【Education Policy Studies Series】

Hong Kong Students on Line: Digital Technologies and Reading in PISA 2009

Esther Sui-chu Ho

Faculty of Education Hong Kong Institute of Educational Research
The Chinese University of Hong Kong

About the Author

Esther Sui-chu Ho is Professor in the Department of Educational Administration and Policy, The Chinese University of Hong Kong. She is also the Director of the Hong Kong Centre for International Student Assessment.

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Education Policy Studies Series

Education embraces aspirations of individuals and society. It is a means of strengthening human resources, sustaining competitiveness of society, enhancing mobility of the underprivileged, and assimilating newcomers to the mainstream of society. It is also a means of creating a free, prosperous, and harmonious environment for the populace.

Education is an endeavor that has far-reaching influences, for it embodies development and justness. Its development needs enormous support from society as well as the guidance of policies that serve the imperatives of economic development and social justice. Policymakers in education, as those in other public sectors, can neither rely on their own visions nor depend on the simple tabulation of financial cost and benefit to arrive at decisions that will affect the pursuit of the common good. Democratization warrants public discourse on vital matters that affect all of us. Democratization also dictates transparency in the policymaking process. Administrative orders disguised as policies have a very small audience indeed. The public expects well-informed policy decisions, which are based on in-depth analyses and careful deliberation. Like the policymakers, the public and professionals in education require a wealth of easily accessible facts and views so that they can contribute constructively to the public discourse.

To facilitate rational discourse on important educational matters, the Hong Kong Institute of Educational Research of The Chinese University of Hong Kong organizes from time to time "Education Policy Seminars" to address critical issues in educational development of Hong Kong and other Chinese societies. These academic gatherings have been attended by stakeholders, practitioners, researchers and parents. The bulk of this series of

occasional papers are the fruit of labor of some of the speakers at the seminars. Others are written specifically as contributions to the series.

The aim of this *Education Policy Studies Series* is to present the views of selected persons who have new ideas to share and to engage all stakeholders in education in an on-going discussion on educational matters that will shape the future of our society.

International Assessment of Education Quality Series

Entering the era of globalization, Hong Kong is getting more and more related to other parts of the world. It is important for us to examine the quality of education and the effectiveness of educational reforms in Hong Kong from an international as well as a comparative perspective. How do the various reforms impact on students' cognitive ability, attitude, and style of learning? Have students acquire the knowledge and skills essential for meeting the challenges of the twenty-first century? Are students able to make rational decision and communicate their idea effectively? Are students prepared for life-long learning? Also, how will the family's cultural, social and economic resources impact on students' learning? At the organizational level, how do education policies and the various aspects of school life (e.g., school decentralization, school climate, teacher autonomy, and parental involvement, etc.) impact on the quality of education and school effectiveness? All these are important questions worthy of investigation.

International Assessment of Education Quality Series aims at extending our understanding of the quality and equality of educational systems from an international comparative perspective. This series will be of value to various stakeholders in the field of education: researchers can examine the current state of affair of education and the outcome of educational reforms; policymakers can formulate local policies that is responsive to global development; teachers and parents can regard education from a broader perspective to understand education in the context of Hong Kong, of the Chinese communities, or further in the international context. In sum, the series, by providing stakeholders of the education community with "reason" and "data," attempts to support them in their decision and action for a better future of our students.

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Hong Kong Students on Line: Digital Technologies and Reading in PISA 2009

Abstract

Using the PISA 2009 database, this paper is the first to examine Hong Kong students' digital performance in reading and to explore the nature and impact of students' ICT attitudes and behavior at home and in school on their performance from an international perspective.

Hong Kong gets a mean score of 515 on the digital reading literacy scale, which is significantly higher than the OECD average. However, this score is far below that of Korea (568) and also significantly lower than those of New Zealand (537) and Australia (537). Although almost all 15-year-old students have access to computer and the Internet at home and in school in Hong Kong, the discrepancy of digital reading literary is large, especially between schools (45.5%), which is higher than the OECD average of 38.0%. Results indicate that Hong Kong students who engage in computer use most frequently (every day or almost every day) for online forum, using e-mail, communicating with other students about schoolwork, and browsing the Internet for schoolwork perform better in digital reading. However, frequent users of computers who engage in maintaining blog and downloading entertainment materials perform slightly worse on average than moderate users.

Introduction

Hong Kong has undertaken significant investment in enhancing the role of Information and Communications Technology (ICT) in education since 1997. This paper is the first to examine students'

digital performance in reading and to explore the nature and impact of students' ICT attitudes and behavior at home and in school on students' performance from an international perspective.

There is no general consensus in the literature regarding the impact of ICT on students' learning. Tamim, Bernard, Borokhovski, Abrami, and Schmid (2011) conducted a second-order meta-analysis and validation study on the impact of technology on learning. With a systematic review over forty years of research on the role of technology in learning, they showed positive impact of technology and computer on learning. They also found that different ways of computer use in school might have different effects on student learning outcomes. Computer technology "supporting instruction" has a slightly but significantly higher average effect size (0.42) than technology application used for "direct instruction" (0.31) (Tamim et al., 2011, p. 15).

Recent research also points to a more complex relation between ICT and learning, with mediating variables related to individual, family, and school factors playing an important role (Balanskat, Blamire, & Kefala, 2006; Kulik, 2003; Light, Strother, & Polin, 2009; Organisation for Economic Co-operation and Development [OECD], 2005, 2010; Tamim, et al., 2011; Trucano, 2005). PISA (Programme for International Student Assessment) 2009 offers the first opportunity to look at the role of ICT on learning in digital reading. A total of 45 countries/regions undertook the option of implementing an internationally comparable student questionnaire on ICT familiarity. Moreover, 19 countries/regions participated in digital reading assessment, and 17 of them implemented both the digital reading assessment and the ICT familiarity questionnaire.

The combined analysis of these two data collection exercises will provide a wealth of comparative data to shed light on the educational consequences of students' use of ICT at home and in school. The purpose of this paper is fourfold: (a) to report the digital reading performance of Hong Kong students from an international comparative perspective; (b) to identify the student characteristics and family factors related to students' digital reading performance; (c) to report Hong Kong students' ICT familiarity at home and in school; (d) to examine the relative contribution of various student, school and family factors, and ICT-related characteristics on students' digital reading literacy.

Definition of Digital Reading

PISA 2009 is the first large-scale international study to assess performance in digital reading. It represents a continuation of the data strategy of PISA 2000 adopted in 1997 by OECD countries. As in 2000, reading literacy is the focus of the 2009 survey, but the reading framework has been updated to incorporate the assessment of reading of digital texts.

Digital reading demands that new emphases and strategies be added to the repertoires of readers. Gathering information on the Internet requires skimming and scanning through large amounts of material and immediately evaluating its credibility. Critical thinking, therefore, has become more important than ever in reading literacy (Halpern, 1989; Shetzer & Warschauer, 2000; Warschauer, 1999). Warschauer (1999) concludes that overcoming the "digital divide" is not only a matter of achieving online access, but also one of enhancing people's ability to integrate, evaluate, and communicate information (PISA 2009 conceptual framework).

Assessment of Digital Reading in PISA 2009

In PISA 2009, 40 minutes are allocated to the assessment of reading and understanding of digital texts. The test units are compiled into 3 clusters of 20 minutes each. Any two of the clusters are put together to form an ordered pair representing one version of test. By rotating the clusters, 6 versions of test, each with 40 minutes' worth of test material, are generated (see Table 1). Every student taking part in the digital reading assessment is assigned randomly one of the six versions to work on.

Table 1. Test Design of Digital Reading Assessment in PISA 2009

Test version	Ordered pair of clusters	
	First cluster	Second cluster
1	A	B
2	B	A
3	B	C
4	C	B
5	C	A
6	A	C

Similar to the paper-and-pencil test unit, a digital reading test unit is composed of a stimulus (e.g., text, table, chart, figures, etc.) followed by a number of related assessment tasks. This feature allows questions to go into greater depth than if each question is introduced with a wholly new context. It allows time for the student to digest the material that can then be used to assess multiple aspects of performance.

Table 2 shows the similarities and differences between print and digital reading by the main framework characteristics, including: situations, text environments, text formats, text types and the four aspects of reading literacy.

Table 2. Similarities and Differences Between Print and Digital Reading

	Print reading	Digital reading
Situation	Personal; public; occupational; educational	Personal; public; occupational; educational
Text environment	Not applicable	Authored; message-based
Text format	Continuous; non-continuous; mixed; multiple	Continuous; non-continuous; mixed; multiple
Text type	Argumentation; description; exposition; narration; instruction; transaction	Argumentation; description; exposition; narration; instruction; transaction
Aspect 1: Access and retrieve	• Search • Orient and navigate in concrete information space (e.g., go to library, search in a catalog, find a book) • Use navigation tools and structures (e.g., table of contents; page numbers; glossary) • Select and sequence information - Low reader control - One sequence of linear reading	• Search • Orient and navigate in abstract information space (e.g., enter URL; user search engines) • Use navigation tools and structures (e.g., menus; embedded hyperlinks) • Select and sequence information - High reader control - Multiple sequences of linear reading
Aspect 2: Integrate and interpret	• Integrate at a lower level of demand: larger portions of text are simultaneously visible (one or two pages) • Develop an interpretation • Form a broad understanding	• Integrate at a higher level of demand: limited parts of text are simultaneously visible (limited by screen size) • Develop an interpretation • Form a broad understanding
Aspect 3: Reflect and evaluate	• Pre-evaluate information (e.g., use table of contents; skim passages, check for credibility and usefulness) • Evaluate credibility of source (usually less important due to filtering and pre-selection in the publishing process) • Evaluate plausibility of content • Evaluate coherence and consistency • Hypothesize • Reflect in relation to personal experience	• Pre-evaluate information (e.g., use menus; skim web pages, check for credibility and usefulness) • Evaluate credibility of source (usually more important due to lack of filtering and pre-selection in open environment) • Evaluate plausibility of content • Evaluate coherence and consistency • Hypothesize • Reflect in relation to personal experience
Aspect 4: Complex	• The range of sources to be consulted is relatively undefined • The sequence of steps within the task is undirected (e.g., finding, evaluating and integrating information from multiple printed texts)	• The range of sources to be consulted is relatively undefined • The sequence of steps within the task is undirected (e.g., finding, evaluating and integrating information from multiple electronic texts)

Digital Reading Performance of Hong Kong Students in PISA 2009

Overall performance in digital reading

Table 3 shows the mean scores in digital reading of the 19 participating countries/regions. The OECD average is 499.[1] Hong Kong gets a mean score of 515. While Hong Kong ranks 5th among the 19 participating countries/regions, its score is only significantly lower than those of the top three countries, namely Korea, New

Table 3. Student Performance in Digital Reading Across Countries/Regions

Country/region	Mean score	*SE*	*SD*	Rank	Upper rank	Lower rank
Korea	568	(3.0)	68	1	1	1
New Zealand	537	(2.3)	99	2	2	3
Australia	537	(2.8)	97	3	2	3
Japan	519	(2.4)	76	4	4	5
Hong Kong, China	**515**	**(2.6)**	**82**	**5**	**4**	**7**
Iceland	512	(1.4)	91	6	5	8
Sweden	510	(3.3)	89	7	5	9
Ireland	509	(2.8)	87	8	6	9
Belgium	507	(2.1)	94	9	7	9
Norway	500	(2.8)	83	10	10	11
OECD average	*499*	*(0.8)*	*90*	—	—	—
France	494	(5.2)	96	11	10	13
Macao, China	492	(0.7)	66	12	11	13
Denmark	489	(2.6)	84	13	11	13
Spain	475	(3.8)	95	14	14	15
Hungary	468	(4.2)	103	15	14	16
Poland	464	(3.1)	91	16	15	17
Austria	459	(3.9)	103	17	16	17
Chile	435	(3.6)	89	18	18	18
Colombia	368	(3.4)	83	19	19	19

Note: The scores of Korea, New Zealand and Australia are statistically significantly higher than the score of Hong Kong. The scores of Japan, Hong Kong, Iceland and Sweden have no significant difference. The scores of others are statistically significantly lower than that of Hong Kong.

Zealand, and Australia, but shows no significant difference from those ranking 4th to 7th.

Korea is the top-performing country, with a mean score of 568. New Zealand and Australia are in the second and third positions, both scoring 537. Another Asian country, Japan (519), and Hong Kong (515), are in next ranks, together with Iceland (512) and Sweden (510).

Two European countries, Ireland (509) and Belgium (507), have mean scores significantly higher than the OECD average. Norway (500) and France (494) have means not significantly different from the OECD average (499). Denmark (489) and Macao (492) have means not significantly different from that of France, though they are below the OECD average. The scores of Spain (475), Hungary (468), Poland (464), Austria (459), Chile (435) and Colombia (368) are significantly lower than the OECD average.

Distribution of proficiency levels of students

Another way to examine achievement of students is to look at the distribution of students' achieved proficiency levels in digital reading. The Appendix provides a description of the skills, knowledge and understanding required at each proficiency level of the digital reading scale, while Table 4 shows the percentage of students at each level sorted by Level 2 or above.

Similar to print reading literacy, Level 2 has been established as the baseline for digital reading literacy. Students at Level 2 or above demonstrate the reading competencies that will enable them to participate effectively and productively in the information age. Across the participating OECD countries, more than 80% of students are proficient at Level 2 or above (83.1%). Hong Kong has a total

Table 4. Percentage of Students at Each Proficiency Level of the Digital Reading Literacy Scale (Sorted by Level 2 or Above)

Country/region	Below Level 2	Level 2	Level 3	Level 4	Level 5 or above	Level 2 or above*
Korea	1.8	8.3	28.7	42.0	19.2	98.2
Japan	6.7	20.5	38.9	28.2	5.7	93.3
Australia	9.6	16.5	28.2	28.5	17.3	90.4
Hong Kong, China	9.8	20.3	36.8	26.8	6.3	90.2
New Zealand	10.2	16.1	27.2	27.8	18.6	89.8
Macao, China	10.5	31.8	39.9	15.8	2.0	89.5
Ireland	12.1	23.4	32.7	24.0	7.8	87.9
Iceland	12.9	21.1	32.2	24.1	9.7	87.1
Sweden	13.0	21.2	32.4	24.7	8.6	87.0
Norway	13.3	25.5	34.4	21.4	5.4	86.7
Belgium	15.9	20.2	28.8	26.3	8.8	84.1
Denmark	16.4	26.8	33.9	19.2	3.7	83.6
France	16.7	22.4	32.3	23.6	5.1	83.3
OECD average	16.9	22.3	30.4	22.6	7.8	83.1
Spain	23.1	25.4	30.2	17.3	3.9	76.9
Poland	26.3	28.4	28.6	14.7	2.0	73.7
Hungary	26.8	25.0	27.1	16.3	4.8	73.2
Austria	28.5	25.7	28.3	14.9	2.6	71.5
Chile	37.7	30.6	22.5	8.0	1.1	62.3
Colombia	68.4	22.4	7.7	1.4	0.1	31.6

* Minor discrepancies in adding up are due to rounding-off errors.

of 90.2% of students at Level 2 or above, which is higher than the OECD average but lower than those of Korea (98.2%), Japan (93.3%) and Australia (90.4%).

