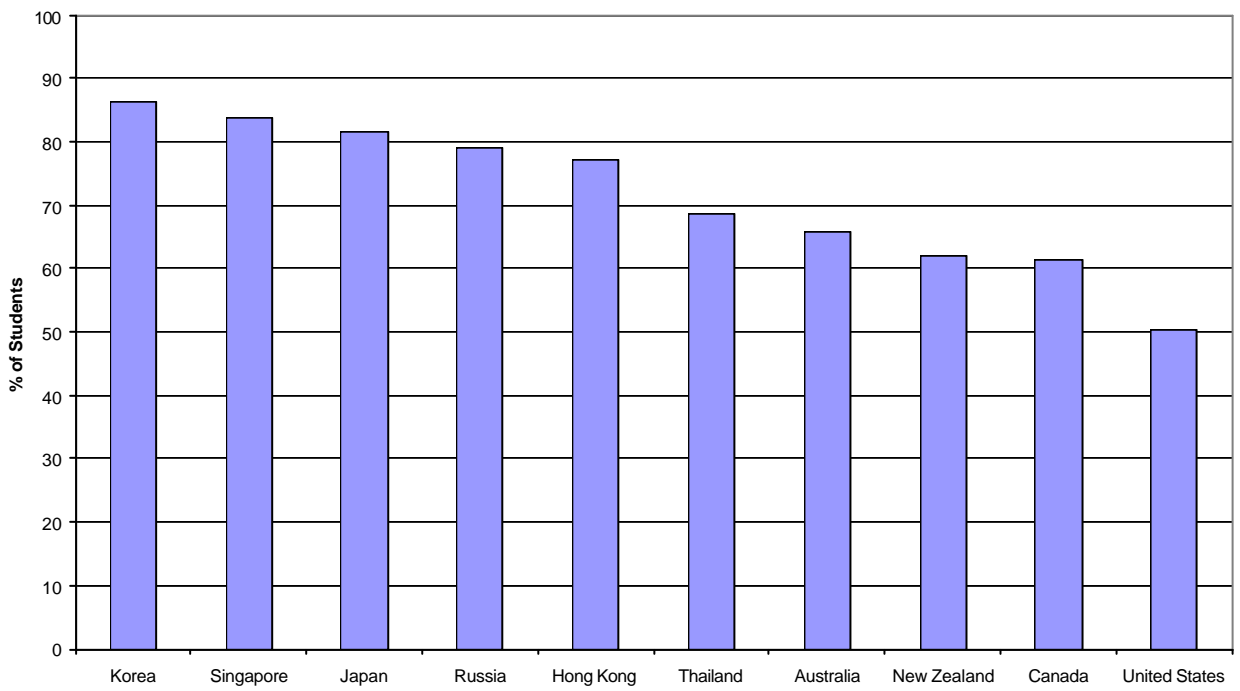


Figure 14

Attribution of Success to Luck (Grade 4)

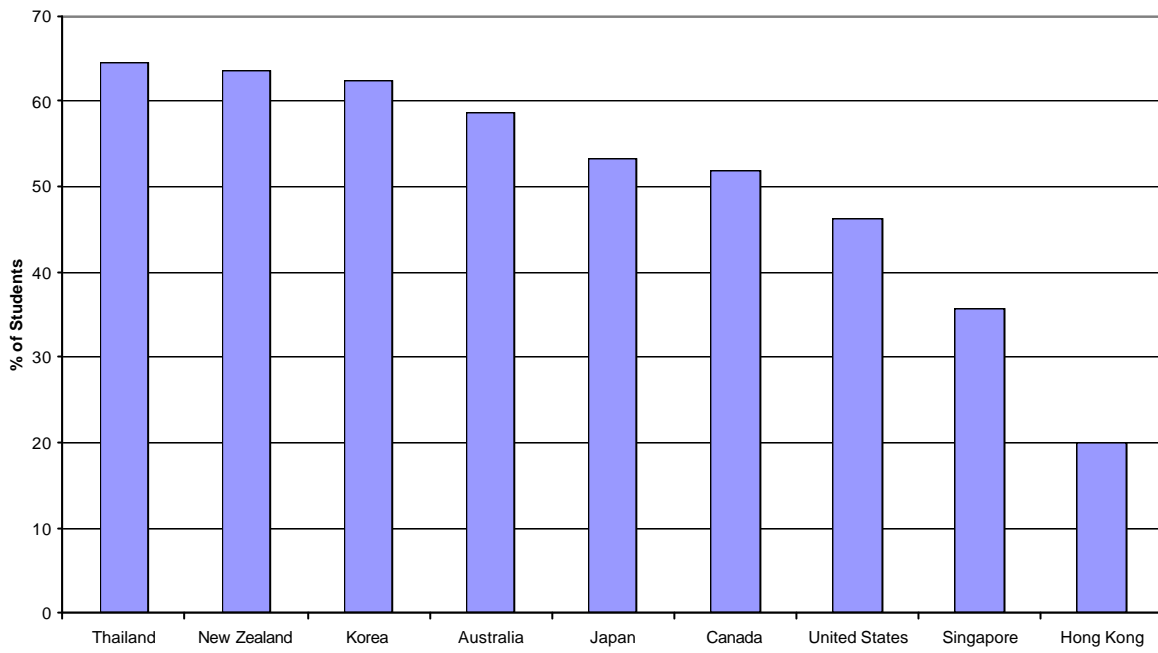


Figure 15

Attribution of Success to Luck (Grade 8)

