OECD PISA
經濟合作與發展組織

The Second HKPISA Report
Executive Summary

From PISA 2000

To PISA 2003

MONITORING THE QUALITY AND EQUALITY OF EDUCATION IN HONG KONG FROM AN INTERNATIONAL PERSPECTIVE
從國際視野鑑察香港教育的質素與均等

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1. The Programme for International Student Assessment (PISA) is a collaborative effort among the member countries of the Organization for Economic Co-operation and Development (OECD). The primary goal of this international study is to assess how well 15-year-old youths approaching the end of compulsory education have acquired the knowledge and skills essential for participation in our challenging society. Based on the findings, the researchers will develop educational indicators to help governmental bodies and policy makers examine, evaluate, and monitor the effectiveness of the education system at both national and school levels.

2. The PISA assessment takes place every three years starting from 2000. PISA 2003 is the second cycle of this assessment. Similar to PISA 2000, the present assessment covers the domains of "Mathematical", "Scientific", and "Reading" Literacy, with the major focus shifting from reading literacy towards mathematical literacy. In order to examine the ability of students to solve problems in real-life situations, another subject domain of "Problem Solving Skills" has been introduced in PISA 2003.

3. In PISA 2003, over 250,000 students from more than 9,000 schools in 41 countries/regions (Table 1) took part in a two-hour test in their schools.

Table 1 Participating Countries/Regions of PISA 2003

OECD Countries/Regions			Partner Countries/Regions
Australia	Hungary	Norway	Brazil
Austria	Iceland	Poland	**Hong Kong, China**
Belgium	Ireland	Portugal	Indonesia
Canada	Italy	Slovak Republic	Latvia
Czech Republic	Japan	Spain	Liechtenstein
Denmark	Korea	Sweden	Macao, China
Finland	Luxembourg	Switzerland	Russian Federation
France	Mexico	Turkey	Serbia and Montenegro
Germany	Netherlands	United Kingdom	Thailand
Greece	New Zealand	United States	Tunisia
			Uruguay

4. The purpose of PISA is to assess students' acquisition of the important knowledge and skills needed in adult life, but not necessarily be restricted to the school curriculum. The term "literacy" is used in the PISA study to encapsulate this broader conception of knowledge and skills. The PISA Consortium has developed a framework describing the scope and dimensions of the assessment for the four domains of literacy. Each domain has three dimensions: the *content* or *structure* of knowledge that students should acquire; the *processes* that need to be performed; and the *situation* or *context* in which knowledge and skills are applied or drawn on. In addition to the assessment of the four domains, in PISA 2003 students and school principals were required to complete the background questionnaires (an additional parent questionnaire is included in

HKPISA) to gather more background information of the participating students. The collected data are vital to provide a solid base for policy-oriented analysis of the assessment results.

MAIN STUDY OF HKPISA 2003

5. The HKPISA 2003 main study was conducted from May to July 2003. A two-stage stratified sampling design was used. In the first stage, a random sample of schools from each stratum were selected with probability proportional to the sample size. Schools were stratified based on the type of the school (government, aided and independent/private) and student academic intake (high, medium and low). The distribution of schools is shown in Table 2.

Table 2 Participating Schools for Each Sampling Stratum in HKPISA 2003

Explicit Stratum	Implicit Stratum	Total Number of Schools	Number of Schools Participated
Government	High Ability	17	8
	Medium Ability	9	3
	Low Ability	10	4
Aided	High Ability	127	50
	Medium Ability	124	41
	Low Ability	107	33
Independent/Private[#]	Local/DSS[*]	29	5
	International	20	1
Total		**443**	**145**

Note: [#]There is no intake classification for independent/private schools.
[*]DSS refers to schools under the Direct Subsidy Scheme.

6. In the second stage, thirty-five 15-year-old students were randomly selected from each school that agreed to participate. A total of 4,478 students from 145 schools participated in the final analysis and international comparison. The sample represents the target population well. Table 3 shows the grade distribution of the sampled students in HKPISA 2003.

Table 3 Grade Distribution of Students Participating in HKPISA 2003

Form/Grade	Number of Students	Proportion (%)
S1/7	211	4.7
S2/8	439	9.8
S3/9	1,132	25.3
S4/10	2,692	60.1
S5/11	4	0.1
Total	**4,478**	**100**

7. To ensure the data are collected in internationally comparable conditions, the HKPISA Centre trained 51 test administrators to administer the assessment in schools according to the OECD assessment procedures. After data collection, 8 markers for reading and 16 markers each for mathematics, science and problem solving were recruited. They are teachers or prospective teachers in the relevant fields. They were trained by our subject experts according to the marking guides of open-ended response questions provided by OECD. Open-ended response questions of 900 booklets were selected for multiple marking by four markers so that marker reliability can be assessed.

MAJOR FINDINGS

Quality and Equality

8. The findings derived from HKPISA 2003 are important to shed light on both the ***quality*** and ***equality*** of the education system in Hong Kong. Quality refers to the effectiveness of the education system in fostering students' literacy skills. Equality of educational opportunity, specifically in this report, refers to the level of educational outcomes of students from different social, economic, and cultural backgrounds.

9. Concerning the overall quality, Hong Kong students performed well in the four assessment domains. Consistent with the first cycle of PISA + study, Hong Kong ranked among the top 10 countries/regions in all four domains (ranked 1st in mathematics, 2nd in problem solving, 3rd in science, and 10th in reading). The mean performance was significantly above the OECD average.[1] Taking statistical significance into account, Hong Kong performed better in mathematical literacy than all other participating countries/regions except Finland, Korea, the Netherlands, Liechtenstein, and Japan. Hong Kong's scientific literacy performance was better than other participating countries/regions except Finland, Japan, Korea, Liechtenstein, Australia, Macao, the Netherlands, and Czech Republic. Hong Kong outperformed in problem solving skills other countries/regions except Korea, Finland, Japan, New Zealand, Macao, and Liechtenstein. Only Finland, Korea, Canada, and Australia performed better than Hong Kong in reading literacy. (See Appendix I)

10. As far as equality in education is concerned, the differences between high (95th percentile) and low (5th percentile) achievers in all domains are relatively small and less than the OECD averages. It suggests that most Hong Kong students have similar access to, and can benefit from, schooling in the Hong Kong education system. Besides, socio-economic and cultural background (SES) has only a relatively small impact on the literacy performance of Hong Kong students. The

[1] The OECD average is set to 500 points with standard deviation of 100.

impact of SES on academic achievement is often expressed as "socio-economic gradient"[2]. The slope of the gradient line is an indication of the extent of inequality in student performance attributable to SES. The modest socio-economic gradient of Hong Kong suggests that Hong Kong students perform equally well regardless of their different socio-economic and cultural background. One reason could be that Hong Kong educators and parents are doing well in helping the disadvantaged students. Hong Kong's 15-year-olds also scored higher than students with similar socio-economic and cultural background in many other countries/regions (see Appendix II).

11. Although Hong Kong is moving towards a more equal educational policy, for instance, by reducing the number of performance bands (officially named allocation bands) from five to three in the SSPA (Secondary School Places Allocation System), in reality the secondary education system is still highly segregated based on academic achievement. Results from HKPISA2003 indicated that schools' academic intake is still a significant determining factor of students' performance in mathematics, science, reading, and problem solving. Despite this segregation, Hong Kong's low achievers performed better in all of the four domains than the OECD countries/regions, on average. It can be posited tentatively that our schools and teachers are catering to the needs of low achievers quite effectively.