As for Level 3, across the participating OECD countries, a majority (30.4%) of 15-year-olds are proficient at Level 3. In most of these countries, this is also the modal level of highest attainment; only Korea, Australia and New Zealand have a higher modal level of performance (Level 4), and Chile a lower one (Level 2). Among partner economies, students in both Hong Kong and Macao also most commonly perform at Level 3, while the modal performance of students in the partner country Colombia is below the described levels.

As for Level 4, 22.6% of students are proficient at this level across the participating OECD countries. For Hong Kong, 26.8% of students perform within this level. A notable exception is Korea, where over 40% of students perform within Level 4. Taken together with the students performing at Level 5 or above, over 60% of Korean students are proficient at Level 4 or above — a proportion larger than that of any other countries.

According to the total percentage of students at Level 5 or above, regions with the highest proportions of top students include Korea (19.2%), New Zealand (18.6%), and Australia (17.3%). It suggests that these countries are good at nurturing excellent digital readers/ learners. The total percentage of high achievers in digital reading of Iceland (9.7%), Belgium (8.8%), Sweden (8.6%), and Ireland (7.8%) are above the OECD average (7.8%). There are only 6.3% of top achievers in Hong Kong, which is even lower than the OECD average.

In sum, these statistics reflect that the majority of Hong Kong students reached the baseline level of digital reading literacy. Yet it is noteworthy that the amount of high performing students of Hong Kong (6.3% for Level 5 or above) is even lower than the OECD average and much lower than those of Korea, New Zealand and Australia, and also slightly lower than those of Iceland, Belgium, Sweden and Ireland.

Discrepancy between high and low achievers across countries/regions

Disparities across countries/regions are evident (see Table 5). Disparities between high (95th percentile) and low achievers (5th percentile) is 293 score points for the OECD average. As for Hong Kong, discrepancy between high and low achievers is 262 points,

Table 5. Disparities Between High and Low Achievers Across Countries/Regions (95th versus 5th Percentile)

Country/region	Percentile						Difference
	5th	10th	25th	75th	90th	95th	(95th – 5th)*
Macao, China	381	406	448	537	576	600	219
Korea	452	479	526	614	650	671	220
Japan	394	426	475	570	608	630	236
Hong Kong, China	371	409	467	570	610	634	262
Colombia	236	264	311	424	477	507	271
Norway	356	392	448	557	602	629	273
Denmark	341	378	436	547	592	617	276
Ireland	357	398	453	570	616	643	286
Sweden	354	392	454	573	619	645	291
OECD average	342	380	442	562	609	635	293
Chile	283	316	374	497	549	578	295
Poland	306	343	404	529	577	601	295
France	328	371	439	561	603	626	298
Iceland	353	392	455	574	624	654	301
Belgium	341	377	444	577	621	645	304
Spain	308	347	414	543	592	618	310
Australia	367	411	477	603	654	684	317
Austria	282	323	395	533	579	605	323
New Zealand	363	406	476	607	658	687	323
Hungary	288	328	401	542	596	624	337

* Minor discrepancies in percentile differences are due to rounding-off errors.

which is smaller than the OECD average and the other 15 countries. It is interesting to find that all the four Asian countries/regions, namely Hong Kong, Korea, Japan and Macao, have the smallest achievement gap between high and low achievers among the 19 participating countries/regions.

Discrepancy between schools

The discrepancy of students' digital reading performance between schools in Hong Kong is 45.5%, which is higher than the OECD average of 38.0%. Table 6 shows that five countries/regions have higher discrepancy between schools than the OECD average. They are Austria (66.7%), Ireland (65.6%), Chile (59.1%), Belgium (59.6%), and Hong Kong (45.5%).

Table 6. Discrepancy in Digital Reading Performance Between Schools

Country/region	Within-school variance	Between-school variance	Total variance	% of between-school variance
New Zealand	5,702	1,350	7,052	19.1%
Japan	6,704	1,676	8,379	20.0%
Iceland	6,123	1,706	7,830	21.8%
Denmark	5,384	1,748	7,132	24.5%
Poland	7,627	2,474	10,101	24.5%
Macao, China	3,484	1,152	4,636	24.9%
Sweden	6,156	2,048	8,204	25.0%
Spain	6,490	2,177	8,667	25.1%
Australia	6,877	2,768	9,645	28.7%
Korea	4,496	1,809	6,306	28.7%
Hungary	6,091	2,628	8,719	30.1%
Norway	3,874	2,303	6,176	37.3%
OECD average	5,456	3,346	8,802	38.0%
Hong Kong, China	3,993	3,327	7,320	45.5%
Belgium	4,167	5,900	10,068	58.6%
Chile	4,228	6,107	10,335	59.1%
Ireland	3,800	7,248	11,048	65.6%
Austria	4,121	8,249	12,370	66.7%

* Minor discrepancies in total variance and percentage are due to rounding-off errors.

Student Characteristics and Family Background Related to Digital Reading Performance

Gender discrepancy between girls and boys

A. Overall gender difference

Consistent with the print reading literacy, girls show advantage in digital reading in all participating countries/regions. Significant gender difference is found in 18 out of 19 participating countries/regions. In the case of Hong Kong, girls outperform boys on average by 8 score points which, despite being significant statistically, is much smaller than the OECD average of 24 as well as those of the other 16 countries/regions (see Table 7).

Countries with gender differences greater than the OECD average are: New Zealand (40 points difference), Norway (35),

Table 7. Gender Discrepancy in Digital Reading Performance

Country/region	Boys (B)		Girls (G)		Difference	*SE*
	Mean	*SE*	Mean	*SE*	(B – G)*	
Colombia	367	(4.5)	370	(3.8)	–3	(4.8)
Denmark	486	(3.1)	492	(2.9)	**–6**	(3.1)
Hong Kong, China	511	(3.2)	519	(3.2)	**–8**	(3.9)
Macao, China	486	(1.0)	498	(1.1)	**–12**	(1.6)
Korea	559	(4.3)	577	(3.5)	**–18**	(5.2)
Chile	425	(4.3)	444	(3.8)	**–19**	(3.9)
Spain	466	(4.3)	485	(3.8)	**–19**	(3.1)
France	484	(5.2)	504	(5.7)	**–20**	(3.3)
Hungary	458	(5.0)	479	(4.8)	**–21**	(5.1)
Austria	447	(4.6)	469	(5.1)	**–22**	(6.0)
Japan	508	(3.2)	531	(2.9)	**–23**	(4.0)
Belgium	496	(3.0)	520	(2.4)	**–24**	(3.7)
OECD average	487	(1.0)	511	(0.9)	**–24**	(1.0)
Sweden	497	(3.5)	524	(3.5)	**–26**	(2.3)
Australia	522	(3.6)	550	(2.9)	**–28**	(3.5)
Poland	449	(3.4)	478	(3.3)	**–29**	(2.7)
Iceland	497	(2.1)	527	(1.8)	**–30**	(2.6)
Ireland	494	(3.7)	525	(2.9)	**–31**	(3.9)
Norway	483	(3.2)	518	(3.0)	**–35**	(2.6)
New Zealand	518	(3.5)	558	(2.7)	**–40**	(4.1)

* Figures in bold are statistically significant. Minor discrepancies in gender difference are due to rounding-off errors.

Ireland (31), Iceland (30), Poland (29), Australia (28), and Sweden (26). The four Asian societies (Korea, Japan, Hong Kong and Macao) have gender differences lower than the OECD average.

B. Gender difference among high achievers (Level 5 or above) and low achievers (below Level 2)

In Hong Kong, the proportion of high-achieving girls is about the same amount of high-achieving boys for digital reading (both 6.3%). This is quite different from the pattern of print reading (16.4% for girls versus 8.9% for boys). As for low achievers, low-achieving boys (below Level 2) are more than low-achieving girls in 16 out of the 19 participating countries/regions including Hong Kong. Hong Kong has 10.7% of low-achieving boys, which is 1.9% higher than that of low-achieving girls (see Table 8).

Table 8. Gender Difference Among Low Achievers and High Achievers

Country/region	Below Level 2		Difference	Country/region	Level 5 or above		Difference
	Boys (%)	Girls (%)	(Boys – Girls)*		Boys (%)	Girls (%)	(Boys – Girls)*
Hungary	30.4	8.5	22.0	Japan	4.4	22.4	–18.0
Iceland	17.3	3.9	13.4	Hungary	4.2	11.9	–7.7
Poland	32.6	19.3	13.3	Korea	16.4	22.4	–6.0
Spain	26.8	13.9	12.9	Australia	14.7	19.8	–5.1
Chile	42.9	32.4	10.5	Norway	3.3	7.6	–4.3
Norway	18.1	8.3	9.8	Ireland	5.8	9.9	–4.1
Austria	33.4	23.8	9.6	Belgium	7.2	10.6	–3.4
Ireland	16.6	7.4	9.2	Spain	3.1	6.5	–3.4
Japan	9.4	1.0	8.4	Sweden	7.1	10.2	–3.1
Sweden	17.1	8.8	8.3	*OECD average*	6.3	9.3	–3.0
OECD average	20.7	13.1	7.6	Poland	1.6	4.7	–3.1
Australia	13.1	6.2	6.9	France	3.6	5.5	–1.9
Belgium	19.1	12.4	6.7	Austria	2.1	3.1	–1.0
Macao, China	12.6	8.3	4.4	Denmark	3.3	4.0	–0.7
Colombia	70.1	66.8	3.3	Chile	0.9	1.4	–0.5
Hong Kong, China	10.7	8.7	1.9	Macao, China	1.8	2.1	–0.3
Denmark	17.2	15.6	1.6	**Hong Kong, China**	6.3	6.3	0.0
Korea	2.5	4.7	–2.2	Iceland	7.5	7.1	0.4
France	19.6	23.1	–3.6	New Zealand	15.0	2.4	12.6
New Zealand	15.4	20.0	–4.5	Colombia	0.2	0.0	0.2

* Minor discrepancies in percentage differences are due to rounding-off errors.

Distribution of digital reading scores by family economic, social, and cultural status

An index of family economic, social, and cultural status (ESCS) is derived based on parents' occupational status, years of schooling, and home possessions of the student. Thus, a greater value represents a more advantaged family background. The ESCS index is standardized for all the participating OECD countries to have a mean of 0 and a standard deviation of 1. Therefore, a negative value of the index implies that the socio-economic and cultural status of the student's family is below the OECD average.

A. Impact of ESCS on digital reading performance of Hong Kong students

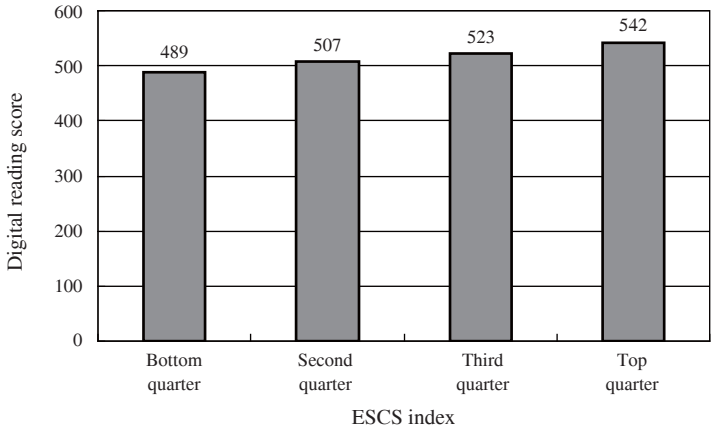
Figure 1 shows the digital literacy scores of Hong Kong students grouped by their ESCS indices in PISA 2009. The students are divided into four groups according to their ESCS indices. The mean digital reading score is computed for each group. The figure shows that the score increases moderately with students' ESCS; that is, students from more advantaged families tend to achieve higher scores.

B. Impact of ESCS at the student and school level across countries/regions

Figure 2 shows the percentage of variance in digital reading performance explained by the student-level ESCS and the school mean ESCS. Across OECD countries, only 7.4% of the variance in performance is explained by student ESCS whereas 48.4% is explained by school mean ESCS. This pattern is similar to the finding in print reading performance.

As for Hong Kong, only 3.4% of the variance in digital reading

Figure 1. Distribution of Digital Reading Scores by ESCS Index of Hong Kong Students



performance is explained by student ESCS but 31.7% is explained by school mean ESCS. Therefore, we may argue that the impact of ESCS is relatively smaller at both the student and the school level. It appears that Hong Kong has provided students with equal opportunity of digital learning regardless of their socio-economic background. Yet the strong impact of school-level ESCS suggests that between-school segregation of ESCS is still a significant factor impacting on students' digital learning.