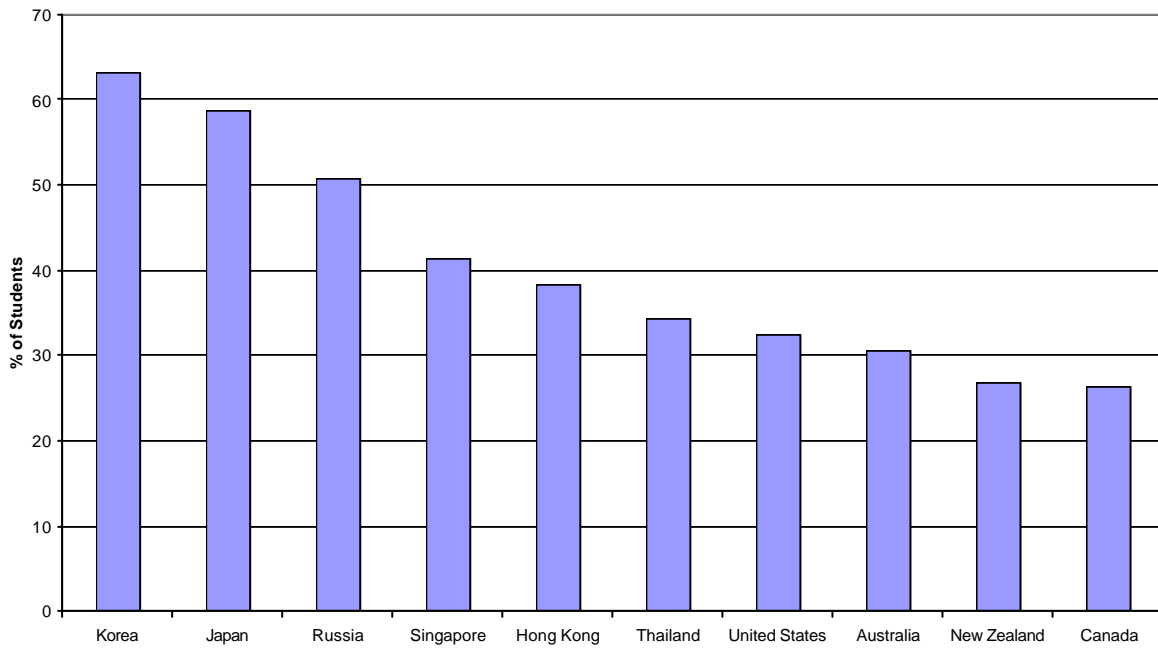


Figure 16

Attribution of Success to Memory (Grade 4)

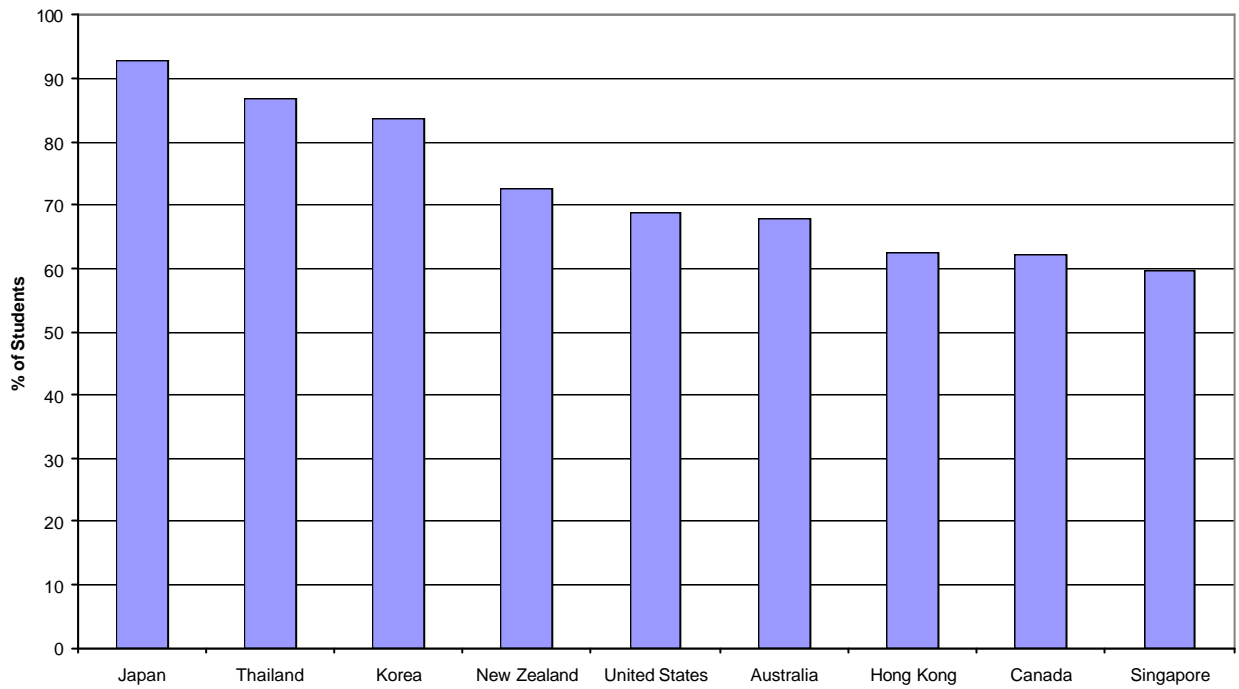


Figure 17

Attribution of Success to Memory (Grade 8)