Student Achievement in Mathematical Literacy

12. On average, Hong Kong students perform well and maintain the highest ranking among all participating countries/regions in the combined mathematical literacy scores (550 points). Their scores on the four mathematics sub-scales are 558, 558, 545, and 540 in "space and shape", "uncertainty", "quantity", and "change and relationships" respectively, which are much higher than the corresponding OECD averages of 496, 502, 501, and 499. In particular, our students outperform students in other countries in "space and shape" and "uncertainty", and are comparable to students in the top scoring countries in "quantity" and "change and relationships". The performance of our students is also much higher than the OECD averages in various mathematical literacy assessment dimensions such as different mathematical strands, processes, situations as well as item formats.

13. Besides, both lower and higher achievers of Hong Kong are better than their international counterparts. In fact, our students not only perform the best in PISA mathematics assessment, Hong Kong also takes the lead in the percentage of higher proficiency students in mathematics. There are altogether 30.7% of our students achieving high proficiency levels of Level 5 and Level 6. These outstanding results in mathematical literacy may suggest that our students could highly make sense of different mathematical problems and situations in their daily life experience.

[2] Steeper gradients indicate greater impact of SES on student performance, which means more inequality. In contrast, smaller gradients indicate smaller impact of SES on student performance and hence suggest less inequality.

14. It is worth noting that the gender difference in mathematical literacy among Hong Kong students is reduced from 18 points in HKPISA+ to 4 points in HKPISA 2003, which is not statistically significant anymore in the present study. It may signify a trend of growing gender equality in mathematical learning and performance in Hong Kong. However, the gender difference in learning attitudes and learning processes of mathematics needs further investigation.

Student Achievement in Scientific Literacy

15. Hong Kong students achieve an average score of 539 points in scientific literacy, ranking 3rd among the 41 participating countries/regions. Across different percentile groups, our scores are consistently higher than the OECD averages. Such difference is particularly great in the lower ability levels (the 5th, 10th, and 25th percentiles), indicating that Hong Kong's low achievers are less disadvantaged in scientific literacy when compared with other countries. Hong Kong students perform better than students in the OECD countries, on average, in all four components of scientific literacy, particularly in "understanding concepts" and "identifying evidence". These results reflect the strength of our science education in the mastery of scientific knowledge and the integration of practical work with learning of science concepts derived from the investigatory approach in the junior secondary science curriculum.

16. Similar to mathematical literacy, there is no significant gender difference in Science performance in the present study. However, boys tend to do better than girls in "understanding scientific knowledge", while girls perform better than boys in other competency areas pertaining to the process of scientific enquiry. This raises an issue of what constitutes a valid assessment instrument for scientific literacy in terms of the relative weightings assigned to scientific knowledge and process skills, and the different formats of assessment items.

Student Achievement in Reading Literacy

17. In reading, Hong Kong students did not do as well in PISA 2003 compared with PISA+. The rank drops from the 6th (525 scores) in PISA+ to the 10th (510 scores) in PISA 2003. This may be due to a drop in performance among the high achievers. Besides, comparatively speaking, there is a significant decrease in the proportion of Hong Kong students attaining Level 4 and Level 5 with a concomitant significant increase in the proportion of students at Level 1 and Level 2. The present result shows that, compared to the top reading performance countries/regions, we have fewer proficient readers and more less-proficient readers.

18. Across different text types in the reading assessment framework, Hong Kong students performed the best in the argumentative text type in PISA+. However, the ability to comprehend argumentative texts was not assessed in PISA 2003. Among the three text types assessed, Hong Kong students did not handle narrative texts as effectively as expository and descriptive texts. In

fact, the reading skills involved in comprehending the narrative text are quite different from the skills required for the other two text types. Concerning gender difference, boys' disadvantage is persistent such that the gender gap was widened from 16 points in HKPISA+ to 32 points in HKPISA 2003, which is statistically significant.

Student Achievement in Problem Solving Skills

19. Hong Kong ranked 2nd in terms of the mean scores of the problem solving scale (548 points). Both the higher and lower achievers in Hong Kong performed better than their international counterparts. The difference between the higher and lower achievers in Hong Kong is also smaller than the OECD average. Over one-third of our students reached Proficiency Level 3 indicating that they are "reflective and communicative problem solvers". Hong Kong students generally perform better than their OECD counterparts in all of the three types of problem solving skills, i.e. decision-making, system analysis and design, and trouble shooting. Also, gender difference in problem solving skills is small in Hong Kong.

20. It is worth noting that there is a significant correlation between problem solving and other areas of performance, especially mathematics. Similar to mathematical literacy, problem solving also requires a high level of analytical reasoning skills.

Parental Involvement and Investment

21. Home-based communication and investment are important to student achievement. Similar to the first cycle of HKPISA+ study, "social and educational communication" contributed significantly to students' mathematics, reading and problem solving performance in PISA 2003. Students, who communicate with their parents more often about daily "social and educational" topics, indicated by their spending time talking, having the evening meals together, and discussing schoolwork and school life, tend to perform better in three of the domains of literacy.

22. Parental investment in cultural, educational and computer resources has a significant contribution to students' literacy performance. Students whose families have more cultural possessions, such as classical literature, books of poetry, and works of art, tend to perform better in mathematics, science and problem solving. Students with more educational resources such as a dictionary, a desk for study, textbooks, calculators, and a quiet place to study tend to perform better in mathematics. Secondary school students with more computer facilities such as educational software at home perform better than others in all four domains.

23. Overall, home-based communication and educational facilities show the greatest significant effects on literacy performance in all subjects. These results suggest that effort to improve students' communication with their family and to improve the accessibility of educational facilities are good investments in student learning.

IMPLICATIONS AND RECOMMENDATIONS

For Policy Makers

24. While this was the second cycle of the PISA assessment administered in Hong Kong, the testing interval between the previous and the present assessment (PISA+ and PISA 2003) is only 18 months. Therefore, it is difficult to draw a clear and comparable picture with the previous one and the two results do not make a trend. For a more reliable comparison over time, we look forward to the third cycle of assessment in 2006.

25. Overall, Hong Kong students perform quite well in all four domains of literacy. It can be posited tentatively that our education system is effective in developing students' literacy without sacrificing equality. Students, regardless of their socio-economic background, can benefit from the education system. However, academic segregation in terms of ability of student intake among schools is still very high. Education policy should aim to alleviate the burden of structural constraints in the education system such as providing extra teaching force for disadvantaged schools and designing relevant teaching and learning strategies to cater for the diverse needs of students.

26. The effect of parental involvement and investment are consistently significant in the two PISA studies in 2000 and 2003. At the policy level, parenting education was explicitly emphasized in the 1999 Policy Address and a total of 50 million dollars were allocated to promote family education by 2000-2005. This kind of funding for parenting education should be allocated on a long-term basis. These parenting programmes should focus on improving parents' attitude and skills in communicating with their children.