C. Quality and equality of digital reading performance across countries/regions

Countries/regions with higher performance and lower impact of ESCS in comparison with the respective OECD averages are considered to be "high quality and high equality" countries/regions. Figure 3 divided the countries/regions participating in digital reading assessment into four groups: (a) high performance/low socio-

Figure 2. Variation in Digital Reading Performance Explained by Student ESCS and School Mean ESCS

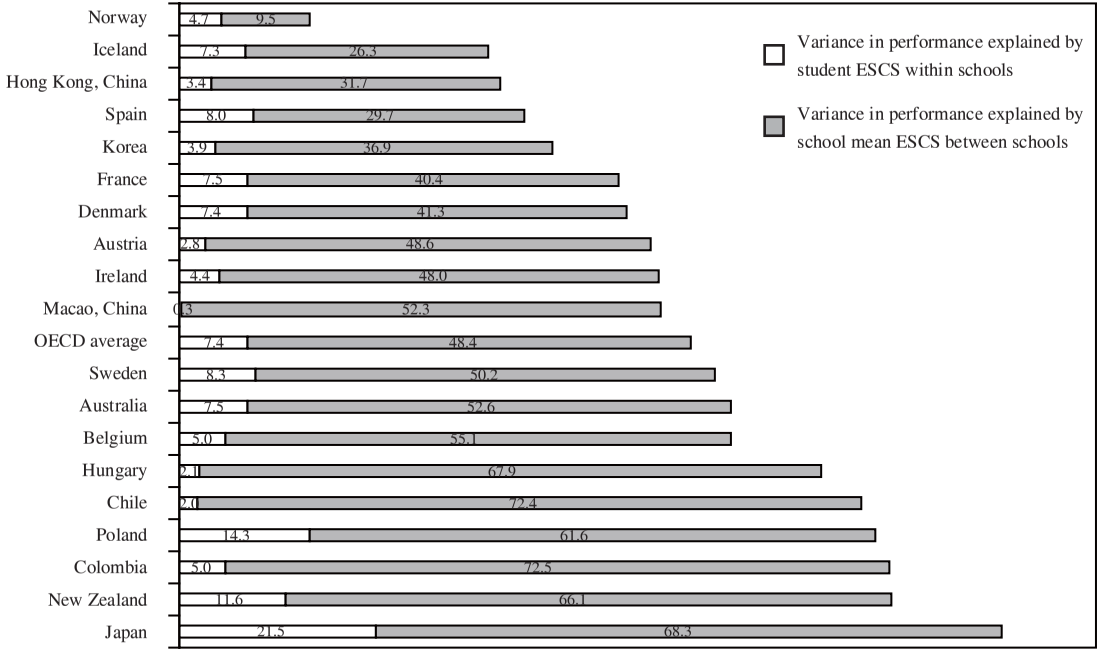
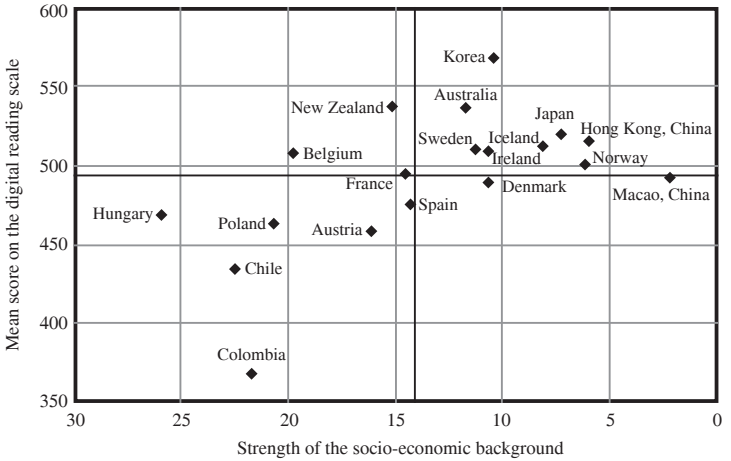


Figure 3. Quality and Equality of Digital Reading Performance Across Countries/Regiions



economic impact; (b) high performance/high socio-economic impact; (c) low performance/high socio-economic impact; and (d) low performance/low socio-economic impact.

Among the participating countries/regions, Korea, Japan, Australia, Hong Kong, Iceland, Sweden, Ireland and Norway constitute the "high performance/low socio-economic impact" group. New Zealand and Belgium are "high performance/high socio-economic impact" countries. Hungary, Poland, Austria, Chile and Colombia are "low performance/high socio-economic impact" countries. Denmark is a "low performance/low socio-economic impact" country. Some countries/regions, such as France, Spain and Macao, are too close to the boundaries to be clearly categorized.

Reading engagement

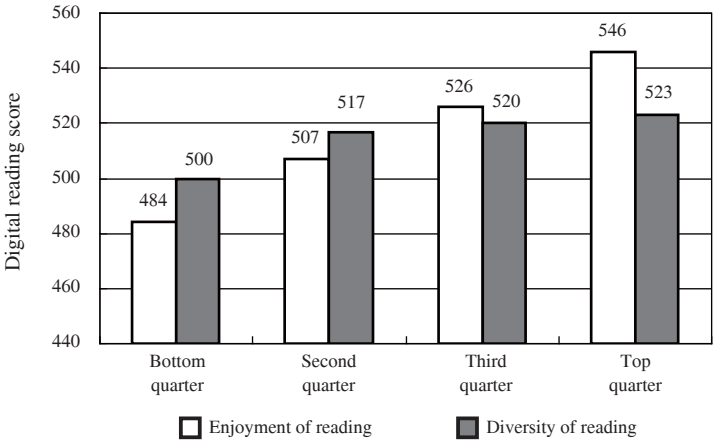
In the related PISA 2009 Hong Kong report, reading engagement and learning strategies are identified as two most important predictors of

reading performance besides the background factors discussed in the last section. In this section, three constructs of reading engagement, namely enjoyment of reading, diversity of reading, and online reading, will be examined and their relative contribution to digital reading performance will be assessed.

A. Relationship between enjoyment of reading and digital reading performance of Hong Kong students

The case of Hong Kong is presented in Figure 4. Students are divided into four groups based on the magnitude of their reading enjoyment and reading diversity indices. The mean digital reading score is computed for each group. The figure shows that digital reading score rises as enjoyment of reading increases. A positive relationship is also shown between digital reading performance and reading diversity. In the case of reading diversity, the score rises more rapidly from the first quarter to the second quarter and then the effect levels off slightly, representing a lower rate of score increase with

Figure 4. Relationship Between Enjoyment of Reading, Diversity of Reading and Digital Reading Performance of Hong Kong Students



the higher quarters of reading diversity. This pattern is similar to the print reading performance in PISA 2009, suggesting that students' enjoyment of reading has a stronger positive relationship with their digital reading performance than that of reading diversity.

B. Relationship between enjoyment of reading and digital reading performance across countries/regions

Another way to assess the relationship between enjoyment of reading and digital reading performance is to estimate the change in digital reading score per unit increase of the index. Table 9 shows the strength of the relationship between enjoyment of reading and digital reading performance by gender. Across the participating OECD countries, the effect of enjoyment of reading is 33.8 and there is no significant variation related to gender. In most countries/regions, there are some variations of effect of enjoyment related to gender but the differences are not significant. The variation of the relationship between reading enjoyment and digital reading proficiency related to gender is not statistically significant in 15 out of 19 countries/regions.

As for Hong Kong, the impact of enjoyment is stronger for girls than for boys but the difference is not significant statistically. In four countries, the impact of enjoyment is significantly stronger for boys than for girls: Poland and Australia, where the gender differences are over 9 score points; and Sweden and Japan, where the gender differences are about 8 and 7 score points respectively.

C. Relationship between diversity of reading and digital reading performance across countries/regions

Another way to assess the relationship between diversity of reading and digital reading performance is to estimate the change in the digital reading score per unit increase of the index. As shown in Table 10, across the participating OECD countries, the digital

Table 9. Strength of Relationship Between Enjoyment of Reading and Digital Reading Performance by Gender (Sorted by Gender Disparity)

Country/region	Change in digital reading score per unit of reading enjoyment index							
	All		Boys (B)		Girls (G)		Difference	*SE*
	Effect	*SE*	Effect	*SE*	Effect	*SE*	(B – G)*	
Poland	40.69	(1.75)	43.53	(2.60)	34.23	(2.24)	**9.30**	(3.36)
Australia	37.04	(1.01)	41.62	(1.87)	32.57	(1.16)	**9.05**	(2.09)
Sweden	35.45	(1.56)	39.40	(2.21)	31.78	(2.35)	**7.62**	(3.02)
Japan	34.73	(1.37)	37.27	(2.44)	30.59	(1.73)	**6.68**	(2.95)
New Zealand	32.87	(1.45)	32.01	(2.10)	29.55	(1.86)	2.46	(2.59)
Denmark	36.08	(1.45)	39.03	(2.15)	37.59	(1.70)	1.44	(2.58)
OECD average	33.80	(0.44)	33.69	(0.65)	32.76	(0.53)	0.92	(0.76)
Korea	22.68	(1.27)	21.83	(1.48)	21.12	(1.47)	0.71	(1.65)
Norway	29.07	(1.97)	28.48	(2.67)	27.78	(2.53)	0.70	(3.50)
Iceland	36.79	(1.67)	35.22	(2.77)	34.91	(1.76)	0.31	(3.01)
Colombia	11.96	(2.29)	11.92	(3.97)	11.94	(3.07)	−0.02	(5.27)
Spain	30.95	(1.49)	29.39	(2.74)	30.50	(1.71)	−1.11	(3.10)
Austria	30.10	(1.66)	29.32	(2.47)	31.39	(2.07)	−2.07	(3.21)
France	36.42	(1.58)	35.23	(2.40)	37.99	(2.34)	−2.76	(3.45)
Ireland	41.83	(2.45)	40.45	(3.94)	43.88	(2.74)	−3.43	(4.36)
Belgium	33.33	(1.13)	30.46	(1.99)	34.54	(1.44)	−4.08	(2.51)
Hungary	30.85	(3.22)	28.00	(3.58)	32.26	(3.49)	−4.26	(2.84)
Macao, China	22.39	(1.12)	19.38	(2.02)	23.74	(2.09)	−4.36	(3.27)
Hong Kong, China	30.41	(1.86)	28.88	(2.60)	33.48	(2.45)	−4.60	(3.39)
Chile	31.90	(1.67)	27.73	(3.07)	33.54	(1.90)	−5.81	(3.49)

* Figures in bold are statistically significant. Minor discrepancies in score differences are due to rounding-off errors.

Table 10. Strength of Relationship Between Diversity of Reading and Digital Reading Performance by Gender (Sorted by Gender Disparity)

Country/region	Change in digital reading score per unit of reading diversity index							
	All		Boys (B)		Girls (G)		Difference	*SE*
	Effect	*SE*	Effect	*SE*	Effect	*SE*	(B – G)*	
Hungary	21.23	(2.52)	14.82	(2.41)	5.86	(3.18)	**8.96**	(4.37)
Korea	15.56	(1.27)	15.57	(2.45)	7.91	(1.78)	**7.66**	(2.98)
Poland	12.25	(1.67)	22.80	(2.67)	16.09	(2.14)	6.71	(3.62)
Colombia	2.31	(1.99)	4.08	(2.17)	0.31	(2.62)	3.76	(2.54)
Ireland	12.36	(1.62)	16.62	(2.50)	13.15	(2.80)	3.47	(3.59)
Denmark	18.77	(1.24)	19.23	(1.48)	17.60	(2.11)	1.63	(2.52)
Japan	23.00	(1.49)	16.06	(1.57)	15.15	(1.66)	0.92	(2.13)
Norway	12.78	(1.72)	21.16	(2.14)	20.78	(2.21)	0.38	(2.79)
OECD average	20.40	(0.43)	19.44	(0.56)	19.66	(0.62)	–0.21	(0.81)
Sweden	27.90	(1.45)	26.45	(1.72)	27.05	(1.97)	–0.60	(2.36)
New Zealand	22.47	(1.77)	10.10	(2.16)	11.20	(2.76)	–1.09	(3.58)
Chile	20.64	(1.44)	19.12	(2.13)	20.33	(2.14)	–1.21	(3.03)
Iceland	16.63	(1.98)	20.55	(2.13)	22.28	(2.12)	–1.73	(3.04)
Belgium	26.43	(1.36)	24.87	(1.86)	28.00	(1.75)	–3.13	(2.49)
France	28.14	(1.94)	19.88	(2.83)	23.26	(3.41)	–3.38	(3.67)
Hong Kong, China	9.51	(1.61)	8.25	(1.91)	11.66	(2.78)	–3.41	(3.31)
Macao, China	14.13	(0.99)	12.27	(1.42)	15.83	(1.66)	–3.55	(2.37)
Australia	22.13	(1.37)	19.72	(1.72)	23.48	(2.12)	–3.77	(2.58)
Austria	23.28	(2.35)	21.27	(3.00)	25.12	(3.43)	–3.85	(4.44)
Spain	22.86	(1.83)	22.86	(2.26)	37.24	(3.16)	**–14.38**	(3.68)

* Figures in bold are statistically significant. Minor discrepancies in score differences are due to rounding-off errors.

reading score increases by 20.4 points as the index of diversity in reading increases by 1 unit, an increase smaller than that for reading enjoyment (33.8). There is no significant variation related to gender. In most countries/regions, there are some variations of effect of reading diversity related to gender but the differences are not significant. The variation of the relationship between reading diversity and digital reading proficiency related to gender is not statistically significant in 16 out of 19 countries/regions.

As for Hong Kong, the impact of diversity of reading is stronger for girls than for boys but the difference is also not significant statistically. In two countries, the impact of diversity of reading is significantly stronger for boys. They are Korea where the gender difference is about 8 score points, and Hungary where the gender difference is about 9 score points. On the contrary, in Spain, the diversity of reading has a stronger impact on girls' performance with a difference of over 14 score points.

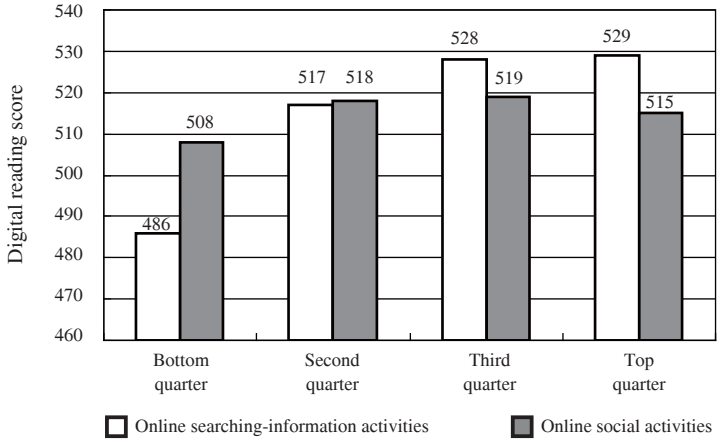
Online reading

The purposes of students' reading online are grouped into two types: reading for searching information or social activities. Searching for information online involves such activities as reading news, consulting dictionaries, searching online information to learn about a particular topic, and searching for practical information. Online social activities involves, among other activities, reading e-mails and chatting.