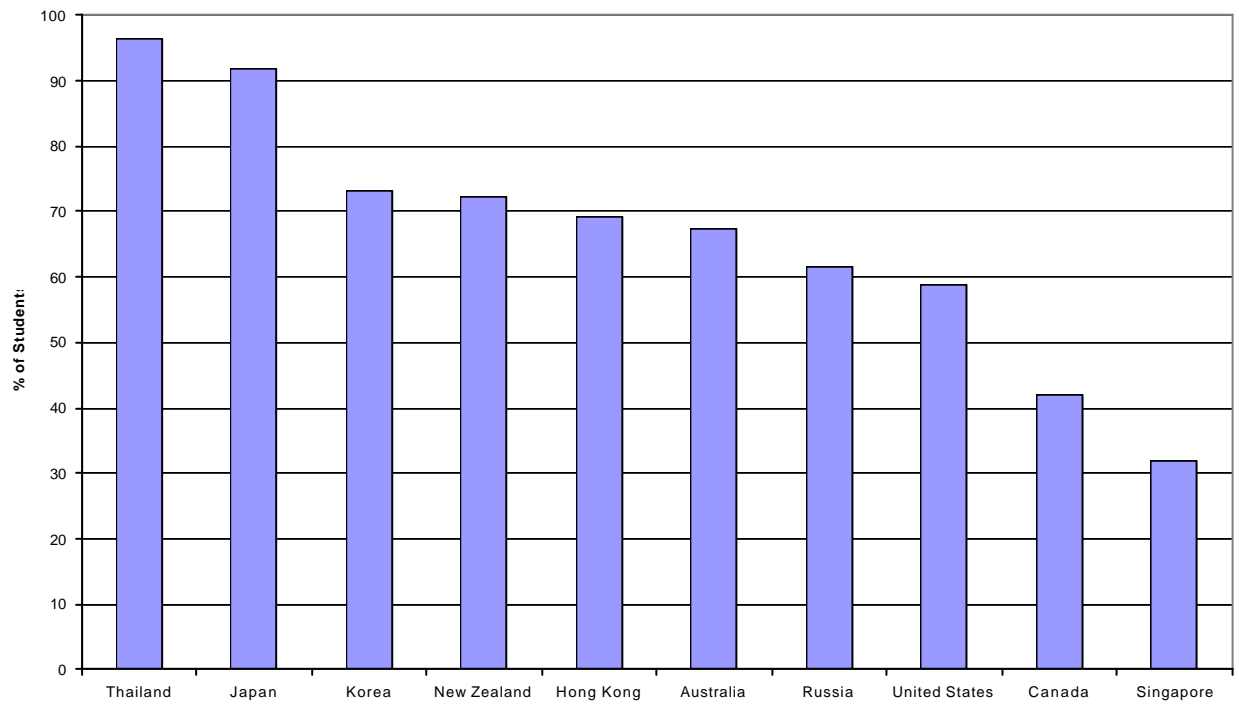


Figure 18

4.4.4 Confidence in Mathematics

In the TIMSS questionnaire, students were asked whether they think they do well in mathematics. In sharp contrast to their high achievement, many students in Hong Kong do not think that they do well in mathematics (see Figures 19 and 20). In fact, Hong Kong is among the top two countries (in both Grades 4 and 8) world-wide in reporting not doing well in mathematics, and in general, girls have a lower perception of their ability than boys. If mathematics education aims at building up students' confidence in tackling mathematics problems, then Hong Kong cannot be considered as having achieved this aim, albeit its students' superior performance in achievement.

It should be pointed out here that this negative finding in Hong Kong may be due to the stress in the Chinese culture on the virtue of humility or modesty. Children under the Chinese culture are taught from when they are young that one should not be boastful. This may inhibit students from rating themselves too highly on the question of whether they think they do well in mathematics, and so the scores may represent less than what students are really thinking about themselves. On the other hand, one's confidence and self image are something that is reinforced by one's learned values, and if students are constantly taught to rate themselves low, they may internalize the idea and may result in really low confidence.

It may be of interest to note that in contrast, some of the low performing countries have students who are very confident in their mathematics ability. So again, there is no conspicuous correlation between a country's performance and their students' confidence in mathematics.

4.4.5 Attitude towards Sports and Having Fun

In contrast to the attitude towards the importance of mathematics, Hong Kong students in general consider sports or having fun less important compared to students in other parts of the world (see Figures 21 to 24).

4.4.6 How Students Use Their Time

Although the curriculum time devoted to mathematics in Hong Kong is no more than that in other parts of the world (see section 3.1.1), Hong Kong students however spend comparative more time out of school doing mathematics homework, studying mathematics or attending extra lessons in mathematics, especially at the primary school level (Figures 25 and 26). In contrast, they spend comparably less time in sports (Figures 27 and 28), although they are required to work less in doing jobs at home.

Students' Report on Doing Well in Mathematics (Grade 4)