27. Moreover, as indicated by the present study, computer facilities have become an essential tool for learning. Therefore, extra computer facilities should be available at schools or in the community, and flexible opening hours in computer laboratories or centres should be implemented so that disadvantaged students can have equal opportunity to learn in the information society.

28. Hong Kong students perform well in mathematics, problem solving and science. Results of the reading performance are relatively lower than other domains, which point to the importance of developing a reading culture at home, in the school and in the community. Besides, boys still perform significantly poorer than girls in reading. Helping boys to do better in reading and to enjoy the process of reading should also be a concern to policy makers, educators and parents.

29. All in all, to promote reading competence, it is important to develop a reading culture at different levels of the society. This can be done, for example, by establishing community libraries that provide convenient access to books and other reading materials by the public, supporting parents to help their children read at home, and implementing extensive reading programmes in schools.

For Educators & Parents

30. Regarding Mathematics, the continual outstanding achievement of Hong Kong students in mathematical literacy of PISA 2003 can be regarded as, first of all, an indicator of the strength of local mathematics education in cultivating basic mathematical knowledge and skills by more conventional pedagogical strategies of mainly lectures, demonstration of examples, and class practice, for which our mathematics teachers' hard work should be recognized and appreciated. Furthermore, it strongly suggests that such proficiency in basic knowledge and skills has, in effect, constituted a solid foundation for individual development of higher-order skills in mathematical thinking, which our teachers are, at least currently, not known to be particularly enthusiastic about in their classroom teaching.

31. Admittedly, the present PISA findings, by themselves, do not have very specific curriculum recommendations. However, given the present situation of a generally outstanding mathematics achievement, our mathematics teachers can have sufficient room to attempt to bring our mathematics teaching in line with a broader conception of mathematics of the information age by taking a more liberal move to de-emphasize the current demands for skills in fast, complicated symbolic or other routine mathematical manipulations, and instead, to give students more opportunities to analyze, to conceptualize, to reason, to argue and to reflect in working out mathematics in the classroom.

32. As a minimal condition for implementing this move, the general public, the parents in particular, have to be simultaneously informed of and gradually inculcated with this broader conception of mathematics. With this new attempt, we may not maintain the top ranking in the next "league table". A trade-off between excellence in achievement rankings by clinging to traditional pedagogy and a more balanced development in students' competencies towards the desirable goals of education may be inevitable, at least in the beginning, but it presents an obvious better option in the long term.

33. In short, what is at issue here in Hong Kong for mathematics educators is not so much about students' performance on the PISA assessment items, but rather the need for a deeper reflection on raising the 21st Century learners' mathematical awareness in coping with the complexity of their future lives.

34. Regarding Science, our scores are better than the OECD averages in all the four components of scientific literacy. However, the performance in "understanding concepts" and "identifying evidence" is better than that in "recognizing questions" and "drawing conclusions". This differential achievement can be attributed to the advocacy of an investigative approach of science teaching in the junior science curriculum. This approach emphasizes the learning of scientific knowledge and skills through engagement in practical work. In general, a guided discovery approach is used in which the students follow highly prescriptive instructions from their teachers, so that they are directed to obtain the 'right' results and arrive at predetermined conclusions, instead of providing them the opportunities to employ their creativity and critical thinking during practical work. This situation can be improved by using generic questions rather than highly structured worksheets to guide the students to design their own investigations, to interpret their own results and to draw their own conclusions.

35. Regarding Reading, efforts should be made in two areas: *what* to teach and *how* to teach. Concerning what to teach, a comprehensive and cross-subject reading curriculum can be designed and implemented. This reading curriculum should incorporate two kinds of reading strategies as the learning objective. The first type of reading strategy facilitates students' text comprehension in general. For example, students can be taught how to skim, how to adjust reading pace for different reading purposes, or how to preview and predict text content. The second kind of strategy helps students understand textbooks and reading materials written for the different school subjects. In particular, students can be taught how information in a reading text is organized, such as a passage describing the process of weathering in Geography, and how to make use of linguistic clues to identify causes and effects in a passage, for example, about environmental protection in Biology.

36. Concerning how to teach, students can be provided with more opportunities to read and be guided to understand, analyze and evaluate text contents and formats through questioning and structured discussions. In addition, students should be encouraged to read a wide range of reading materials written for various contexts e.g. texts written for educational, personal, occupational and public uses. Moreover, reading tasks focusing on higher levels of comprehension (e.g. tasks which elicit readers' reflection on the text content and form) can be designed.

37. Regarding Problem Solving, the results reveal that Hong Kong students are strong problem solvers, and over one–third of 15-year-olds of Hong Kong are "reflective, communicative problem solvers" who are able to tackle the most difficult problems in the assessment. These findings are encouraging. As we now learn that Hong Kong students do have their strengths in problem solving, curriculum planners should take note of this when they plan our new curricula, such as Liberal Studies. It is advisable for curriculum developers to keep in mind the three major components of the framework of problem solving- problem types, problem context and problem-solving processes - established by the OECD when they conduct needs analysis in the current curriculum reform.

38. Regardless of parents' SES, the findings support that home-based involvement and investment is a promising avenue for enhancing students' academic success. Parents can support their children's learning performance by discussing with them about schoolwork and school life, spending time to talk, or having evening meals together at home. However, the association between school-based involvement and student performance is negative, which shows that parental involvement at school level is still low. It suggests that the nature of school-based involvement is still problem-oriented in Hong Kong, i.e. the parents will get involved only if their children have problems at school.

39. Regarding family investment, students in families with more cultural resources and computer facilities at home tend to perform better in all of the four domains. Cultural resources, including classical literature, books of poetry and works of art, appear to be a facilitator for student learning. Educational resources, such as a quiet place or a desk for study, showed a significant association with students' mathematical performance. Spending on computer resources, such as providing educational software, internet and computer access at home, can also promote students' literacy performance. However, parents and teachers should be aware that misuses of computer could distract students from learning, and students still need guidance for the appropriate use of computers as a learning tool.

For Future Research

40. PISA 2003 has provided an opportunity to measure proficiency of mathematics, science, reading and problem solving of the 15-year-olds in Hong Kong in an international context. This report has also discussed the impact of parental involvement and investment on student performance. We have found parental involvement and investment to be important determinants for Hong Kong students' success in school. PISA 2003 has additionally provided useful information about student self-related cognition, learning strategies, and organisational characteristics of the school that are worthy of further study.