A. Relationship between online reading activities and digital reading performance of Hong Kong students

Figure 5 shows a gradual increase in digital reading score as online reading for searching information increases. The score increases more rapidly between the first and the second quarters and reaches

Figure 5. Relationship Between Online Reading Activities and Digital Reading Performance of Hong Kong Students



a peak at the third quarter. On the other hand, there is a more curvilinear relationship between digital reading score and online social activities. Reading score increases gradually from the bottom quarter of the index of online social activities up to the third quarter, and then it drops slightly at the top quarter.

In sum, the more students go online searching information, the higher will be their digital reading scores. The pattern is slightly different for online social activities. Too much online social communication might even be detrimental to digital reading performance.

B. Relationship between online searching-information activities and digital reading performance across countries/regions

As for the OECD average, the digital reading score increases by 24.12 points as the index of online searching-information activities increases by 1 unit. This relationship is weaker than that of enjoyment

of reading (33.8) but slightly stronger than that of diversity of reading (20.4). There is significant variation related to gender in the OECD average. In most countries/regions, there are some variations of effect of online searching-information activities related to gender but the difference is not significant in 14 out of 19 countries/regions.

As for Hong Kong, the effect of online searching-information activities is also stronger for girls than for boys but the difference is not significant statistically. In five countries (New Zealand, Poland, Australia, Belgium, and Japan), the impact of online searching-information activities is significantly stronger and more positive for boys than for girls, where the boys' advantages are about 11, 8, 7, 6, 4 score points respectively (see Table 11).

C. Relationship between online social activities and digital reading performance across countries/regions

As shown in Table 12, in most of the 19 countries/regions which took part in the digital reading option, online social activities are weakly related to digital reading proficiency. As for the OECD average, the digital reading score increases by only 5.98 points as the index of online social activities increases by 1 unit. This relationship is much weaker than that of enjoyment of reading (33.8), diversity of reading (20.4), and online searching-information activities (24.12).

In 11 out of the 19 countries/regions, there is no significant variation related to gender. In 8 countries (Austria, Ireland, Hungary, Iceland, New Zealand, Australia, Denmark, and Sweden), the relationship between online social activities and digital reading proficiency is stronger and more positive for boys than for girls.

It is interesting to find negative effect of online social activities in 4 out of the 19 countries/regions (Austria, Norway, Sweden and

Table 11. Strength of Relationship Between Online Searching-Information Activities and Digital Reading Performance by Gender (Sorted by Gender Disparity)

Country/region	Change in digital reading score per unit of index of online reading for information							
	All		Boys (B)		Girls (G)		Difference	*SE*
	Effect	*SE*	Effect	*SE*	Effect	*SE*	(B – G)*	
New Zealand	14.52	(1.72)	30.02	(2.40)	19.03	(2.45)	**10.99**	(3.44)
Poland	25.39	(1.83)	33.76	(2.38)	25.65	(2.22)	**8.11**	(2.98)
Australia	30.87	(1.46)	33.85	(1.88)	27.00	(1.86)	**6.85**	(2.37)
Belgium	14.93	(1.69)	18.04	(2.21)	11.56	(1.86)	**6.47**	(2.48)
Sweden	23.14	(1.51)	26.47	(2.03)	20.67	(2.38)	5.80	(3.21)
Korea	22.50	(1.11)	25.13	(1.90)	20.72	(1.85)	4.41	(2.63)
Spain	30.10	(1.84)	24.76	(2.01)	20.54	(3.02)	4.23	(3.29)
Japan	16.91	(1.50)	23.82	(1.46)	20.04	(1.20)	**3.77**	(1.74)
OECD average	24.12	(0.44)	25.71	(0.55)	23.26	(0.59)	**2.45**	(0.75)
Denmark	20.38	(1.39)	21.88	(1.67)	19.73	(2.04)	2.15	(2.39)
Colombia	22.13	(1.60)	22.77	(2.30)	22.02	(2.12)	0.76	(3.13)
Macao, China	15.13	(1.09)	15.37	(1.36)	14.67	(1.65)	0.69	(2.08)
Ireland	32.79	(2.44)	28.27	(2.26)	28.45	(2.25)	−0.17	(3.20)
Chile	28.18	(1.84)	28.45	(2.16)	28.82	(2.21)	−0.37	(2.52)
Hong Kong, China	18.15	(1.54)	18.13	(1.96)	18.86	(2.29)	−0.73	(2.92)
Norway	23.76	(1.41)	15.28	(2.12)	16.23	(2.22)	−0.96	(2.68)
France	22.98	(1.88)	26.51	(2.51)	27.65	(2.11)	−1.14	(2.60)
Austria	25.79	(2.20)	25.13	(2.21)	27.16	(3.48)	−2.02	(3.60)
Iceland	26.90	(1.67)	18.73	(2.15)	23.13	(2.40)	−4.40	(3.40)
Hungary	26.71	(1.96)	31.27	(3.32)	35.80	(3.30)	−4.52	(4.55)

* Figures in bold are statistically significant. Minor discrepancies in score differences are due to rounding-off errors.

Table 12. Strength of Relationship Between Online Social Activities and Digital Reading Performance by Gender (Sorted by Gender Disparity)

Country/region	Change in digital reading score per unit of index of online social activities							
	All		Boys (B)		Girls (G)		Difference	*SE*
	Effect	*SE*	Effect	*SE*	Effect	*SE*	(B – G)*	
Austria	–1.75	(1.56)	3.35	(2.20)	–8.87	(2.56)	**12.22**	(3.68)
Ireland	4.91	(1.57)	8.41	(2.00)	–3.14	(2.05)	**11.55**	(2.74)
Hungary	18.01	(2.56)	22.16	(3.17)	11.16	(3.48)	**11.00**	(4.29)
Iceland	1.40	(2.13)	4.15	(3.01)	–6.36	(3.41)	**10.52**	(4.74)
New Zealand	13.20	(1.60)	15.09	(2.17)	6.62	(2.35)	**8.47**	(3.05)
Australia	3.64	(1.44)	6.70	(1.96)	–1.74	(1.75)	**8.44**	(2.33)
Denmark	0.83	(1.69)	4.12	(2.19)	–3.72	(2.30)	**7.84**	(3.08)
Sweden	–0.93	(1.77)	2.94	(2.40)	–4.72	(2.52)	**7.66**	(3.38)
OECD average	5.98	(0.44)	8.23	(0.57)	2.03	(0.63)	**6.19**	(0.83)
Norway	–2.81	(1.99)	0.05	(2.49)	–5.98	(2.70)	6.03	(3.43)
Japan	2.76	(1.29)	3.49	(2.07)	–0.19	(2.17)	3.67	(3.38)
France	7.72	(1.70)	8.88	(1.96)	5.53	(2.65)	3.34	(3.06)
Poland	22.73	(1.52)	24.50	(2.17)	21.43	(2.07)	3.07	(2.92)
Korea	–8.00	(1.54)	–7.27	(2.01)	–10.33	(2.05)	3.06	(2.75)
Chile	23.25	(1.50)	24.01	(1.97)	21.85	(2.03)	2.15	(2.66)
Belgium	3.88	(1.79)	4.76	(2.17)	2.89	(2.52)	1.87	(3.10)
Colombia	19.21	(1.86)	18.68	(2.12)	19.62	(2.29)	–0.94	(2.32)
Spain	6.91	(1.81)	6.28	(2.27)	8.07	(2.89)	–1.79	(3.65)
Macao, China	7.30	(1.19)	5.89	(1.78)	8.34	(1.67)	–2.45	(2.53)
Hong Kong, China	6.14	(1.75)	4.74	(2.31)	7.41	(2.38)	–2.68	(3.14)

* Figures in bold are statistically significant. Minor discrepancies in score differences are due to rounding-off errors.

Korea), though the effect might not be significant statistically. As for Hong Kong, the effect of social activities on digital reading is positive and stronger for girls than for boys, but the gender difference is not significant statistically. However, for Korea, the effect is negative for both girls and boys.

In sum, the impact of online social activities on digital reading performance is much weaker than those of enjoyment of reading, diversity of reading, and online searching-information activities. However, for boys, online social activities appear to have a stronger positive effect on digital reading performance than for girls.

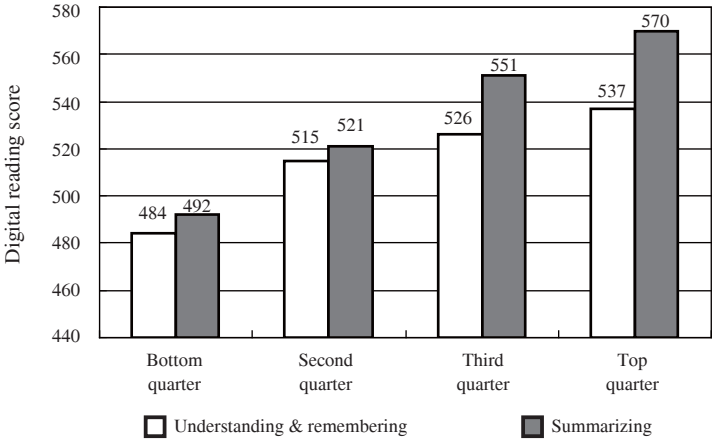
Reading strategies/meta-cognition

The two constructs of reading strategies/meta-cognition have positive association with students' digital reading performance. The more students are able to use strategies of remembering and understanding, or summarizing, the better they score in digital reading.

A. Relationship between reading strategies and digital reading performance of Hong Kong students

Figure 6 shows the relationship between reading strategies and digital reading performance of Hong Kong students. The figure shows that digital reading score increases as the index of understanding and remembering and that of summarizing increase. The reading score increases greatly between the first and the second quarters and then increases moderately to the top quarter of the index of understanding and remembering, appearing to be a curvilinear relationship. Reading score increases moderately from the bottom quarter of the index of summarizing up to the top quarter. In sum, the more students use strategies for understanding and remembering, and those for summarizing, the higher will be their digital reading scores.

Figure 6. Relationship Between Reading Strategies and Digital Reading Performance of Hong Kong Students



B. Relationship between meta-cognition and digital reading performance across countries/regions

Table 13 shows the relationship between meta-cognition and digital reading performance across countries/regions. In most of the 19 countries/regions which took part in the digital reading option, the two meta-cognition constructs are strongly and positively related to digital reading proficiency. As for the OECD average, the digital reading score increases by 31.9 and 38.4 points as the index of understanding and remembering and that of summarizing increase by 1 unit respectively. This effect is comparable to that of enjoyment of reading (33.8), and stronger than that of diversity of reading (20.4), online searching-information activities (24.12), and online social activities (5.98).

As for Hong Kong, the effect of the index of understanding and remembering, and that of summarizing are 20.9 and 23.1 points

Table 13. Change in Digital Reading Score Per Unit Change of Indices of Reading Strategies

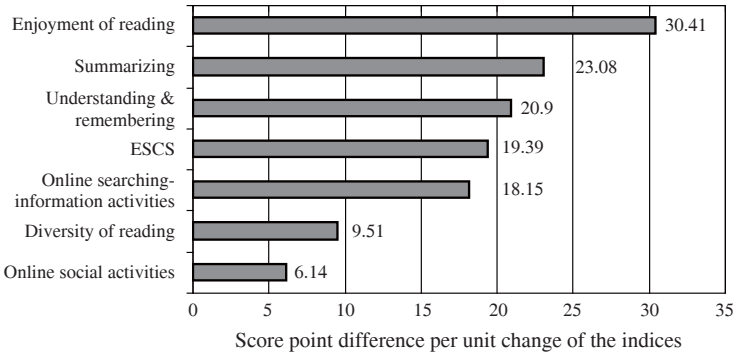
Country/region	Understanding and remembering		Summarizing	
	Effect	*SE*	Effect	*SE*
Belgium	40.6	(1.42)	45.5	(1.35)
Austria	38.0	(1.80)	45.0	(2.18)
Hungary	37.4	(2.63)	43.3	(2.76)
New Zealand	36.4	(1.55)	41.9	(1.34)
Chile	35.8	(1.63)	39.0	(1.75)
Denmark	34.8	(1.51)	38.5	(1.29)
Australia	34.0	(1.12)	40.7	(1.02)
Sweden	32.4	(1.43)	34.4	(1.33)
OECD average	31.9	(0.43)	38.4	(0.44)
Ireland	31.4	(1.98)	31.7	(1.70)
France	30.6	(2.44)	39.6	(2.49)
Colombia	30.1	(1.63)	36.3	(1.80)
Spain	29.1	(1.97)	42.4	(2.48)
Poland	28.1	(1.35)	38.9	(1.40)
Iceland	27.1	(1.42)	36.8	(1.48)
Japan	25.9	(1.54)	31.4	(1.23)
Korea	24.8	(1.75)	30.7	(1.62)
Norway	23.2	(1.41)	33.8	(1.56)
Hong Kong, China	20.9	(1.47)	23.1	(1.39)
Macao, China	12.8	(0.95)	15.8	(0.86)

respectively, which are slightly weaker than the OECD averages. The effect of summarizing appears to be slightly stronger than that of understanding and remembering on digital reading performance.

Summary

To summarize the strength of the effect of the factors in the case of Hong Kong discussed above, Figure 7 shows the score point difference associated with one unit change of each of the selected indices derived from regression analysis. The results indicate that enjoyment of reading has the strongest impact on students' digital reading performance. It is followed by the two meta-cognition reading strategies. ESCS at the student level might not be a strong factor, and so do the two constructs of online usage and diversity of reading materials.

Figure 7. Effect of Selected Background Factors on Digital Reading Performance of Hong Kong Students



ICT Familiarity and Digital Reading Performance of Hong Kong Students

ICTs are used in school and at home to support learning. The questionnaire returned by 15-year-olds in PISA 2009 provides insight into students' ICT use and its possible impact on their digital reading performance.