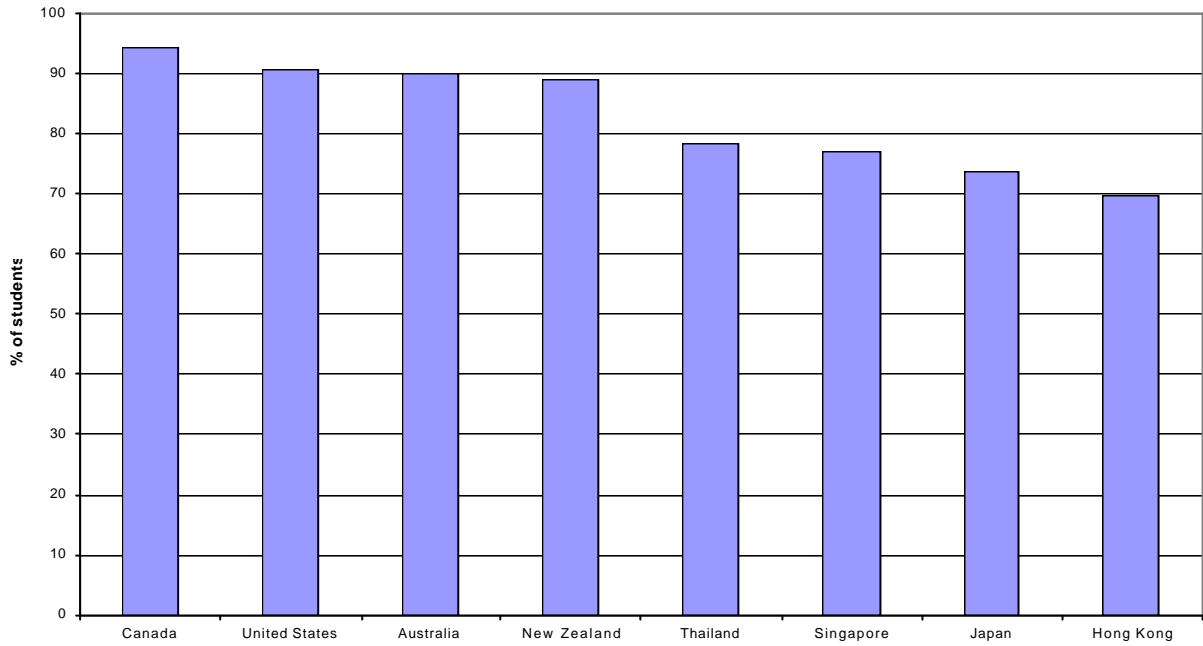


Figure 19

Students' Report on Doing Well in Mathematics (Grade 8)

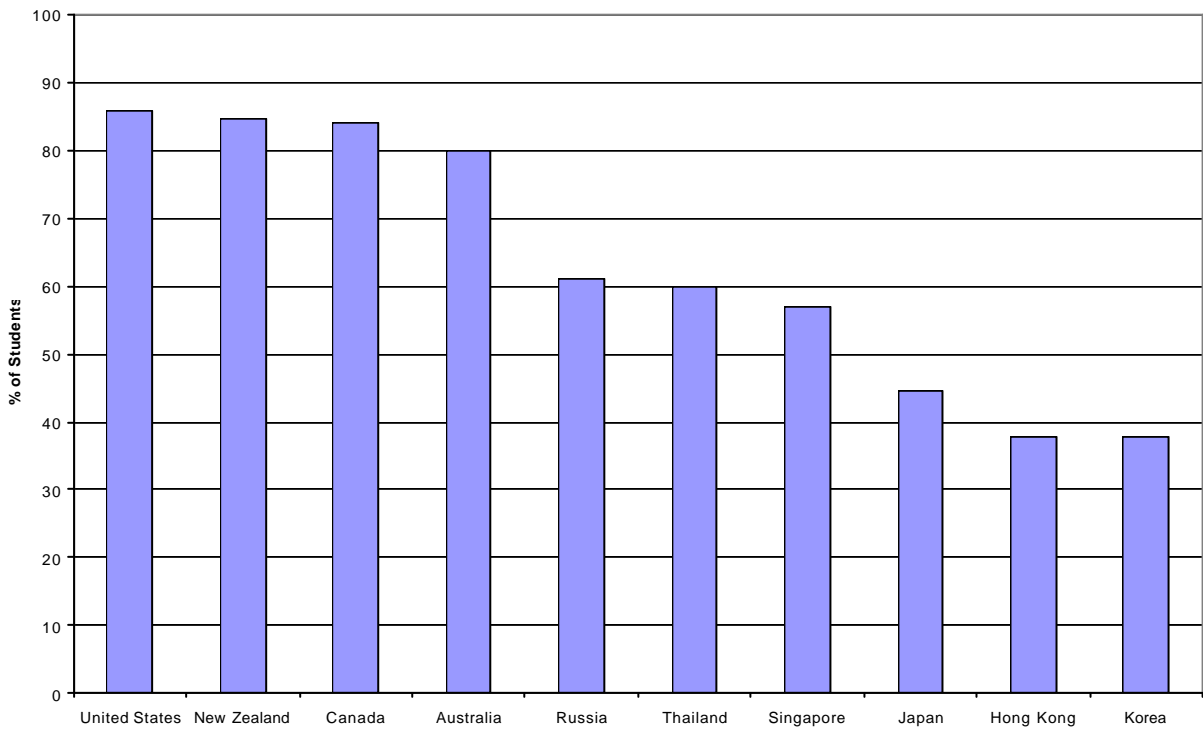


Figure 20

Students' Report on Whether It Is Important to Be Good at Sports (Grade 4)