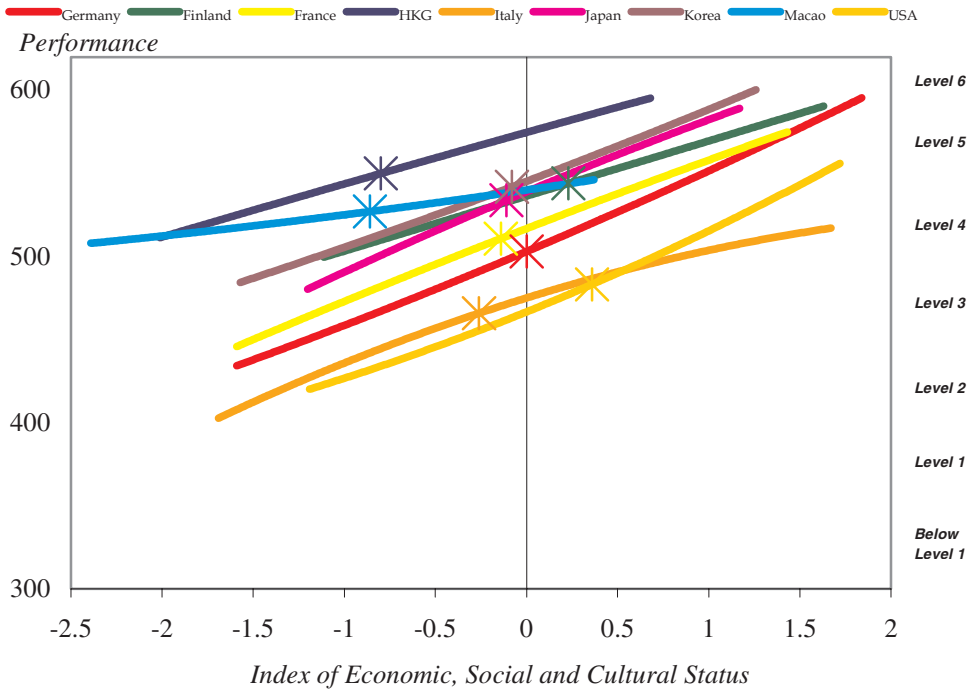
41. In future studies, we plan to strengthen our collaboration with teachers' professional associations, researchers, and policy makers. We hope that by identifying the strengths and weaknesses of Hong Kong students' academic achievement, PISA can inform future curriculum reforms in the areas of curriculum, pedagogy and educational evaluation.

Appendix I Literacy Performance of 15-Year-Olds in the Four Domains of Literacy

Mathematical Literacy			Scientific Literacy			Reading Literacy			Problem Solving Skills		
Country/Region	*Mean*	*S.E.*	*Country/Region*	*Mean*	*S.E.*	*Country/Region*	*Mean*	*S.E.*	*Country/Region*	*Mean*	*S.E.*
Hong Kong	**550**	**(4.5)**	Finland	548	(1.9)	Finland	543	(1.6)	Korea	550	(3.1)
Finland	544	(1.9)	Japan	548	(4.1)	Korea	534	(3.1)	**Hong Kong**	**548**	**(4.2)**
Korea	542	(3.2)	**Hong Kong**	**539**	**(4.3)**	Canada	528	(1.7)	Finland	548	(1.9)
Netherlands	538	(3.1)	Korea	538	(3.5)	Australia	525	(2.1)	Japan	547	(4.1)
Liechtenstein	536	(4.1)	Liechtenstein	525	(4.3)	Liechtenstein	525	(3.6)	New Zealand	533	(2.2)
Japan	534	(4.0)	Australia	525	(2.1)	New Zealand	522	(2.5)	Macao	532	(2.5)
Canada	532	(1.8)	Macao	525	(3.0)	Ireland	515	(2.6)	Australia	530	(2.0)
Belgium	529	(2.3)	Netherlands	524	(3.1)	Sweden	514	(2.4)	Liechtenstein	529	(3.9)
Macao	527	(2.9)	Czech Republic	523	(3.4)	Netherlands	513	(2.9)	Canada	529	(1.7)
Switzerland	527	(3.4)	New Zealand	521	(2.4)	**Hong Kong**	**510**	**(3.7)**	Belgium	525	(2.2)
Australia	524	(2.1)	Canada	519	(2.0)	Belgium	507	(2.6)	Switzerland	521	(3.0)
New Zealand	523	(2.3)	Switzerland	513	(3.7)	Norway	500	(2.8)	Netherlands	520	(3.0)
Czech Republic	516	(3.5)	France	511	(3.0)	Switzerland	499	(3.3)	France	519	(2.7)
Iceland	515	(1.4)	Belgium	509	(2.5)	Japan	498	(3.9)	Denmark	517	(2.5)
Denmark	514	(2.7)	Sweden	506	(2.7)	Macao	498	(2.2)	Czech Republic	516	(3.4)
France	511	(2.5)	Ireland	505	(2.7)	Poland	497	(2.9)	Germany	513	(3.2)
Sweden	509	(2.6)	Hungary	503	(2.8)	France	496	(2.7)	Sweden	509	(2.4)
Austria	506	(3.3)	Germany	502	(3.6)	United States	495	(3.2)	Austria	506	(3.2)
Germany	503	(3.3)	Poland	498	(2.9)	Denmark	492	(2.8)	Iceland	505	(1.4)
Ireland	503	(2.4)	Slovak Republic	495	(3.7)	Iceland	492	(1.6)	Hungary	501	(2.9)
Slovak Republic	498	(3.3)	Iceland	495	(1.5)	Germany	491	(3.4)	Ireland	498	(2.3)
Norway	495	(2.4)	United States	491	(3.1)	Austria	491	(3.8)	Luxembourg	494	(1.4)
Luxembourg	493	(1.0)	Austria	491	(3.4)	Latvia	491	(3.7)	Slovak Republic	492	(3.4)
Poland	490	(2.5)	Russian Federation	489	(4.1)	Czech Republic	489	(3.5)	Norway	490	(2.6)
Hungary	490	(2.8)	Latvia	489	(3.9)	Hungary	482	(2.5)	Poland	487	(2.8)
Spain	485	(2.4)	Spain	487	(2.6)	Spain	481	(2.6)	Latvia	483	(3.9)
Latvia	483	(3.7)	Italy	486	(3.1)	Luxembourg	479	(1.5)	Spain	482	(2.7)
United States	483	(2.9)	Norway	484	(2.9)	Portugal	478	(3.7)	Russian Federation	479	(4.6)
Russian Federation	468	(4.2)	Luxembourg	483	(1.5)	Italy	476	(3.0)	United States	477	(3.1)
Portugal	466	(3.4)	Greece	481	(3.8)	Greece	472	(4.1)	Portugal	470	(3.9)
Italy	466	(3.1)	Denmark	475	(3.0)	Slovak Republic	469	(3.1)	Italy	469	(3.1)
Greece	445	(3.9)	Portugal	468	(3.5)	Russian Federation	442	(3.9)	Greece	448	(4.0)
Serbia	437	(3.8)	Uruguay	438	(2.9)	Turkey	441	(5.8)	Thailand	425	(2.7)
Turkey	423	(6.7)	Serbia	436	(3.5)	Uruguay	434	(3.4)	Serbia	420	(3.3)
Uruguay	422	(3.3)	Turkey	434	(5.9)	Thailand	420	(2.8)	Uruguay	411	(3.7)
Thailand	417	(3.0)	Thailand	429	(2.7)	Serbia	412	(3.6)	Turkey	408	(6.0)
Mexico	385	(3.6)	Mexico	405	(3.5)	Brazil	403	(4.6)	Mexico	384	(4.3)
Indonesia	360	(3.9)	Indonesia	395	(3.2)	Mexico	400	(4.1)	Brazil	371	(4.8)
Tunisia	359	(2.5)	Brazil	390	(4.3)	Indonesia	382	(3.4)	Indonesia	361	(3.3)
Brazil	356	(4.8)	Tunisia	385	(2.6)	Tunisia	375	(2.8)	Tunisia	345	(2.1)

Note: Shaded area indicates scores significantly different from those of Hong Kong.