Availability of computers at home

Table 14 shows the change in access to computers at home from PISA 2000 to PISA 2009. Overall, home access has risen significantly in almost every country/region between 2000 and 2009. On average, about 94% of students from OECD countries reported that they had a computer at home in 2009. There is a substantial increase when compared with the 72% in 2000. Four Nordic countries, Hong Kong and Australia are, nevertheless, exceptions, where there were already about 90% of students having access to a computer at home in 2000.

Table 14. Percentage of Students Who Reported to Have a Computer at Home in PISA 2000 and 2009

Country/region	2009 (%)	2000 (%)	Country/region	2009 (%)	2000 (%)
Liechtenstein	99.7	88.3	Israel	94.8	81.0
Denmark	99.7	91.2	Poland	94.6	45.1
Finland	99.5	81.7	*OECD average-27**	94.3	72.3
Iceland	99.5	95.5	Hungary	93.9	51.1
Norway	99.4	93.0	United States	93.5	82.8
Sweden	99.2	94.6	Spain	91.3	67.3
Switzerland	99.1	88.1	Latvia	91.0	25.9
Hong Kong, China	99.0	94.5	Greece	89.9	44.7
Korea	98.9	85.7	Japan	88.7	67.4
Germany	98.8	87.0	Bulgaria	87.1	31.5
Australia	98.8	91.4	Romania	84.4	28.7
Austria	98.8	85.8	Russian Federation	79.8	17.6
Canada	98.6	87.9	Chile	76.0	31.3
Belgium	98.4	82.9	Argentina	66.9	46.9
Portugal	98.0	56.9	Thailand	55.6	16.4
Czech Republic	97.1	55.2	Brazil	53.3	23.2
Ireland	97.0	67.4	Mexico	49.5	23.2
France	96.7	65.8	Albania	49.3	17.1
Italy	96.7	69.7	Peru	38.2	13.7
New Zealand	96.3	79.3	Indonesia	21.1	6.8

* OECD average-27 means that 27 OECD countries with available data are taken into account in this average.

Figure 8 shows the discrepancy in digital reading performance between students with a computer at home versus those with none. Results from previous study indicated that there were significant differences in mathematics performance between these two groups of students (OECD, 2005, p. 53). Similar pattern was found in PISA 2009. All the countries/regions show the advantage in digital reading performance for students having computer access at home.

Accessibility of the Internet at home (2000–2009)

Table 15 shows the change in access to the Internet at home from PISA 2000 to PISA 2009. Overall, home access to the Internet rose significantly in every country/region between 2000 and 2009. On

Figure 8. Digital Reading Performance of Students Grouped by Computer Access at Home

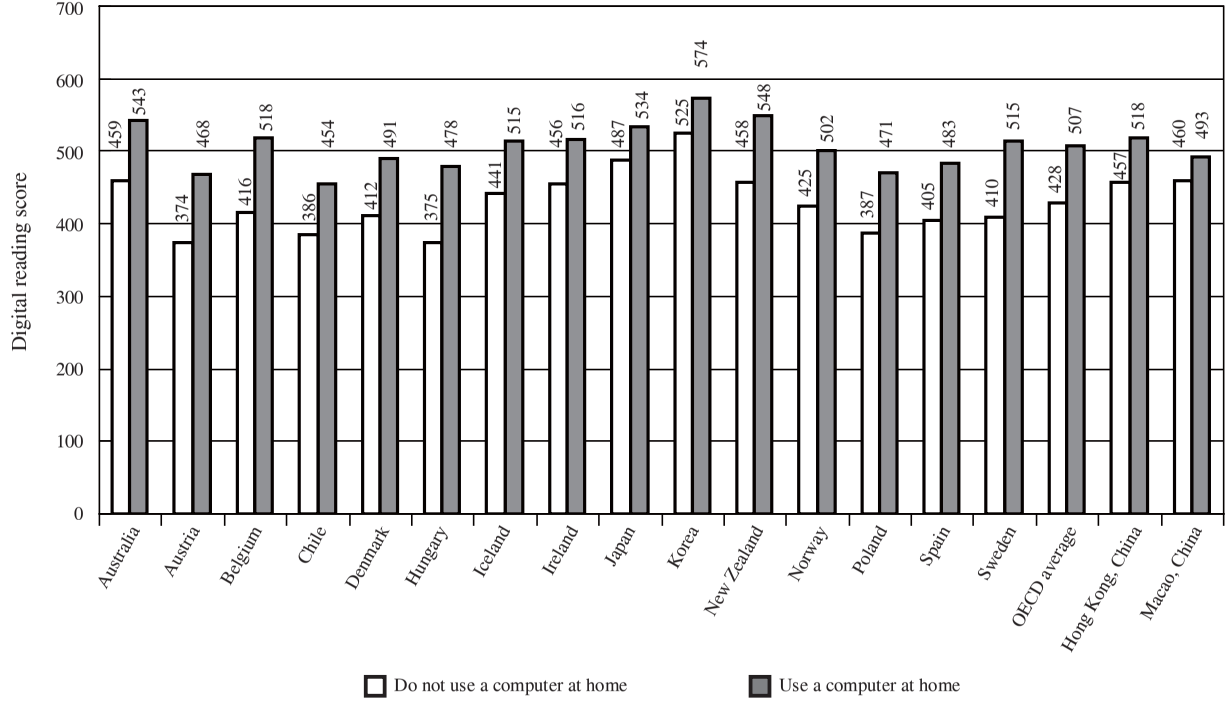


Table 15. Percentage of Students Who Reported to Have Access to the Internet at Home in PISA 2000 and 2009

Country/region	2009 (%)	2000 (%)	Country/region	2009 (%)	2000 (%)
Liechtenstein	99.1	48.7	*OECD average-27**	88.9	44.7
Norway	99.0	71.2	Italy	87.5	32.7
Finland	99.0	55.2	Hungary	85.7	12.9
Denmark	98.9	66.1	Israel	85.6	54.9
Iceland	98.7	80.0	Bulgaria	85.5	26.3
Sweden	98.5	82.8	Poland	85.4	19.0
Switzerland	98.1	51.8	Spain	84.8	24.0
Hong Kong, China	98.0	84.8	Japan	81.5	40.1
Korea	96.9	62.0	Latvia	81.4	9.3
Canada	96.8	70.2	Greece	71.4	25.0
Belgium	96.4	42.6	Romania	69.9	12.8
Australia	96.0	67.4	Brazil	58.3	16.8
Germany	95.8	40.0	Russian Federation	56.0	5.4
Austria	95.4	37.2	Chile	55.5	19.1
Ireland	92.8	43.0	Argentina	50.9	23.6
Czech Republic	92.3	14.7	Thailand	35.8	12.4
France	92.2	27.1	Mexico	35.4	12.1
New Zealand	91.7	61.5	Albania	28.5	8.3
Portugal	91.1	24.3	Peru	25.0	6.7
United States	89.3	70.0	Indonesia	8.3	4.4

* OECD average-27 means that 27 OECD countries with available data are taken into account in this average.

average, about 89% of students from OECD countries reported that they had access to the Internet at home in 2009, which was a substantial increase from 45% in 2000. As for Hong Kong, the percentage increased from 84.8% in 2002 to 98.0% in 2009.

Computer use at home

With the rise in popularity of computers and the Internet, the function to which they are employed also diversifies. The PISA 2009 ICT survey poses 14 questions about how frequently students use their computers for two kinds of activities — for leisure or for schoolwork.

A. Computer use at home for leisure

The construct of computer use at home for leisure included 8 items: (a) Playing one-player games; (b) Playing collaborative online games; (c) Using e-mail; (d) Chatting online (e.g., MSN); (e) Browsing the Internet for fun (such as watching videos, e.g., YouTube); (f) Downloading music, films, games or software from the Internet; (g) Publishing and maintaining a personal website, weblog or blog; and (h) Participating in online forums, virtual communities or spaces (e.g., Second Life or MySpace). The responses are coded as: 1 for "never or hardly ever"; 2 for "once or twice a month"; 3 for "once or twice a week"; and 4 for "every day or almost every day." Items are coded and scaled such that positive scores on this index indicate high level of computer use at home for leisure. Table 16 shows the values of the index across countries/regions. The figure indicates the highest students' use of computer for leisure in three East European countries — Bulgaria, Slovenia, and Estonia. They are followed by Norway, Singapore, Hungary, Czech Republic, Latvia, Liechtenstein, Lithuania, Iceland, and Canada. Hong Kong scored 0.18 and ranked 13th, while Korea ranked 32nd. The countries getting the lowest ranks are Thailand and Japan.

B. Computer use at home for schoolwork

The construct of computer use at home for schoolwork includes 6 items: (a) Browsing the Internet for schoolwork (e.g., preparing an essay or presentation); (b) Using e-mail to communicate with other students about schoolwork; (c) Using e-mail to communicate with teachers about schoolwork; (d) Downloading, uploading or browsing materials from the school's website (e.g., timetable or course materials); (e) Checking the school's website for announcements (e.g., absence of teachers); and (f) Doing homework on the computer. The responses are also coded as: 1 for "never or hardly ever"; 2 for "once

Table 16. Index of Computer Use at Home for Leisure Across Countries/Regions

Country/region	Index	Country/region	Index
Bulgaria	0.43	Slovak Republic	0.01
Slovenia	0.41	Austria	0.01
Estonia	0.39	Italy	0.01
Norway	0.37	*OECD average-28**	0.00
Singapore	0.23	Croatia	–0.01
Hungary	0.21	Switzerland	–0.02
Czech Republic	0.19	Spain	–0.03
Latvia	0.18	Germany	–0.09
Liechtenstein	0.18	Greece	–0.11
Lithuania	0.18	Korea	–0.12
Iceland	0.18	New Zealand	–0.13
Canada	0.18	Ireland	–0.18
Hong Kong, China	0.18	Serbia	–0.31
Macao, China	0.16	Chile	–0.33
Qatar	0.16	Uruguay	–0.34
Finland	0.12	Turkey	–0.41
Denmark	0.11	Russian Federation	–0.52
Belgium	0.10	Trinidad and Tobago	–0.60
Sweden	0.09	Panama	–0.62
Israel	0.08	Jordan	–0.68
Poland	0.07	Japan	–1.26
Australia	0.06	Thailand	–1.65
Portugal	0.03		

* OECD average-28 means that 28 OECD countries with available data are taken into account in this average.

or twice a month"; 3 for "once or twice a week"; and 4 for "every day or almost every day." Items are coded and scaled such that positive scores on this index indicate high level of computer use at home for schoolwork.

Table 17 shows that the extent of using ICT for schoolwork across countries/regions is quite different from that for leisure. The figure indicates the highest students' use of ICT for schoolwork in the Netherlands,[2] Estonia, and Bulgaria. They are followed by Qatar, Slovenia, Portugal, Singapore, Israel, Czech Republic, Latvia, Turkey, Denmark, Slovak Republic and Norway. Hong Kong scored

Table 17. Index of Computer Use at Home for Schoolwork Across Countries/Regions

Country/region	Index	Country/region	Index
Netherlands	0.61	Poland	−0.03
Estonia	0.59	Spain	−0.03
Bulgaria	0.48	Greece	−0.05
Qatar	0.43	Korea	−0.06
Slovenia	0.38	Belgium	−0.06
Portugal	0.37	Iceland	−0.08
Singapore	0.25	Uruguay	−0.09
Israel	0.22	Sweden	−0.11
Czech Republic	0.22	Germany	−0.13
Latvia	0.18	Chile	−0.13
Turkey	0.18	Switzerland	−0.13
Denmark	0.17	Macao, China	−0.15
Slovak Republic	0.13	New Zealand	−0.16
Norway	0.12	Italy	−0.17
Hong Kong, China	0.12	Liechtenstein	−0.23
Australia	0.11	Jordan	−0.31
Croatia	0.10	Trinidad and Tobago	−0.40
Canada	0.09	Russian Federation	−0.52
Hungary	0.07	Finland	−0.55
Lithuania	0.05	Serbia	−0.56
Austria	0.03	Ireland	−0.62
Panama	0.03	Thailand	−0.89
*OECD average-29**	0.00	Japan	−1.02

* OECD average-29 means that 29 OECD countries with available data are taken into account in this average.

0.12 and ranked 15th, while Korea ranked 26th. The countries of the lowest ranks are still Thailand and Japan.

It is interesting to find that both Korea and Japan have low scores in the two indices and both rank so low but perform so well in digital reading. It might be related to the activities within each of the two constructs that contribute differently to the digital reading outcome. In the next section, we need to investigate the possible contribution of different ICT activities to students' digital reading performance.

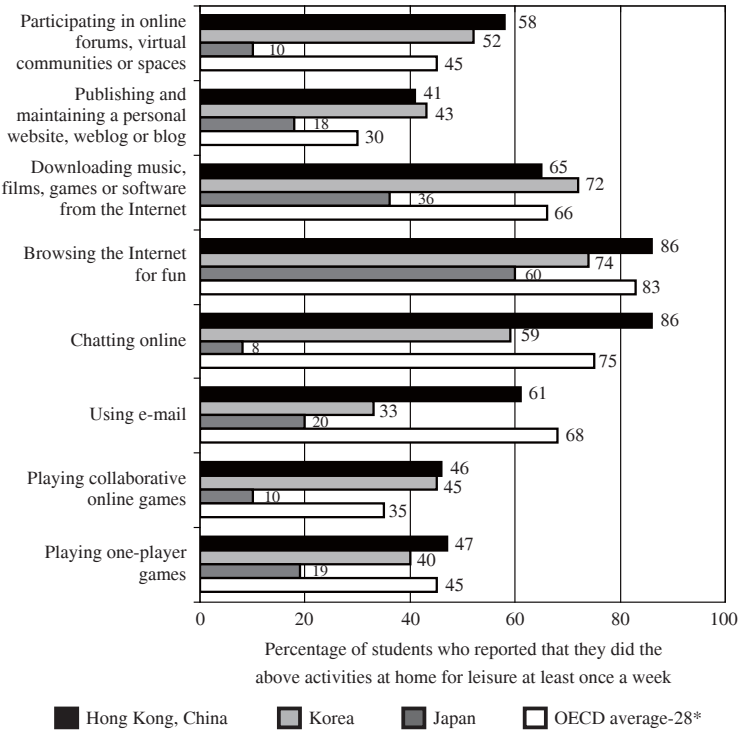
C. Computer use at home in East Asian societies

Computer use at home for leisure. Across OECD countries, browsing the Internet for fun and participating in online chat are the two most popular online activities at home. More than 80% of students reported that they frequently browsed the Internet for fun, and around 75% reported participating in online chat frequently (see Figure 9).