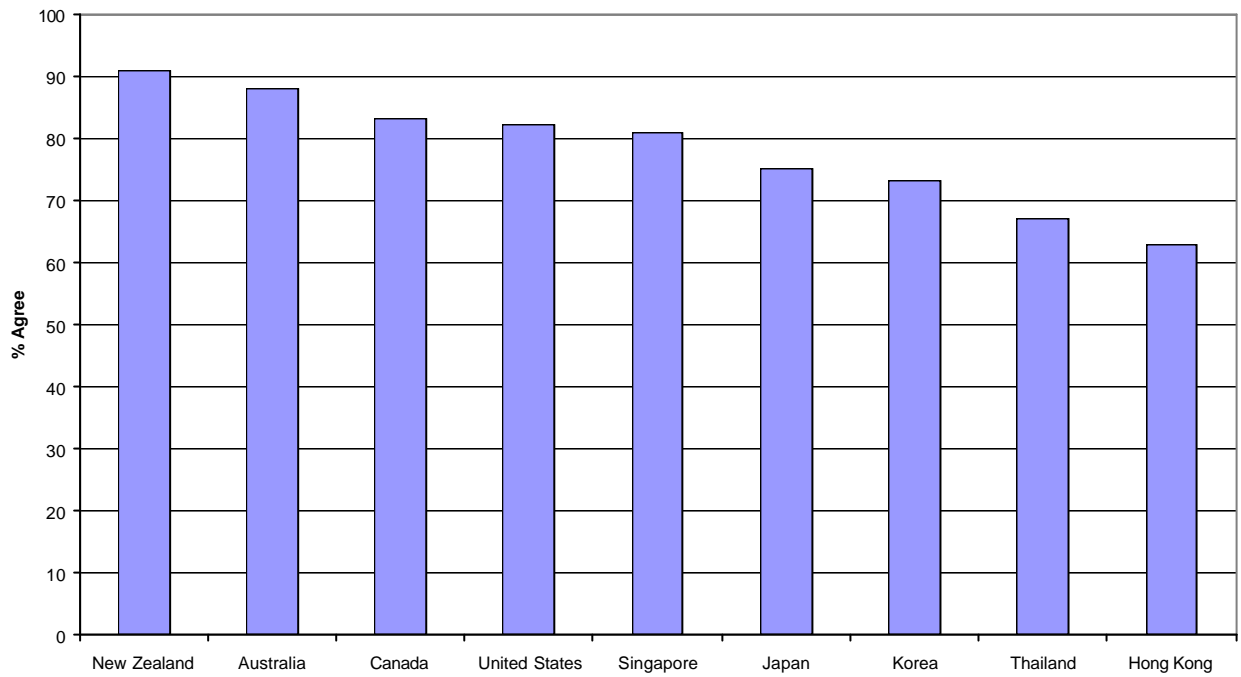


Figure 21

Students' Report on Whether It Is Important to Be Good at Sports (Grade 8)

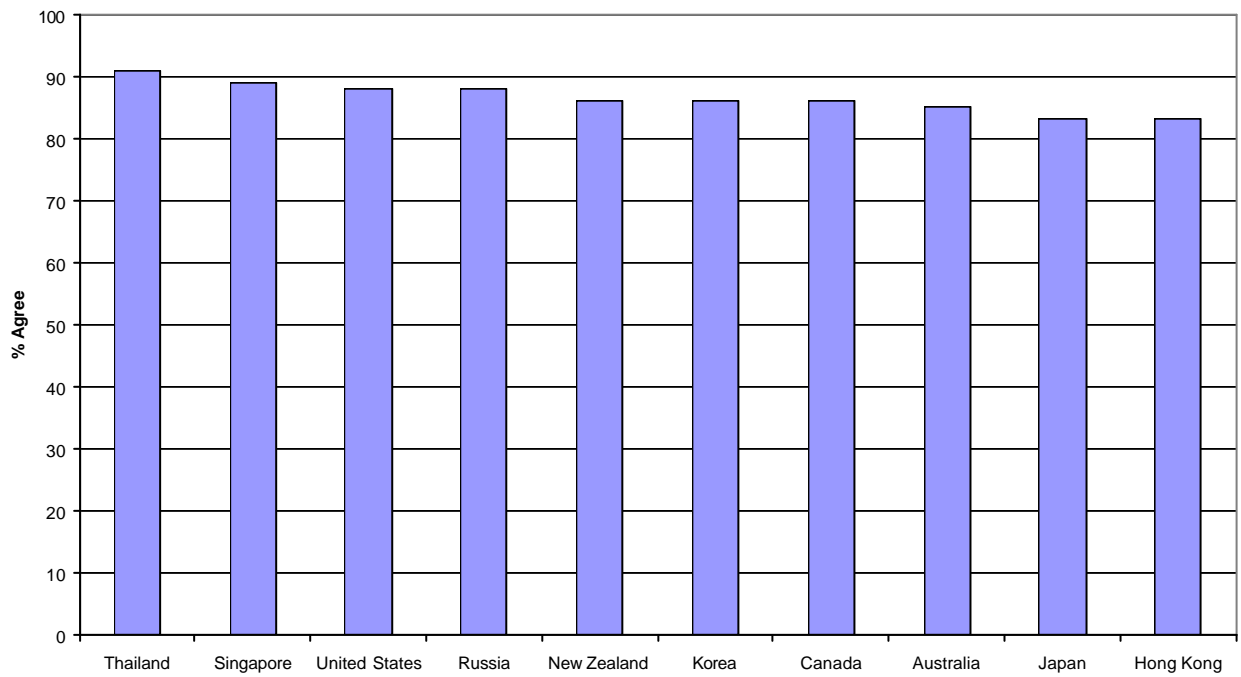


Figure 22

Students' Report on Whether It Is Important to Have Fun (Grade 4)