Appendix II Relationship between Student Performance in Mathematics and ESCS in Nine Countries/Regions



1. 學生能力國際評估計劃(PISA)是由經濟合作與發展組織(OECD)各成員國共同協作制訂的研究計劃。這項國際性研究的基本目的是測試即將完成普及教育的十五歲學童是否能夠掌握社會所需的知識與技能，從而建立一套教育指標讓各國政府部門及政策制訂者審視、評估和監察其國家及學校的整體教育成效。

2. PISA 自 2000 年起每三年進行一次，而 PISA 2003 屬於第二次評核週期。是次評估與 PISA 2000 的情況相若，內容涵蓋了「數學」、「科學」和「閱讀」方面的基礎能力，但當中重點的評估範疇則會由上次的閱讀能力轉爲是次的數學能力。爲了審視學生於日常生活中解決難題的能力， PISA 2003 新增了「解難能力」的評估範疇。

3. 在 PISA 2003 ，共有來自 41 個國家或地區參與，超過 9,000 間學校的 250,000 多名學生參與歷時兩小時的測試，表一顯示了 PISA 2003 的參與國家或地區。

表一 PISA 2003 的參與國家或地區

OECD 成員國家/地區			合作國家/地區
澳洲	匈牙利	挪威	巴西
奧地利	冰島	波蘭	**中國香港**
比利時	愛爾蘭	葡萄牙	印尼
加拿大	意大利	斯洛伐克	拉脫維亞
捷克共和國	日本	西班牙	列支登士頓
丹麥	韓國	瑞典	中國澳門
芬蘭	盧森堡	瑞士	俄羅斯聯邦
法國	墨西哥	土耳其	塞爾維亞及黑山
德國	荷蘭	英國	泰國
希臘	新西蘭	美國	突尼西亞
			烏拉圭

4. PISA的目的並非以測試學生在特定學校課程內容的表現爲主，而是評估他們已否掌握未來生活所需的知識與技能。在廣義上，「基礎能力」(literacy)一詞用來概括這些知識與技能。PISA協作組織(PISA Consortium)構思了一個架構用以評估這四個範疇的基礎能力，每個範疇分爲三個層面，包括學生所具備的知識「內容」或「結構」、其中所涉及的運用「過程」，以及運用知識與技能的「情境」。除了評估這四個範疇的基礎能力之外， PISA 2003 亦會要求學生和校長填寫問卷(HKPISA同時包括額外的家長問卷)作爲蒐集背景資料之用。這些背景資料對於進行政策分析是非常重要的。

5. HKPISA 2003 的正式測試於 2003 年 5 月至 7 月進行，所採用的是二段分層隨機抽樣設計。在第一階段，我們分別按學校類型(政府、資助和私立學校)和收生成績(高、中和低能力)將香港的中學分爲三層，並由OECD以隨機抽樣方式在每層抽取學校，各層之抽取率與各層學校多少及學校內的學生數量成正比例，表二顯示了每層學校的分佈。

表二　每層抽取的參與學校

顯層	隱層	學校數目	參與學校數目
官立學校	高能力	17	8
	中能力	9	3
	低能力	10	4
資助學校	高能力	127	50
	中能力	124	41
	低能力	107	33
私立學校#	本地/直資	29	5
	國際學校	20	1
總數		**443**	**145**

註：# 私立學校沒有收生分類。

* 直資代表直接資助計劃。

6. 在第二階段，HKPISA 中心在同意參與的每所學校中以隨機抽樣方式抽出 35 名十五歲學生作測試。根據 OECD 的抽樣標準，共有來自 145 間中學的 4,478 名學生獲納入國際樣本。表三顯示了樣本學生的年級分佈。

表三　參與 HKPISA 2003 的學生之年級分佈

年級	學生人數	百分比 (%)
中一	211	4.7
中二	439	9.8
中三	1,132	25.3
中四	2,692	60.1
中五	4	0.1
總數	**4,478**	**100**

7. 爲使搜集所得的數據可以進行國際性的比較，HKPISA 中心根據 OECD 所認可的評估程式，培訓了 51 位測試主任執行各校的測試。在搜集數據後，HKPISA 中心招募了 8 位閱讀科閱卷員，以及在數學科、科學科和解難能力各 16 位閱卷員，他們都是相關範疇的在職教師或準教師，我們的學科專家亦根據 OECD 的評分準則，爲他們提供有關評核開放式問題(open-ended response questions)的相關訓練。爲評估各閱卷員的閱卷信度，900 本包含開放式問題的試題簿將分別由四位閱卷員評改，從而量度閱卷信度。

質素與均等

8. 根據HKPISA 2003的研究結果，我們可從「質素」及「均等」兩方面爲本港教育成效提出啓示。就本報告而言，「質素」是指教育系統培育學生基礎能力的成效；「均等」則是指不同社經及文化背景的學生可以達至教育成果的程度。

9. 以整體質素來說，香港學生於四個評估範疇均表現理想，每個範疇皆名列首十名以內(數學第一、解難第二、科學第三、閱讀第十)，而平均表現亦顯著地較OECD的平均值爲高[1]，這個情況與第一次評核週期的PISA+的結果一致。若以統計學上的顯著度而言，在數學方面，除了芬蘭、韓國、荷蘭等五個國家外，香港的表現顯著地比其他參與地優勝；在科學方面的表現，除了芬蘭、日本、韓國等八個地區外，香港學生均顯著地較其他參與地優勝；在新增的解難能力方面，香港與韓國、芬蘭、日本、新西蘭、澳門和列支登士頓並無顯著的差距，而比其他參與地優勝；在閱讀方面，只有芬蘭、韓國、加拿大和澳洲顯著地較香港表現出色。(見附件一)

10. 就教育均等而言，每個範疇中的高分者(第95個百分位)和低分者(第5個百分位)之間的差距較OECD的平均值爲低。這個結果意味著香港大部分學生都可以均等地從學校教育之中獲益。此外，與其他參與地比較，香港學生的社經及文化背景(socio-economic status, SES)對他們的測試表現有較小的影響。SES對學業成績的影響可用「社經坡度」(socio-economic gradient[2])來表示，藉以反映學生的表現有多大程度上可以歸因於SES。整體而言，香港適度的社經坡度意味著無論學生的社經及文化背景如何，他們都能夠均等地表現出色，其中一個原因可能是香港的教育工作者和學生家長均能有效地協助社經背景較差的學生。同時，香港十五歲學生的表現亦較其他有相近社經及文化背景的參與地爲佳。(見附件二)

11. 雖然香港現正逐步走向一個較爲平等的教育環境，例如在中學學位分配辦法中把學能組別（正式名稱爲派位組別）由五個縮減至三個，但現實是香港的中學之間仍然存在明顯的成績分隔現象。HKPISA2003研究結果亦發現學校收生水平與學生在數學、科學、閱讀和解難能力方面的表現有顯著的相關度。儘管如此，香港的低分者於四個評估範疇的表現仍較其他國家或地區的低分者優勝，這暫可推論香港的學校和老師較能有效地照顧到低分者的需要。

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[1] OECD所設定的平均值是500，而標準誤差是100。