As for Hong Kong, 86% of students reported that they regularly browsed the Internet for fun, and 65% of students reported downloading music, films, games or software regularly. About 86% reported that they participated in online chat, which is higher than the OECD average of 75%. Students using e-mail are reported to be 61% which is lower than the OECD average of 68%. A majority of Hong Kong students regularly use their computers at home to participate in online forums, virtual communities or spaces (58% versus the OECD average of 45%), while 41% reported that they regularly publish and maintain personal websites and blogs (versus the OECD average of 30%). About 47% of Hong Kong students reported regularly playing one-player games, and 46% reported playing collaborative online games. Both are higher than the respective OECD averages of 45% and 35%.

Overall, browsing the Internet for fun and chatting online with friends are the two most popular ICT activities for leisure at home for Hong Kong 15-year-old students. The popularity is similar to that in the OECD countries. These are followed by downloading music, films, games or software, communicating using e-mail, and participating in online forums. As compared with the OECD average, the percentages of Hong Kong students using computer at home are higher in all items except using e-mail and downloading music, films, games or software. The percentages are also higher than Japan's, and comparable with Korea's.

Figure 9. Computer Use at Home for Leisure in East Asian Societies

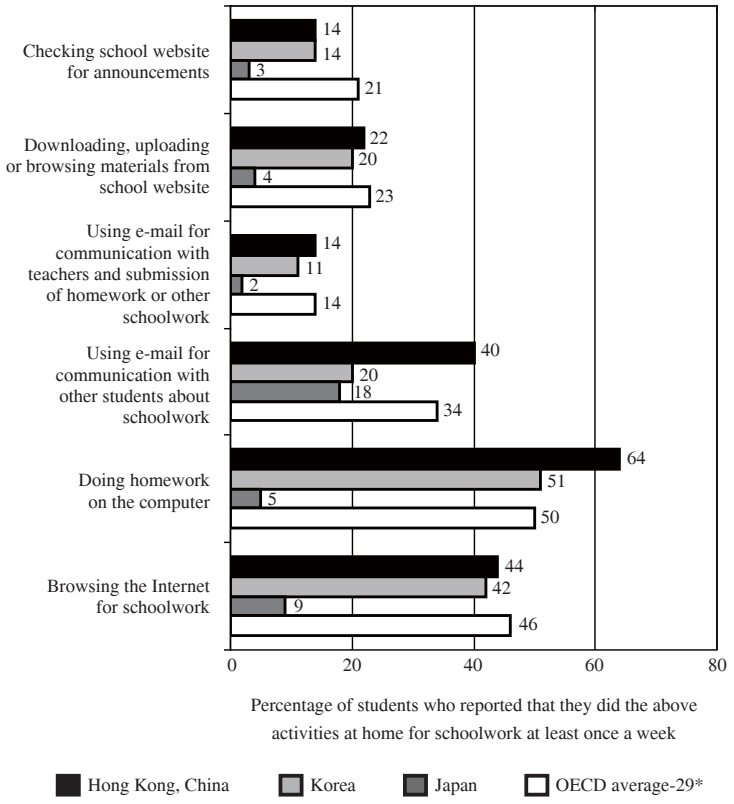


* OECD average-28 means that 28 OECD countries with available data are taken into account in this average.

Computer use at home for schoolwork. Across OECD countries, doing homework on the computer (50%) and browsing the Internet for schoolwork (46%) are the two most popular ICT activities at home (see Figure 10). As for Hong Kong, about 64% of students reported that they regularly did homework with the computer and about 44% of students reported that they regularly browse the Internet for schoolwork. About 40% of Hong Kong students reported that they regularly used their computers to communicate with other students, which is higher than the OECD average of 34%, and 14%

reported doing so with teachers, which is similar to the OECD average. About 22% of Hong Kong students upload or download materials regularly from their school website, which is similar to the OECD average. About 14% of students reported that they regularly checked the school's website for announcements, which is lower than the OECD average of 21%.

Figure 10. Computer Use at Home for Schoolwork in East Asian Societies



* OECD average-29 means that 29 OECD countries with available data are taken into account in this average.

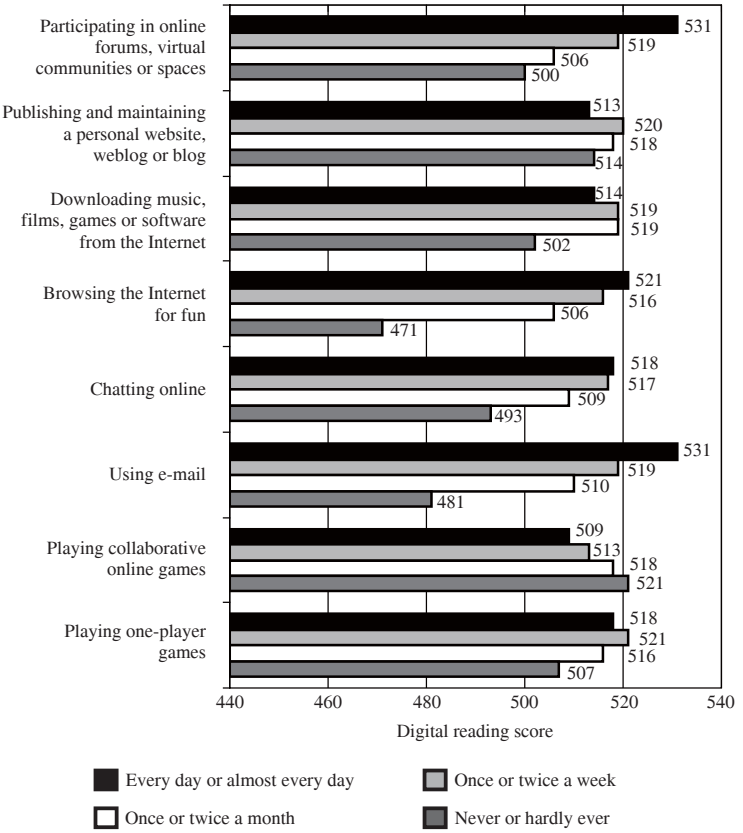
Overall, doing homework with a computer and browsing the Internet for schoolwork are the two most popular ICT activities for schoolwork at home for Hong Kong 15-year-old students, which is similar to the OECD average. These are followed by communicating with other students about schoolwork. As compared with the OECD average, the percentages of Hong Kong students in each of the 6 items of computer use at home for schoolwork are quite similar to the OECD averages and those of Korea, but higher than those of Japan.

D. Use of computer for leisure at home and digital reading performance

Not all activities regarding computer use at home for leisure contribute equally to digital reading performance for Hong Kong students. As for Hong Kong, frequent users (every day or almost every day) of the following four items appear to have the best performance in digital reading: using e-mail; chatting online; browsing the Internet for fun; and participating in online forums (see Figure 11). Students who use computers at home at a sporadic/moderate level of frequency (once or twice a month or a week) in three of the items — playing one-player games; downloading music, films, or games; or publishing or maintaining a personal page or weblog — perform better than rare users (never or hardly ever) and frequent users.

Only one item shows a negative relationship with digital reading; that is, students who never or hardly ever use a computer at home for playing collaborative online games tend to achieve the highest scores in Hong Kong. This pattern is consistent with the OECD average (OECD, 2011). Comparing them with frequent users, students who play collaborative online games every day score 12 points lower than those who never or hardly ever do so.

Figure 11. Computer Use for Leisure at Home and Digital Reading Performance of Hong Kong Students



E. Computer use at home for schoolwork and digital reading performance

Figure 12 shows that in Hong Kong, frequent users (every day or almost every day) of browsing the Internet for schoolwork and communication with other students about schoolwork perform best in digital reading. As for the two items regarding communication with teachers about schoolwork, and downloading, uploading or browsing

materials from the school's website, sporadic/moderate users (once or twice a month to once or twice a week) perform better than frequent users and rare users. Different users of checking the school's website for announcements, however, perform quite similarly. In four out of the five items, rare users perform worst in digital reading.

Accessibility to computers and the Internet in school

Table 18 shows the access to computers and the Internet in school in PISA 2009. Overall, school access to computers and the Internet

Figure 12. Computer Use at Home for Schoolwork and Digital Reading Performance of Hong Kong Students

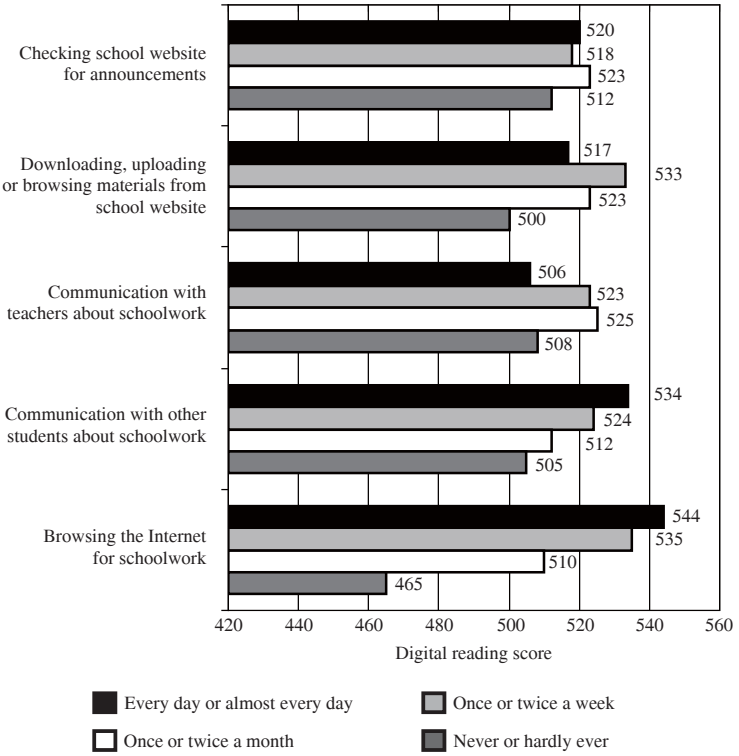


Table 18. Percentage of Students with Access to Computers and Access to the Internet in School

Country/region	Computer (%)	Internet (%)	Country/region	Computer (%)	Internet (%)
Thailand	99.9	99.4	Switzerland	93.8	94.2
Netherlands	99.7	99.7	Poland	93.2	94.9
Denmark	99.4	99.1	*OECD average-29**	93.1	92.6
Australia	99.2	98.9	Lithuania	92.1	96.3
Norway	98.9	98.0	Trinidad and Tobago	91.9	82.6
New Zealand	98.3	98.5	Portugal	91.7	96.5
Hong Kong, China	98.2	98.9	Estonia	91.5	92.7
Canada	98.1	98.4	Qatar	91.5	72.6
Sweden	98.0	98.4	Latvia	90.8	94.8
Austria	97.4	96.5	Korea	89.9	91.4
Singapore	97.3	96.5	Chile	89.8	85.1
Macao, China	96.7	91.4	Belgium	89.8	88.2
Iceland	96.7	95.0	Spain	89.7	90.2
Finland	96.7	97.0	Japan	88.6	83.8
Liechtenstein	96.4	95.5	Jordan	88.1	73.5
Bulgaria	95.7	88.4	Greece	87.5	88.1
Ireland	95.6	95.1	Israel	86.4	83.9
Russian Federation	95.2	89.0	Slovenia	85.2	91.3
Croatia	95.2	90.4	Italy	84.0	72.5
Hungary	95.2	95.6	Serbia	83.9	65.5
Slovak Republic	95.0	95.1	Uruguay	83.8	79.4
Germany	94.9	94.4	Turkey	80.4	76.8
Czech Republic	94.6	95.5	Panama	60.5	47.1

* OECD average-29 means that 29 OECD countries with available data are taken into account in this average.

reach 93% for the OECD average. As for Hong Kong, about 98% of students reported that they had access to computers and 99% to the Internet in school in 2009, which were higher than the respective OECD averages.

Computer use in school

A. Computer use in school across countries/regions

The construct of computer use in school gives information about student involvement in ICT-related tasks in school. Students were asked how often they used a computer for the following nine

activities in school: (a) Chatting online in school; (b) Using e-mail in school; (c) Browsing the Internet for schoolwork; (d) Downloading, uploading or browsing materials from the school's website (e.g., Intranet); (e) Posting work on the school's website; (f) Playing simulations in school; (g) Practicing and drilling (such as practicing for foreign language learning or for mathematics); (h) Doing individual homework on a school computer; and (i) Using school computers for group work and communication with other students. The responses are also coded as: 1 for "never or hardly ever"; 2 for "once or twice a month"; 3 for "once or twice a week"; and 4 for "every day or almost every day." Items are coded and scaled such that positive scores on this index indicate high level of computer use at home for school work.

Table 19 shows that the pattern across countries/regions of the index of computer use in school is very different from that at home. The figures indicate that students' use of ICT in school is highest in Norway, Denmark and the Netherlands. They are followed by Bulgaria and Thailand (Thailand is the lowest in the index of computer use at home). Hong Kong scored 0.13 and ranked 15th. Surprisingly, the lowest in the queue are Korea and Japan, which are supposed to be technologically developed countries.

B. Computer use in school in East Asian societies

Figure 13 shows how students use computers in school in Hong Kong, Japan, Korea and the OECD average. Students who reported that they do more than once a week an activity listed were considered frequent users.