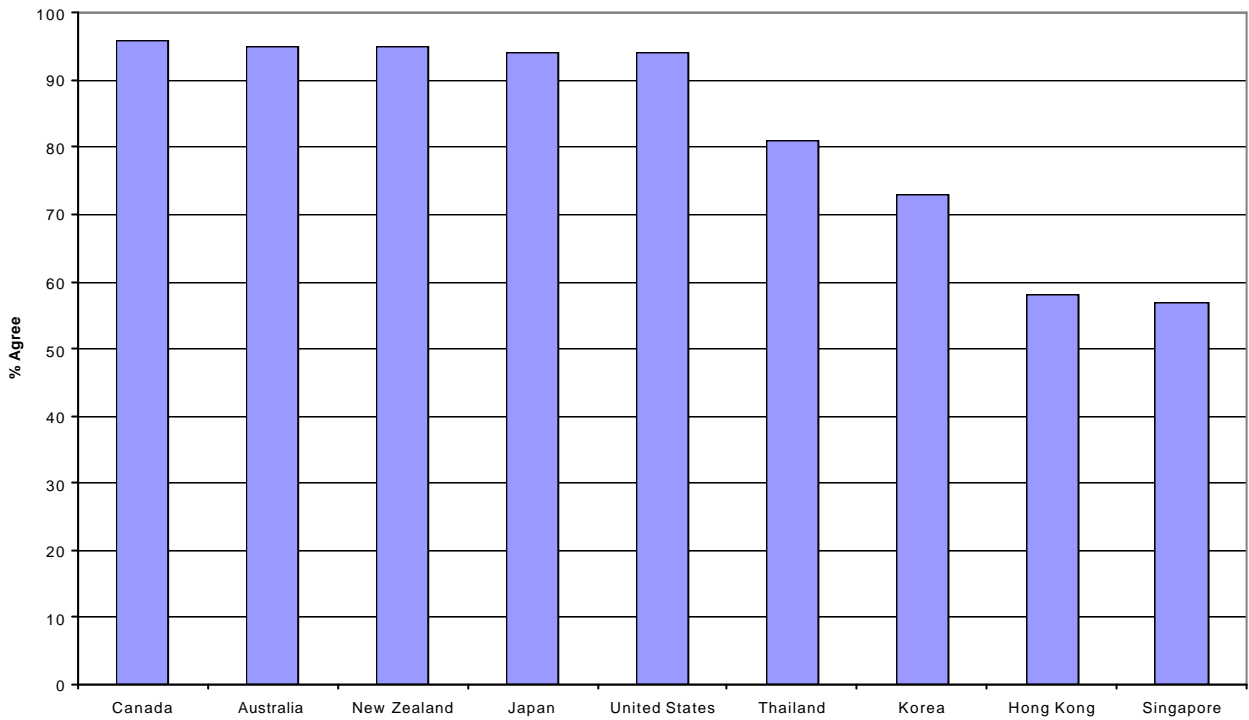


Figure 23

Students' Report on Whether It Is Important to Have Fun (Grade 8)

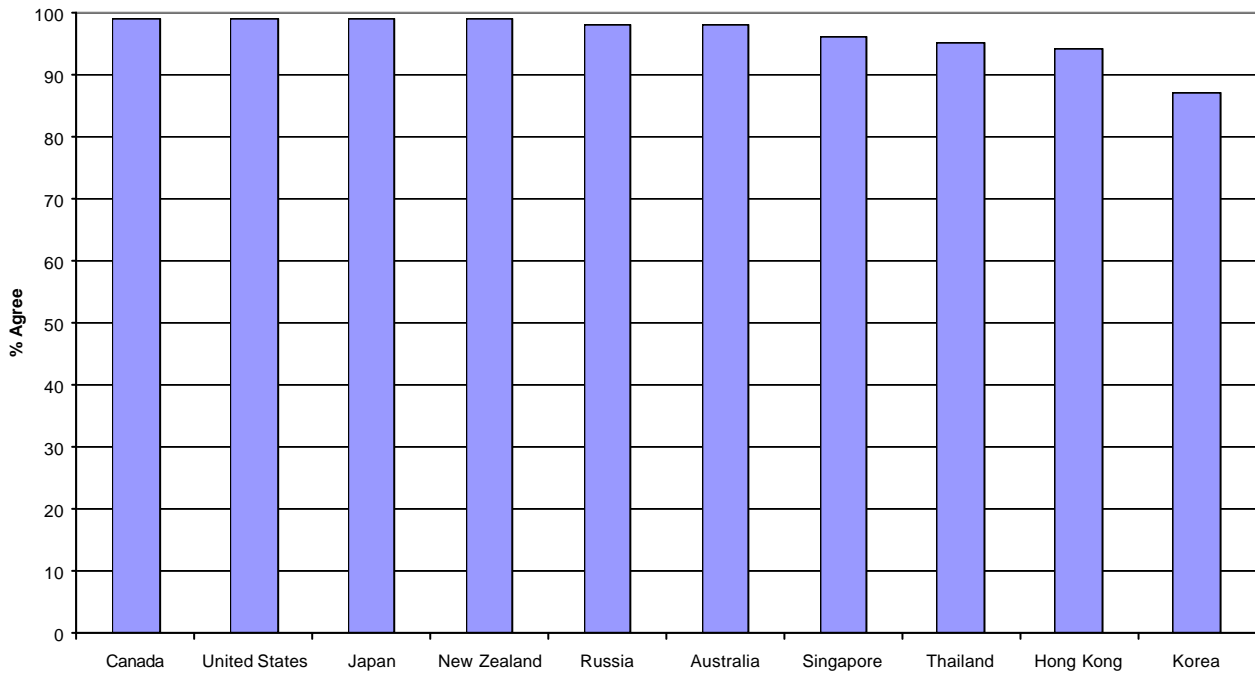


Figure 24

Out-of-School Time Studying Mathematics or Doing Mathematics Homework (Grade 4)