[2] 坡度愈大，顯示SES對學生表現有較大的影響，即代表較爲不平等；相反地，坡度愈小，顯示SES對學生表現有較少的影響，亦即較少不平等的情況。

數學能力的表現

12. 香港學生在數學能力方面表現卓越，得到 550 分，保持排名首位。他們在「空間與圖形」(space and shape)、「不確定性」(uncertainty)、「數量」(quantity)和「轉變與關係」(change and relationships)的四個次範疇中，所得分數分別爲 558 、558 、545 和 540 ，較 OECD 相關平均值的 496 、502 、501 及 499 爲高，當中香港學生於前兩者的表現更凌駕其他高分數的參與地，而在後兩者的成績亦能與他們看齊。同時，香港學生於不同的數學評估層面，例如數學要素、數學運用的過程和處境，以及題目形式的成績均遠高於 OECD 的平均值。

13. 此外，無論是低分者還是高分者，香港的表現均較其他參與地爲佳。事實上，我們的學生除了在是次數學評估展現整體優勢之外，香港在高能力組別的學生(students with higher proficiency)的百分比亦處於領先的地位，共有 30.7% 的學生達到第五級和第六級的高能力水平。由此可見，是次傑出的數學能力表現，意味著香港學生確能有意識地在日常生活的經驗中應付不同處境的數學問題。

14. 值得注意的是，香港學生在數學能力方面的性別差異由 HKPISA+ 的 18 分縮減至是次評估的 4 分，而在統計學上亦再無顯著的分別，這顯示了香港中學的男女生在數學成績上，正趨向平等，但兩性在學習數學之態度和過程上的差異仍有待探討。

科學能力的表現

15. 香港學生在科學能力方面得到 539 分，於 41 個參與地中排名第三。在不同的百分位群中，香港的分數都一致地較 OECD 的平均值爲高。這個差別於低水平能力(第 5 、10 和 25 個百分位)時就更爲顯著，顯示香港的低分組學生較其他參與地的低分者爲強。香港學生在四個科學能力的元素中，尤其是「概念理解」和「証據辨識」方面的成績較 OECD 的平均值爲高，這個結果反映香港科學教育在初中實施的探究式教學法(investigatory approach)，能使學生擅於掌握科學知識，以及整合實驗與科學概念。

16. 就性別差異而言，是次研究的科學能力與數學能力的情況相若，男女生的表現並無顯著的差距。可是，男生在「理解科學知識」(understanding scientific knowledge)方面的表現趨向較女生爲佳，而女生則在「與科學探究過程有關」(process of scientific enquiry)的能力上較男生表現理想。這裡帶出一個值得思考的問題：在構思一個能有效地評估科學能力的工具時，該如何釐訂科學知識和探究技能所佔的比重及不同形式的題目的份量呢？

閱讀能力的表現

17. 在閱讀能力方面，香港學生在是次評估的表現顯著地較 HKPISA+ 遜色，只得 510 分，排名由第六下跌至第十，這可能與高分者的表現下降有關。此外，相對來說，香港學生能夠達到第四級和第五級高能力水平的百分比顯著減少，而學生處於低能力水平(第一和第二級)的百分比則顯著地增加了。這個結果顯示與其他閱讀表現出色的國家比較，香港高水平的閱讀者較少，低水平的閱讀者則較多。

18. 就文章體裁來說，香港學生於 PISA+ 中以處理「議論文」(argumentative text)的表現爲最佳，但是這類文體在是次評估中不再列爲其中一個測試範圍。至於其他文章體裁方面，香港學生對「記敍文」(narrative text)的處理能力較弱，卻比較擅長於理解「說明文」(expository text)和「描寫文」(descriptive text)。事實上，理解記敍文所涉及的閱讀技巧與其他兩類的文章所要求的技巧是有所不同的。在性別差異方面，男生在 PISA+ 的弱勢不但持續，與女生的差距更由 HKPISA+ 的 16 分擴大至是次評估的 32 分，並達統計學上顯著的差異。

解難能力的表現

19. 香港學生在解難能力方面得 548 分，排名第二。當中高分者和低分者的表現都比其他參與地爲佳。並有超過三分之一的學生達到第三級的能力水平，屬於「反思性和溝通性的解難者」(reflective and communicative problem solvers)。此外，香港學生在三種解難技巧，包括決策(decision making)、系統分析與設計(system analysis and design)和解決問題(trouble shooting)的表現均高於 OECD 的平均值。同時，香港學生在解難能力方面的性別差異亦低於 OECD 的平均值。

20. 值得注意的是，在是次研究之中，香港學生在解難與數學兩方面的表現有著顯著的相關性，這是由於兩個測試範疇所涉及的技巧頗有重疊，同樣需要高度的邏輯分析技巧。

家長參與和投入

21. 家庭爲本的溝通和家庭資源的投入對培育學生的能力發展是非常重要的。PISA2003 的研究結果與前期的 PISA+ 相似：「社會性和教育性的溝通」(social and educational communication)，即家長多與子女共聚和交談，多關心子女的校園生活、學習情況，會對學生於數學、閱讀、解難的能力發展有幫助。

22. 家長於文化、教育和電腦資源上的投入亦對學生基礎能力的發展有顯著的幫助。研究結果顯示，當一個家庭擁有較多文化資源時，例如文學經典、詩集、藝術品等，學生於數學、科學和解難的表現會較爲理想；當學生擁有較多教育資源時，例如字典、個人書桌、教科書、計算機和一個寧靜的溫習環境等，他們在數學的表現會較

好；而家庭配置較多電腦設備（如教育軟件）的學生，他們於所有四個範疇的表現亦會相應地較好。

23. 整體而言，家庭裡的溝通和教育設備對學生的基礎能力表現有顯著的相關。這個結果意味著，改善學生與家長的溝通和添置教育設備是值得的資源投放。

啓示及建議

給教育政策制訂者

24. 是次研究是香港第二次參與PISA的評估計劃，與首次參與的PISA+只有十八個月的時間差距，因此較難利用兩次的測試結果來顯示香港學生的基礎能力的發展趨勢。我們寄望 2006 年進行的第三輪評估，能作出一個更加可靠的比較研究。

25. 整體而言，香港學生在四項基礎能力的評估中均表現理想。這暫可推論香港的教育系統能夠提供優質而均等的教育機會，即在有效地發展學生的能力的同時，不同社經及文化背景的學生均可在教育系統中有所獲益。儘管如此，香港中學之間仍然存在明顯的「成績分隔」現象，不同學校所收得的學生，出現很大的學習能力差距。我們建議政府應該著眼於減輕教育系統中存在的結構性限制所引起的困難，例如爲學生成績較差的學校提供額外的教學人手，以及設計合適的教學方法與學習策略以照顧學生的不同需要，這將有助縮短學校之間的成績差距。

26. HKPISA+ 和HKPISA2003兩次的研究發現，均顯示家長的參與和資源投入與學生的能力表現有顯著的相關性。在政策層面上，政府已在1999年的施政報告中強調家庭教育對學生成長的重要性，並於 2000 至 2005 年撥款 5,000 萬推廣家庭教育。我們建議政府應爲這項計劃作長期撥款資助，而計劃的目標應著重改善家長與子女溝通的態度和技巧。