As for Hong Kong, 28% of students reported that they frequently browsed the Internet for schoolwork, which is lower than the OECD average (39%). The percentages of Hong Kong students reporting that they frequently used school computers for group work and

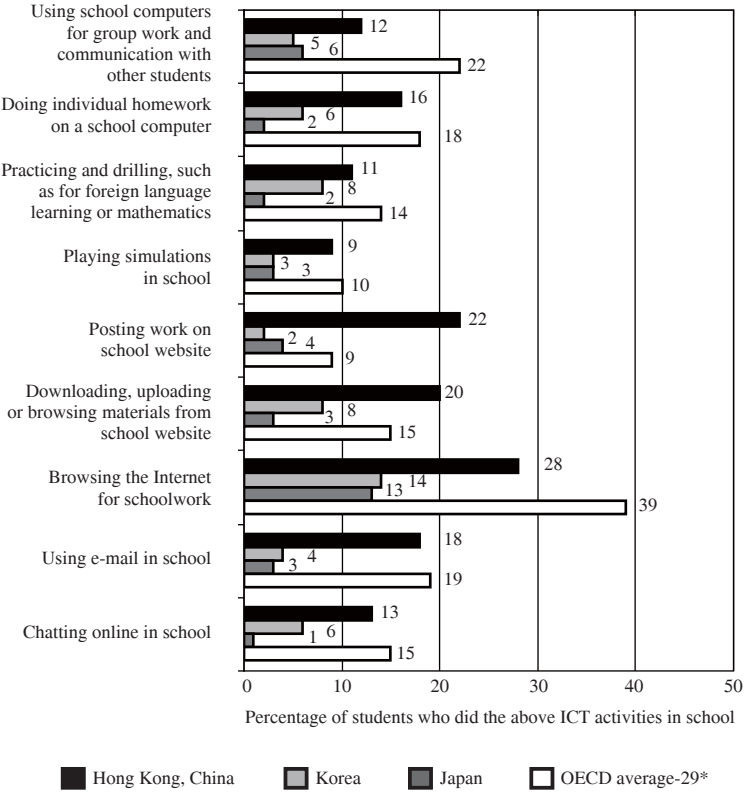
Table 19. Index of Computer Use in School Across Countries/Regions

Country/region	Index	Country/region	Index
Norway	0.74	Switzerland	0.04
Denmark	0.74	Hungary	0.04
Netherlands	0.59	Macao, China	0.02
Bulgaria	0.53	*OECD average-29**	0.00
Thailand	0.52	Slovenia	–0.02
Australia	0.40	Singapore	–0.13
Liechtenstein	0.40	Italy	–0.16
Czech Republic	0.35	Lithuania	–0.16
Jordan	0.23	Croatia	–0.18
Sweden	0.23	Trinidad and Tobago	–0.22
Canada	0.22	Israel	–0.24
Slovak Republic	0.17	Germany	–0.25
Austria	0.16	Russian Federation	–0.32
New Zealand	0.15	Belgium	–0.32
Hong Kong, China	0.13	Turkey	–0.33
Panama	0.11	Estonia	–0.35
Chile	0.11	Uruguay	–0.36
Finland	0.11	Poland	–0.36
Qatar	0.08	Serbia	–0.37
Iceland	0.07	Ireland	–0.37
Greece	0.06	Latvia	–0.42
Portugal	0.05	Korea	–0.91
Spain	0.05	Japan	–1.05

* OECD average-29 means that 29 OECD countries with available data are taken into account in this average.

communication with other students (12%) and that they frequently used a computer for practicing and drilling (11%) are all lower than the respective OECD averages (22% and 14% respectively). On the other hand, 20% of Hong Kong students reported that they frequently downloaded, uploaded or browsed materials from the school's website, while 22% reported that they frequently posted work on the school's website. Both percentages are higher than the respective OECD averages of 15% and 9%. As for using e-mail in school, doing homework on a school computer, and chatting online in school, Hong Kong students reported similar frequencies (18%, 16% and 13% respectively) as students in OECD countries (19%, 18% and 15% respectively).

Figure 13. Computer Use in School in East Asian Societies



* OECD average-29 means that 29 OECD countries with available data are taken into account in this average.

In sum, the most frequent ICT activities of Hong Kong students in school are: browsing the Internet for schoolwork; downloading, uploading or browsing materials from the school's website; and posting work on the school's website. As compared with Korea and Japan, Hong Kong students' engagement in ICT activities in school tends to be higher.

C. Computer use in school and digital reading performance across countries/regions

Computer use in school tends to have a positive relationship with digital reading performance in some countries/regions but not all, and the effect appears to be much smaller than that of computer use at home. Similar pattern was reported in the PISA 2003 study (OECD, 2005). OECD (2005) pointed out that home use of computer has a strong and positive relationship with student performance in mathematics in 2003, whereas the relationship between computer use in school and achievement is more ambiguous and even negative in some correlation studies. One possible explanation is that weaker students may be more likely to be given computer-aided instruction in school in many countries/regions (OECD, 2005, pp. 53–54).

Tables 20 and 21 compare the difference in digital reading performance by computer use at home versus in school. It is quite obvious that students who use computers at home performed significantly better in all the 17 countries/regions.

Across OECD countries, students using computer at home have a mean score in digital reading of 507 score points, while those who do not use computers at home get only 428 score points. The difference is substantial and statistically significant, which is equivalent to more than a proficiency level of digital reading performance. The advantage of computer use at home ranged from 105 score points in Sweden to 33 score points in Macao. It appears that the advantage of computer use at home in the four East Asian societies is the least among the 17 countries/regions in PISA 2009.

However, students using computer in school do not, in all countries/regions, perform better than the others. No advantage of computer use in school was found in 9 countries/regions. Across

Table 20. Differences in Digital Reading Performance by Computer Use at Home

Country/region	Students who do not use a computer at home (A)		Students who use a computer at home (B)		Difference in digital reading scores	*SE*
	Mean score	*SE*	Mean score	*SE*	(B – A)*	
Macao, China	460	(5.4)	493	(0.7)	**33**	(5.4)
Japan	487	(2.9)	534	(2.3)	**48**	(2.9)
Korea	525	(4.6)	574	(3.1)	**49**	(4.7)
Ireland	456	(6.4)	516	(2.8)	**60**	(6.4)
Hong Kong, China	457	(7.3)	518	(2.5)	**61**	(7.1)
Chile	386	(3.8)	454	(3.5)	**69**	(3.8)
Iceland	441	(24.7)	515	(1.4)	**74**	(24.8)
Norway	425	(14.9)	502	(2.8)	**77**	(14.7)
Spain	405	(7.0)	483	(3.8)	**78**	(6.9)
Denmark	412	(11.9)	491	(2.6)	**79**	(12.4)
OECD average	428	(2.7)	507	(0.8)	**80**	(2.7)
Australia	459	(5.9)	543	(2.7)	**84**	(6.0)
Poland	387	(5.2)	471	(3.1)	**84**	(5.2)
New Zealand	458	(5.7)	548	(2.2)	**90**	(5.6)
Austria	374	(13.0)	468	(3.5)	**94**	(12.3)
Belgium	416	(6.8)	518	(2.0)	**102**	(6.9)
Hungary	375	(9.3)	478	(3.9)	**102**	(8.8)
Sweden	410	(10.9)	515	(3.2)	**105**	(10.4)

* Figures in bold are statistically significant. Minor discrepancies in score differences are due to rounding-off errors.

Table 21. Differences in Digital Reading Performance by Computer Use in School

Country/region	Students who do not use a computer in school (A)		Students who use a computer in school (B)		Difference in digital reading scores	*SE*
	Mean score	*SE*	Mean score	*SE*	(B – A)*	
Hungary	488	(5.8)	461	(4.1)	**–27**	(4.8)
Poland	469	(3.9)	461	(3.2)	**–8**	(3.5)
Austria	471	(5.1)	465	(3.9)	–6	(5.4)
Ireland	514	(3.1)	511	(3.3)	–3	(3.2)
Korea	567	(2.9)	569	(3.8)	2	(3.7)
Chile	435	(4.6)	437	(3.6)	2	(4.0)
Hong Kong, China	513	(4.5)	516	(2.6)	3	(4.3)
Macao, China	489	(2.0)	493	(0.8)	4	(2.2)
Denmark	485	(6.2)	491	(2.6)	6	(6.0)
Belgium	509	(3.4)	518	(2.2)	**9**	(3.8)
OECD average	494	(1.2)	503	(0.8)	**9**	(1.2)
Spain	470	(5.1)	481	(3.9)	**11**	(4.7)
Japan	513	(2.9)	527	(2.8)	**14**	(3.6)
New Zealand	525	(4.1)	545	(2.6)	**20**	(4.9)
Iceland	497	(3.9)	519	(1.6)	**22**	(4.4)
Norway	478	(6.3)	503	(2.9)	**25**	(6.0)
Sweden	487	(6.7)	516	(3.3)	**28**	(6.6)
Australia	502	(4.7)	544	(2.8)	**42**	(4.4)

* Figures in bold are statistically significant. Minor discrepancies in score differences are due to rounding-off errors.

OECD countries, students using computer in school have a mean score in digital reading of 503, and those without using computer in school have only 494 points; that is, 9 point scores higher. Two countries, Hungary and Poland, have shown significant lower scores for students using computer in school. Seven countries/regions — including Hong Kong, Macao and Korea — have shown no significant difference in computer use in school. Only eight countries have shown significant advantages of computer use in school.

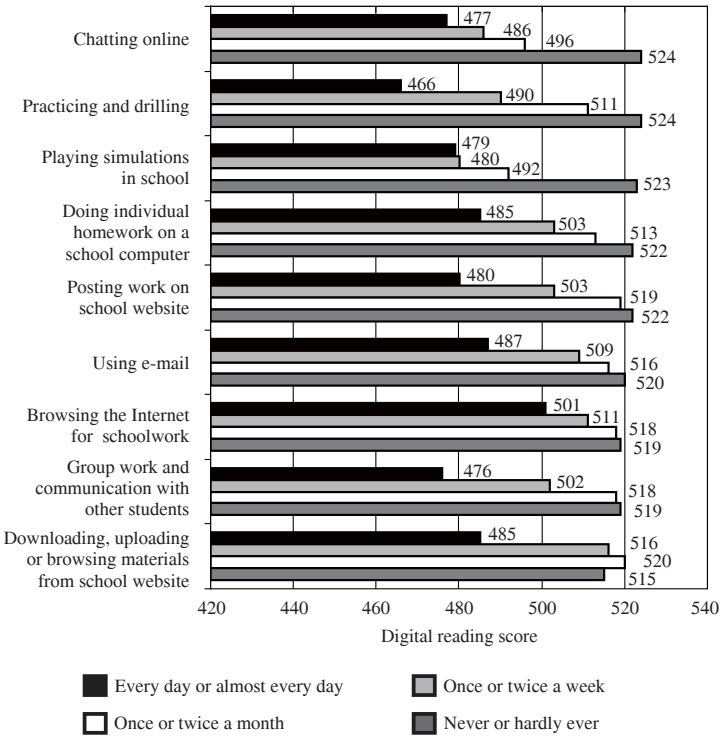
D. Computer use in school and digital reading performance in Hong Kong

As for Hong Kong, rare users (never and hardly ever) of computers in school generally perform better than moderate users (once/twice a week or a month) and moderate users perform better than frequent users (every day or almost every day). This pattern is somewhat different from, in fact opposite to, that of computer use at home.

A closer examination of digital reading performance in Hong Kong by the frequency students using computer in school shows that, in almost all the 9 items, except downloading or uploading schoolwork, the less students use computer in school, the higher their digital reading scores (see Figure 14).

Similar pattern has been found in previous ICT impact study in Europe (Balanskat et al., 2006). It might be related to the high accessibility to computer and the Internet at home in technologically developed societies similar to Hong Kong where students' e-learning depends more on the resources at home and much less in school. Another interpretation given by OECD (2011) is that student use of computers in school, especially for practicing and drilling, might be for low achievers for remedial purposes. Moreover, computer use in school may be related to lack of access at home for students of low socio-economic status.

Figure 14. Computer Use in School and Digital Reading Performance in Hong Kong



Confidence in doing ICT tasks

Items measuring students' confidence in doing high-level ICT tasks were included in PISA 2009. The set of five items used in PISA 2009 is similar to but shorter than the version of the PISA 2006 item set. The ICT survey asked students to report to what extent they are able to do each of the following five tasks on a computer: (a) Editing digital photographs or other graphic images; (b) Creating a database (e.g., using Microsoft Access); (c) Using a spreadsheet to plot a graph; (d) Creating a presentation (e.g., using Microsoft PowerPoint);

and (e) Creating a multimedia presentation (with sound, pictures or video).

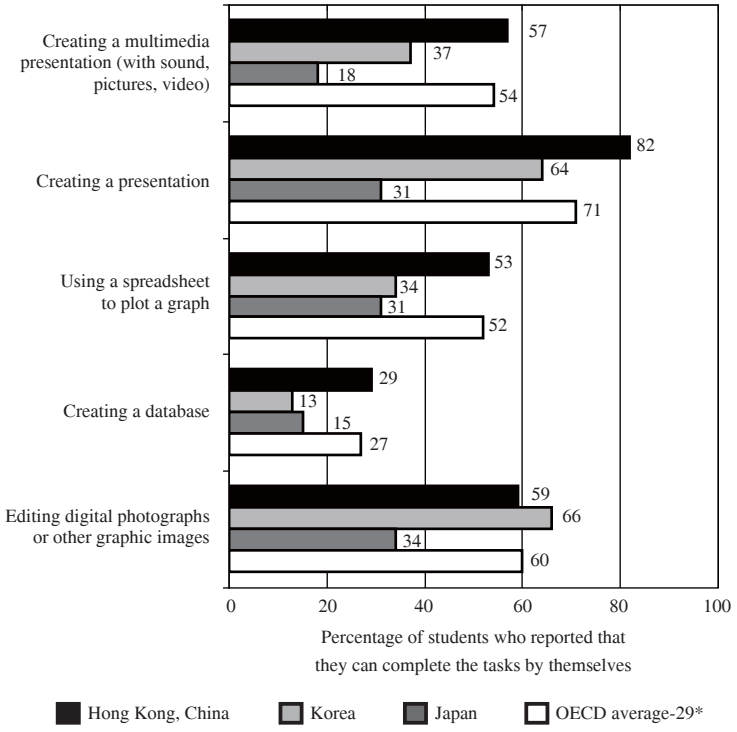
The responses are coded as: 1 for "I can do this very well by myself"; 2 for "I can do this with help from someone"; 3 for "I know what this means but I cannot do this"; and 4 for "I don't know what this means." Items are coded and scaled such that positive scores on this index indicate high self-confidence.