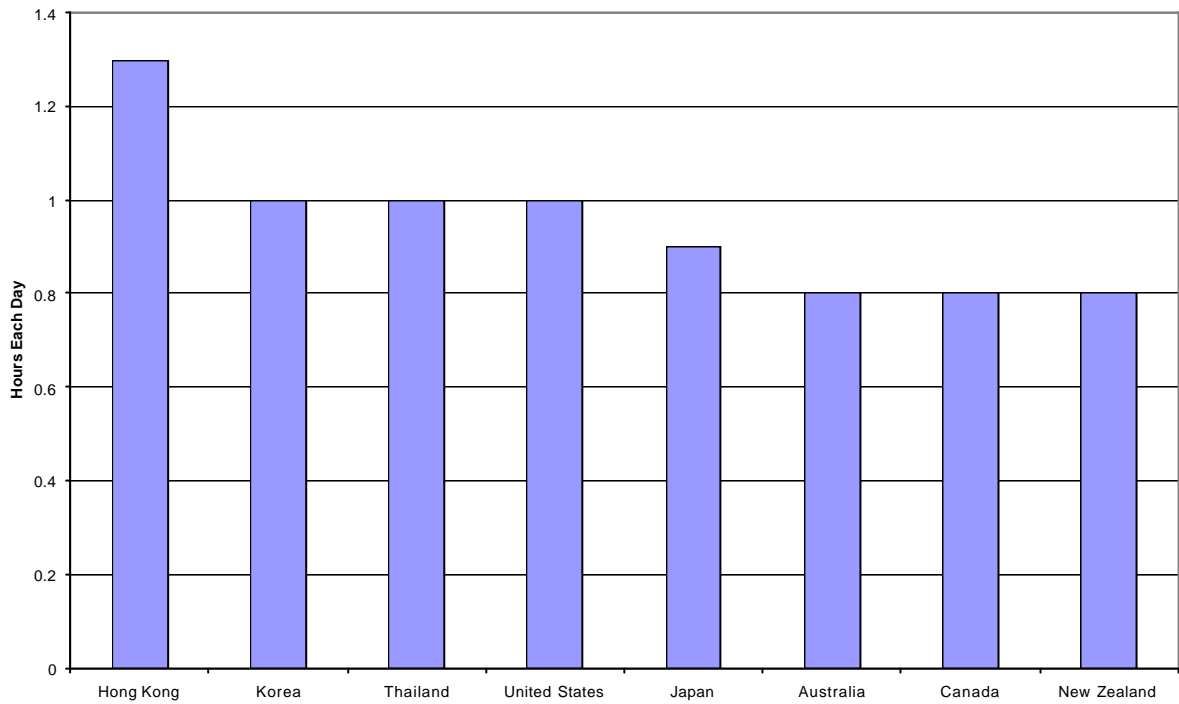


Figure 25

Out-of-School Time Studying Mathematics or Doing Mathematics Homework (Grade 8)

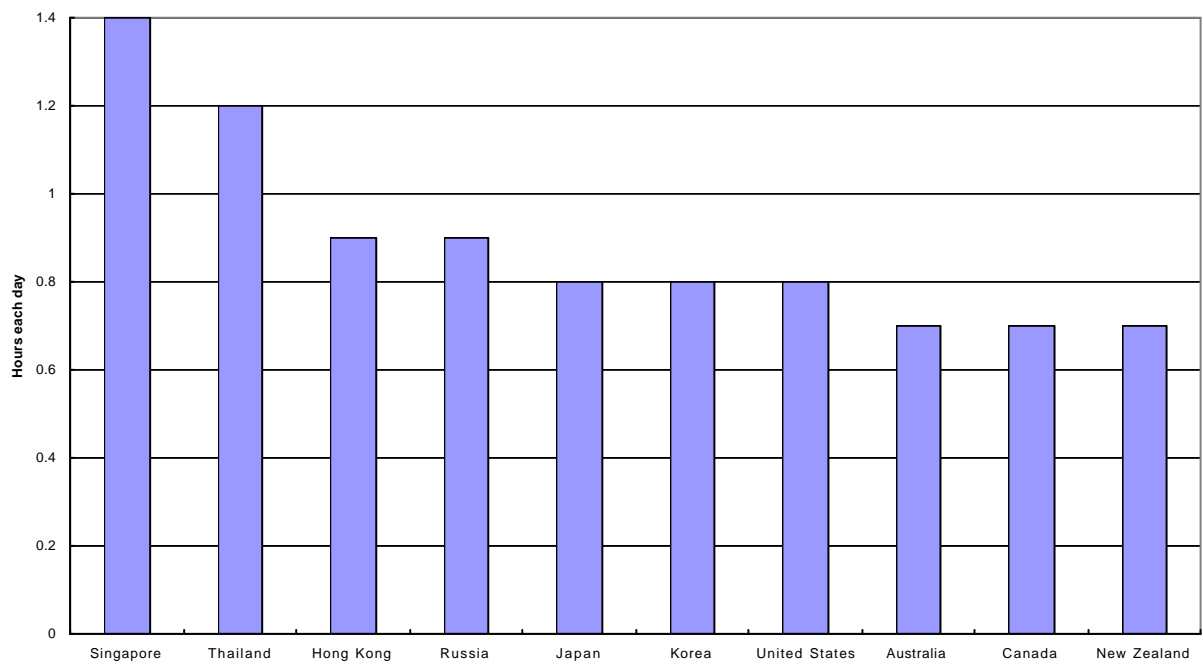


Figure 26

Time Playing Sports (Grade 4)