27. 是次研究顯示，電腦設備是促進學習的不可或缺的工具。我們建議，各學校和社區中心應該配備更多電腦裝置，以及執行彈性開放時間，讓社經背景較差的學生能在現今的資訊型社會中有均等的學習機會。

28. 香港學生於數學、解難和科學的能力評估中均表現理想，但閱讀的表現則略爲遜色。這研究結果說明了在家庭、學校和社區中建立閱讀文化的重要性。此外，男生在閱讀方面的表現顯著地較女生爲差，故此如何幫助男生改善閱讀能力和享受閱讀過程，也是政策制訂者、教育工作者和家長需要思考的。

29. 總括而言，爲了加強學生的閱讀能力，在社會的不同層面上建立良好的閱讀文化是非常重要的。例如從質與量兩方面改善社區圖書館，使其更方便市民閱讀、鼓勵家長陪伴子女一起閱讀，以及擴展學校的閱讀計劃。

30. 在數學能力方面，香港學生於連續兩次的PISA中均有出色的表現，這肯定了本地數學教育以講授、例題及練習爲主的傳統教學策略，在培育學生數學能力的優勢；而數學老師的努力也是值得肯定和嘉許的。而學生的基礎能力亦爲他們發展高層次的數學思維奠定了穩固的基礎。

31. 雖然是次PISA有關數學能力的研究發現未能引申出具體的課程建議，但香港學生全面的和出色的數學表現，卻讓教師有機會去嘗試將現今資訊時代中廣義的數學概念引進香港的數學教育。我們建議老師可以採取一個較爲開放的教學方向，由一直以來強調培育快速、慣性的運算技巧，轉爲逐步讓學生有更多機會於課堂中進行分析、概念化、論証和反思數學運算的過程。

32. 要達致這個數學教學法的最基本條件，我們需要向普羅大眾(特別是家長)傳達和灌輸這些數學學習理念。基於這一個新嘗試，我們很有可能未能於下次PISA數學的評估中，保持領先的位置。但值得注意的是，在新教學法實施的初期，傳統教學法所帶來的傑出成績受到影響而下降是無可避免的，然而這是達到長遠的教育目標的最佳途徑。

33. 簡而言之，對數學教育工作者來說，今天香港面對的重要問題，並非關乎學生作答PISA試題的能力表現，而是在於有需要深思如何提升學生的數學意識，以應付二十一世紀未來生活的複雜性。

34. 在科學方面，香港學生在四個科學範疇中的得分均較 OECD 的平均值爲高，當中以「概念理解」(understanding concepts)和「証據辨識」(identifying evidence)的表現較「問題辨認」(recognizing questions)和「結論擬定」(drawing conclusions)優勝，這個差異可以歸因於我們在初中科學課程中所提倡的探究式教學法，而這個教學策略主要是強調透過進行實驗來學習科學的知識與技巧。相反，引導發現教學法(guided discovery approach)則強調學生緊隨老師的指引，使他們可以直接地得到「正確」的答案，並擬定預設的結論。因此，這個教法並不能提供足夠機會讓學生在進行實驗時，發揮個人的創造力和批判性思考。我們相信，這個情況的改善，可以透過採用開放式的探究問題而非結構緊密的工作紙，來引導學生自行設計實驗研究、闡釋結果和擬定結論。

35. 在閱讀方面，當教育工作者於思考有關閱讀的教學策略時，有兩個問題是需要留意的：一是「教什麼？」，二是「怎樣教？」。對於在閱讀上教些什麼，我們可以專注於加強學生對一般文章和不同學科範疇的讀物的理解技巧。對於一般文章，我們可以教導學生怎樣略讀文章，和因應不同閱讀目的而改變閱讀速度，以及怎樣推敲文章內容。對於不同學科的文章，我們可以向學生講解文章包含的資訊內容是如何舖排的，（例如地理課本中會如何描述岩石的風化過程），和教導學生如何

利用文章的結構、用字等作爲線索去找出文章的重點（例如生物課本上辨析與環境保護有關的成因和影響）。

36. 至於怎樣教好閱讀方面，我們可以爲學生提供更多的閱讀機會，透過老師的發問和師生之間的討論，幫助學生理解、分析和評估文章的內容和形式。此外，學生應該廣泛閱讀涉及不同情境的文章或資料，例如屬於教育、個人、職業和公眾等不同情境的文章。同時，我們可以爲學生設計較高程度的閱讀理解練習，例如一些可以讓讀者作出反思的文章等。

37. 在解難方面，結果顯示普遍香港學生均具有頗強的解難能力，當中更有超過三分之一的十五歲學生是屬於高能力組別的「反思性和溝通性的解難者」，這是十分令人鼓舞的研究發現。既然香港學生於解難能力方面展現了優勢，課程策劃者在計劃通識教育等新課程時理應著眼這一點，並對現時的教育改革進行需求分析時，衡量OECD 確立解難架構的三大元素：問題種類(problem types)、問題情境(problem context)和解難過程(problem-solving processes)。

38. 無論家長的社經地位如何，研究結果顯示家庭爲本的參與和資源投入均與學生的能力發展有顯著的相關。家長可以透過與子女傾談、一起晚膳、討論功課和學校生活等來支持他們的學習。但同時，研究又發現，家長於學校爲本的參與卻與學生成績呈負相關的關係。這顯示香港中學生的家長在學校層面的參與程度仍然偏低，而且往往是以問題取向爲主，即學生有問題時家長才有所參與。

39. 在家庭資源方面，當學生的家庭擁有較多文化和電腦資源時，他們於四個範疇的表現亦會相應地較好。文化資源如文學經典、詩集和藝術品等能夠促進學生學習；教育資源如寧靜的溫習環境或個人書桌等均與學生的數學表現有顯著的相關；而電腦資源如家用電腦、教育軟件和互聯網的接駁等皆有助提升學生的基礎能力。但同時，家長和老師也須注意，誤用電腦可令學童在學習時分心，所以必需指導學童如何適當地運用電腦。

給將來研究的啓示

40. 作爲一項國際性的教育研究， PISA 2003 爲香港十五歲學生於數學、科學、閱讀和解難能力方面的發展提供了一個評估機會。除了測試香港學生於這四個範疇的表現之外，本報告亦討論了家長參與和資源投入對學生學習的相關度。此外， PISA 2003提供了不少有關學生的自我認知與學習策略，以及學校組織特性等的數據，這對將來的研究有重要的參考價值，我們會就這些主題另外作詳細的分析和報告。