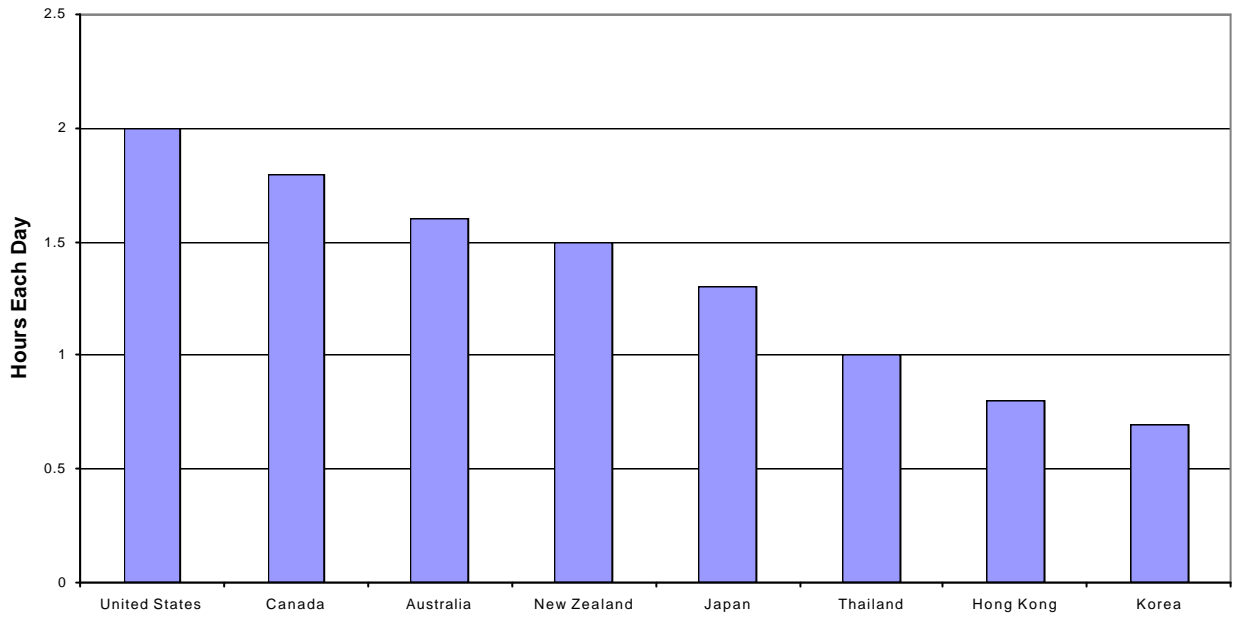


Figure 27

Time Playing Sports (Grade 8)

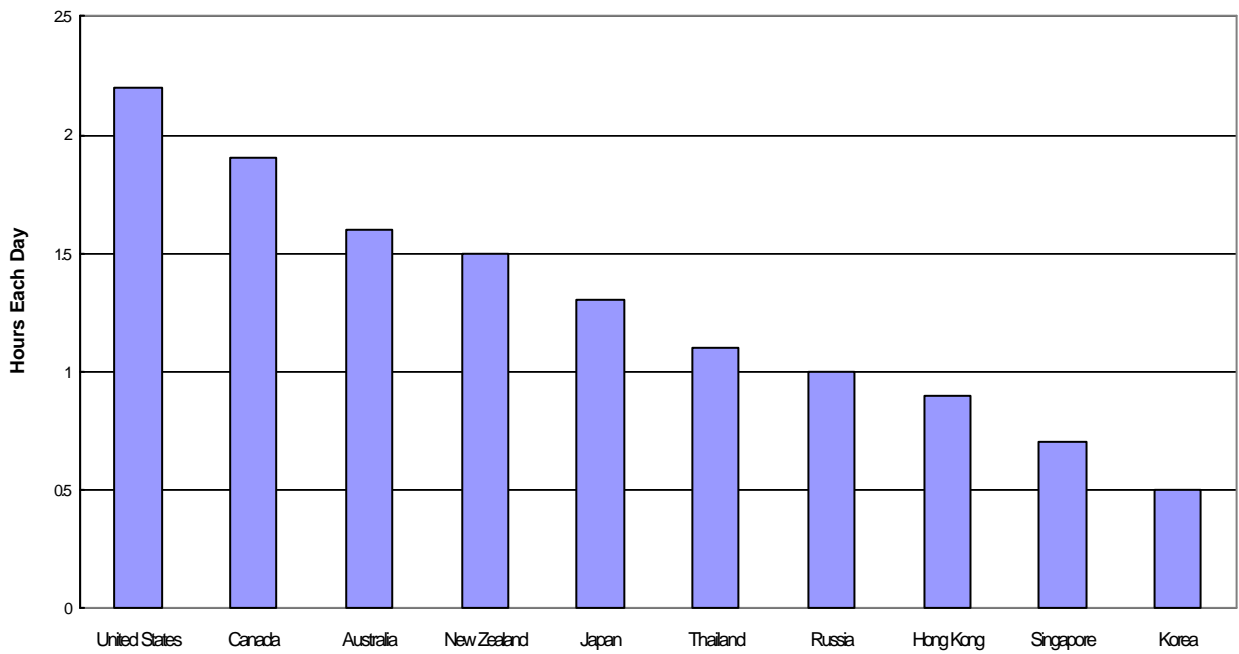


Figure 28

4.5 Conclusion

Despite adverse conditions such as low education spending and large class size, Hong Kong students did extremely well in the TIMSS mathematics tests. But this may have been achieved at the expense of other aspects of the development of the students. For example, Hong Kong students comparatively found sports or having fun less important, and they spent less time in sports compared to their counter-parts in other countries. They also displayed relatively negative attitudes towards mathematics. In particular, Hong Kong students lacked confidence in doing mathematics. This may be a result of the Chinese culture stressing modesty, but it may also well be a result of the competitive examinations system and a culture of lack of encouragement on the part of the teachers.