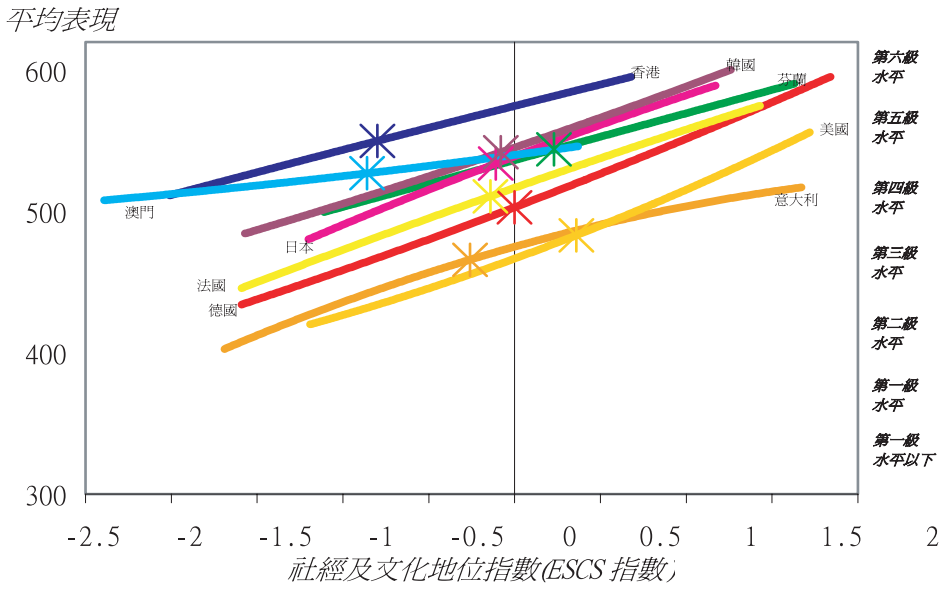
41. 在未來的研究中，我們計劃加強與教師團體、教育研究者和政策制訂者的合作。我們亦希望透過PISA，審視學生於不同基礎能力方面的優點與缺點，爲未來的課程、教學法和教育評鑑方面的改革帶來啓示。

附件一　參與 PISA 2003 的十五歲學生於四個評估範疇的表現

數學能力			科學能力			閱讀能力			解難能力		
國家/地區	*平均值*	*標準差*	*國家/地區*	*平均值*	*標準差*	*國家/地區*	*平均值*	*標準差*	*國家/地區*	*平均值*	*標準差*
中國香港	550	(4.5)	芬蘭	548	(1.9)	芬蘭	543	(1.6)	韓國	550	(3.1)
芬蘭	544	(1.9)	日本	548	(4.1)	韓國	534	(3.1)	**中國香港**	548	(4.2)
韓國	542	(3.2)	**中國香港**	539	(4.3)	加拿大	528	(1.7)	芬蘭	548	(1.9)
荷蘭	538	(3.1)	韓國	538	(3.5)	澳洲	525	(2.1)	日本	547	(4.1)
列支登士頓	536	(4.1)	列支登士頓	525	(4.3)	列支登士頓	525	(3.6)	新西蘭	533	(2.2)
日本	534	(4.0)	澳洲	525	(2.1)	新西蘭	522	(2.5)	中國澳門	532	(2.5)
加拿大	532	(1.8)	中國澳門	525	(3.0)	愛爾蘭	515	(2.6)	澳洲	530	(2.0)
比利時	529	(2.3)	荷蘭	524	(3.1)	瑞典	514	(2.4)	列支登士頓	529	(3.9)
中國澳門	527	(2.9)	捷克共和國	523	(3.4)	荷蘭	513	(2.9)	加拿大	529	(1.7)
瑞士	527	(3.4)	新西蘭	521	(2.4)	**中國香港**	510	(3.7)	比利時	525	(2.2)
澳洲	524	(2.1)	加拿大	519	(2.0)	比利時	507	(2.6)	瑞士	521	(3.0)
新西蘭	523	(2.3)	瑞士	513	(3.7)	挪威	500	(2.8)	荷蘭	520	(3.0)
捷克共和國	516	(3.5)	法國	511	(3.0)	瑞士	499	(3.3)	法國	519	(2.7)
冰島	515	(1.4)	比利時	509	(2.5)	日本	498	(3.9)	丹麥	517	(2.5)
丹麥	514	(2.7)	瑞典	506	(2.7)	中國澳門	498	(2.2)	捷克共和國	516	(3.4)
法國	511	(2.5)	愛爾蘭	505	(2.7)	波蘭	497	(2.9)	德國	513	(3.2)
瑞典	509	(2.6)	匈牙利	503	(2.8)	法國	496	(2.7)	瑞典	509	(2.4)
奧地利	506	(3.3)	德國	502	(3.6)	美國	495	(3.2)	奧地利	506	(3.2)
德國	503	(3.3)	波蘭	498	(2.9)	丹麥	492	(2.8)	冰島	505	(1.4)
愛爾蘭	503	(2.4)	斯洛伐克	495	(3.7)	冰島	492	(1.6)	匈牙利	501	(2.9)
斯洛伐克	498	(3.3)	冰島	495	(1.5)	德國	491	(3.4)	愛爾蘭	498	(2.3)
挪威	495	(2.4)	美國	491	(3.1)	奧地利	491	(3.8)	盧森堡	494	(1.4)
盧森堡	493	(1.0)	奧地利	491	(3.4)	拉脫維亞	491	(3.7)	斯洛伐克	492	(3.4)
波蘭	490	(2.5)	俄羅斯聯邦	489	(4.1)	捷克共和國	489	(3.5)	挪威	490	(2.6)
匈牙利	490	(2.8)	拉脫維亞	489	(3.9)	匈牙利	482	(2.5)	波蘭	487	(2.8)
西班牙	485	(2.4)	西班牙	487	(2.6)	西班牙	481	(2.6)	拉脫維亞	483	(3.9)
拉脫維亞	483	(3.7)	意大利	486	(3.1)	盧森堡	479	(1.5)	西班牙	482	(2.7)
美國	483	(2.9)	挪威	484	(2.9)	葡萄牙	478	(3.7)	俄羅斯聯邦	479	(4.6)
俄羅斯聯邦	468	(4.2)	盧森堡	483	(1.5)	意大利	476	(3.0)	美國	477	(3.1)
葡萄牙	466	(3.4)	希臘	481	(3.8)	希臘	472	(4.1)	葡萄牙	470	(3.9)
意大利	466	(3.1)	丹麥	475	(3.0)	斯洛伐克	469	(3.1)	意大利	469	(3.1)
希臘	445	(3.9)	葡萄牙	468	(3.5)	俄羅斯聯邦	442	(3.9)	希臘	448	(4.0)
塞爾維亞及黑山	437	(3.8)	烏拉圭	438	(2.9)	土耳其	441	(5.8)	泰國	425	(2.7)
土耳其	423	(6.7)	塞爾維亞及黑山	436	(3.5)	烏拉圭	434	(3.4)	塞爾維亞及黑山	420	(3.3)
烏拉圭	422	(3.3)	土耳其	434	(5.9)	泰國	420	(2.8)	烏拉圭	411	(3.7)
泰國	417	(3.0)	泰國	429	(2.7)	塞爾維亞及黑山	412	(3.6)	土耳其	408	(6.0)
墨西哥	385	(3.6)	墨西哥	405	(3.5)	巴西	403	(4.6)	墨西哥	384	(4.3)
印尼	360	(3.9)	印尼	395	(3.2)	墨西哥	400	(4.1)	巴西	371	(4.8)
突尼西亞	359	(2.5)	巴西	390	(4.3)	印尼	382	(3.4)	印尼	361	(3.3)
巴西	356	(4.8)	突尼西亞	385	(2.6)	突尼西亞	375	(2.8)	突尼西亞	345	(2.1)

註: 著色部分代表這些國家或地區與香港的分數在統計學上呈顯著分別。

附件二　九個參與國家或地區的學生數學表現與ESCS指數的關係



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