A. Confidence in doing ICT tasks across countries/regions

Figure 15 shows students' self-confidence in doing five types of ICT tasks. The highest levels of self-confidence is "completed the task by themselves." On average across OECD countries, "creating a presentation" was the task that students felt most confident performing by themselves (71%). "Editing digital photographs or other graphic images" received the second-highest rating, with 60% of students indicating that they could perform this task very well by themselves. Slightly over half of the students reported that they could "create a multimedia presentation" (54%) and "use a spreadsheet to plot a graph" (52%) by themselves, while the smallest proportion of students (27%) felt confident enough to "create a database" (OECD, 2011, p. 327, Table VI.5.24).

As for Hong Kong, "creating a presentation" is also the task that students felt most confident performing by themselves. About 82% of students reported that they can do that by themselves, which is higher than the OECD average (71%) and the percentages of Korea (64%) and Japan (31%). "Editing digital photographs or other graphic images" received the second-highest rating for Hong Kong, with 59% of students indicating that they could perform this task very well by themselves, which is lower than the OECD average (60%) and the percentage of Korea (66%) but higher than that of

Figure 15. Confidence in Doing High-level ICT Tasks in East Asian Societies



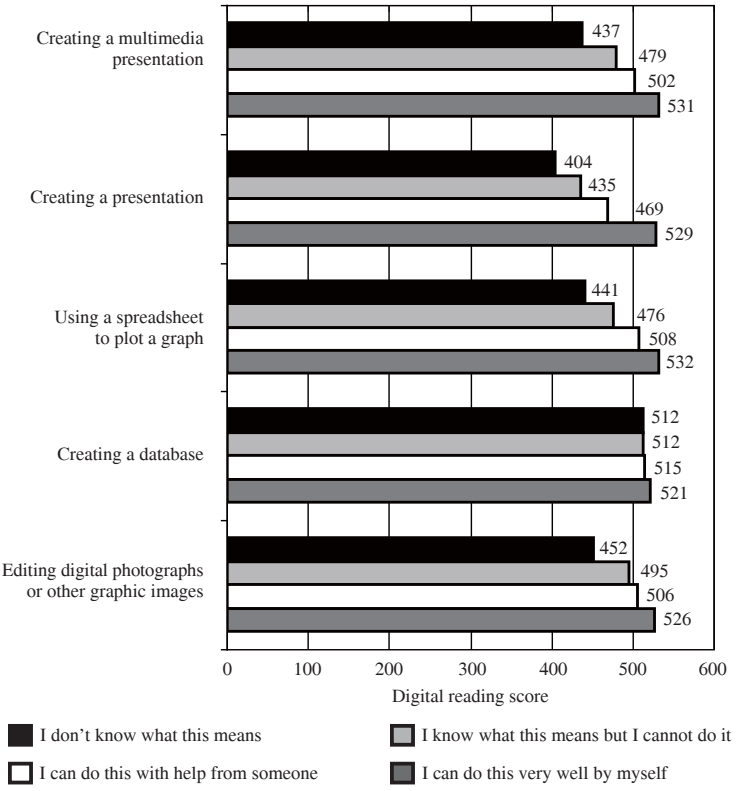
* OECD average-29 means that 29 OECD countries with available data are taken into account in this average.

Japan (34%). Over half of the Hong Kong students reported that they could "create a multimedia presentation" (57%) and "use a spreadsheet to plot a graph" (53%) by themselves. These percentages are similar to the OECD average and higher than those of Korea and Japan. Only about 29% of students felt confident enough to "create a database" by themselves, which is, however, higher than the OECD average and the percentages of Korea and Japan.

B. Confidence in computer use and digital reading performance of Hong Kong students

In Hong Kong, students who reported that they can do the various IT tasks by themselves are the best performers in digital reading (see Figure 16). Only the question which concerns "creating a database" is slightly different — the performance difference between the highly confident and unconfident students is small. One possible explanation is that there is only a small number of students reporting that they have confidence in creating a database.

Figure 16. Confidence in Computer use and Digital Reading Performance of Hong Kong Students



Attitude toward computers

In PISA 2009, we asked students to report to what extent they agree with the following statements: (a) It is very important to me to work with a computer; (b) I think playing or working with a computer is really fun; (c) I use a computer because I am very interested; and (d) I lose track of time when I am working with a computer. Items are coded and scaled such that higher scores on this index mean a more positive attitude toward computers.

A. Index of attitude toward computer use and self-confidence in ICT tasks across countries/regions

As shown in Table 22, Hong Kong students scored 0.16 and ranked 9th in the index of self-confidence in ICT tasks, which is higher than the OECD average of 0.00. Hong Kong students scored –0.07 and ranked 33rd in the index of attitude toward computers, which is slightly lower than the OECD average.

B. Attitudes toward computer use across countries/regions

Figure 17 shows that on average across OECD countries, over two-thirds of students reported positive attitude toward computers for all four statements. The statements with the highest proportion of students who reacted positively are "playing or working with a computer is really fun" (87%) and "it is very important to me to work with a computer" (83%). While 76% of students indicated that they "use a computer because they are interested", 69% reported they "lose track of time when working with a computer" (OECD, 2011, p. 324, Table VI.5.22).

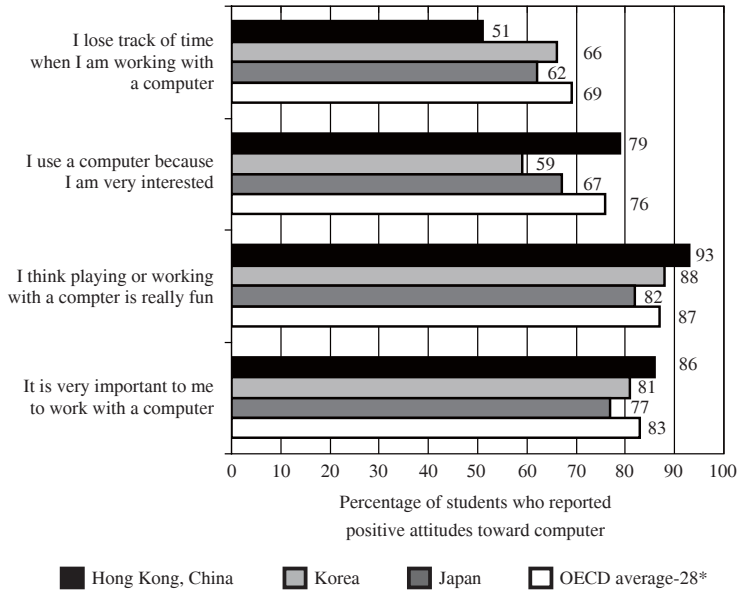
Similarly to the OECD countries, the statements with most Hong Kong students reacting positively are "playing or working with a computer is really fun" (93%) and "it is very important to me to

Table 22. Confidence in ICT Tasks and Attitude Toward Computers Across Countries/Regions

Country/region	Self-confidence in ICT tasks	Country/region	Attitude toward computers
Portugal	0.56	Netherlands	m
Croatia	0.34	Portugal	0.43
Austria	0.33	Bulgaria	0.31
Liechtenstein	0.32	Croatia	0.28
Poland	0.23	Greece	0.28
Czech Republic	0.23	Jordan	0.26
Slovenia	0.22	Chile	0.21
Spain	0.21	Italy	0.18
Hong Kong, China	0.16	Israel	0.16
Australia	0.14	Austria	0.14
Germany	0.13	Qatar	0.13
Hungary	0.13	Trinidad and Tobago	0.12
Estonia	0.10	Slovak Republic	0.12
Uruguay	0.10	Liechtenstein	0.11
Switzerland	0.07	Uruguay	0.11
Serbia	0.06	Slovenia	0.08
Bulgaria	0.06	Belgium	0.08
Qatar	0.06	Germany	0.06
Greece	0.05	Switzerland	0.05
Canada	0.05	Norway	0.04
Norway	0.03	Canada	0.04
Lithuania	0.02	Macao, China	0.04
Latvia	0.02	Serbia	0.03
Belgium	0.02	Ireland	0.02
Russian Federation	0.02	Denmark	0.02
Jordan	0.00	Czech Republic	0.01
*OECD average-29**	0.00	*OECD average-28**	0.00
Trinidad and Tobago	−0.04	Singapore	−0.03
Slovak Republic	−0.05	Spain	−0.03
Denmark	−0.06	Sweden	−0.04
Italy	−0.06	Iceland	−0.04
Netherlands	−0.06	Thailand	−0.05
New Zealand	−0.07	Hungary	−0.06
Chile	−0.07	**Hong Kong, China**	−0.07
Ireland	−0.11	Russian Federation	−0.09
Iceland	−0.14	Poland	−0.10
Turkey	−0.17	Lithuania	−0.13
Israel	−0.18	Panama	−0.13
Macao, China	−0.21	Latvia	−0.16
Singapore	−0.23	Korea	−0.18
Sweden	−0.24	Finland	−0.20
Finland	−0.31	Estonia	−0.22
Korea	−0.34	Japan	−0.23
Panama	−0.35	Turkey	−0.25
Thailand	−0.56	New Zealand	−0.26
Japan	−0.66	Australia	−0.32

* OECD average-28 and OECD average-29 mean that 28 and 29 OECD countries with available data are taken into account in these averages respectively.

Figure 17. Attitudes Toward Computer Use in East Asian Societies



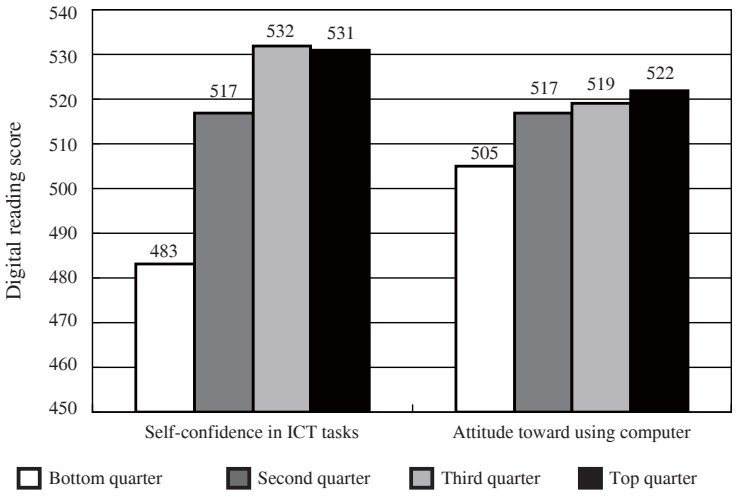
* OECD average-28 means that 28 OECD countries with available data are taken into account in this average.

work with a computer" (86%). While 79% of Hong Kong students indicated that they "use a computer because they are interested," only 51% reported they "lose track of time when working with a computer."

C. Confidence in and attitude toward computer use and digital reading performance of Hong Kong students

The more confidence in and more positive attitude toward computers students have, the better their performance in digital reading. Figure 18 shows that the impact of self-confidence on specific ICT tasks appears to be stronger than that of attitude toward computers. The performance difference between the bottom quarter and the top

Figure 18. Confidence in and Attitude Toward Computers and Digital Reading Performance of Hong Kong Students



quarter of self-confidence is 48 points whereas for attitude toward computers, the difference is 17 points.

Summary: Overall effect size of ICT factors

Figure 19 shows the score point change associated with one unit change on the indices of the five ICT factors discussed in this section. Self-confidence in performing high-level ICT tasks has the strongest effect on students' digital reading performance, which is even stronger than students' attitude toward computers. This is followed by students using computer at home for schoolwork and for leisure. It is interesting to find that computer use in school shows a negative effect.

Factors Relating to the Affective Domains of Digital Reading

Multilevel analysis is employed to assess the factors related to student confidence in and attitude toward computer use. Results in

Figure 19. Overall Effect Size of ICT Factors for Hong Kong

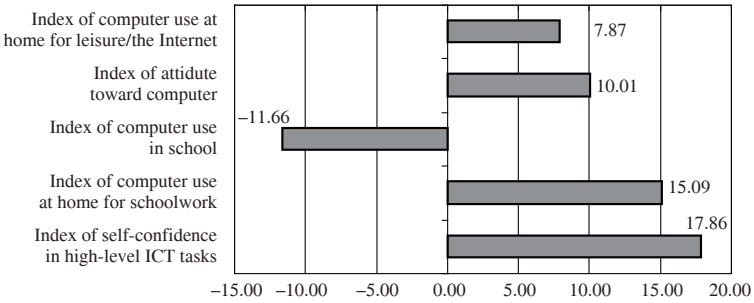


Table 23 indicate that the school's social background does not have an impact on students' confidence in performing ICT tasks and their attitude toward computer use. The percentage of girls in a school is not related to their confidence but positively related to their attitude toward computer use. It is likely that schools with more girls or even girl schools have higher student academic intake, therefore, their attitude toward computer use is not at a disadvantage. Yet at the individual level, girls appear to be less confident in performing ICT tasks compared with boys, but there is no gender difference in attitude toward computer use.

Impact of family and student background on confidence in and attitude toward computers

Of the three family background factors, none of them is related to students' confidence in and attitude toward computers. Of the four family resources factors, students' confidence in ICT tasks is highly related to the educational, cultural, and ICT resources available at home. However, material resources are not a significant factor for students' confidence in performing ICT tasks. None of the four family resources factors is related to students' attitude toward computers.

Table 23. HLM Analysis on the Affective Domains of Digital Learning

	Confidence in ICT tasks		Attitude toward computers	
	Coefficient	*SE*	Coefficient	*SE*
Intercept	0.171***	(0.016)	0.065***	(0.012)
School factors				
Mean ESCS	0.048	(0.033)	0.029	(0.028)
Percentage of girls	0.127	(0.070)	0.120*	(0.050)
Student background				
Girls	−0.087**	(0.026)	−0.040	(0.025)
Parent occupation	0.000	(0.001)	0.000	(0.001)
Mother education	−0.005	(0.010)	0.013	(0.008)
Father education	0.001	(0.010)	−0.011	(0.010)
Family resources				
Material resources	−0.003	(0.024)	−0.016	(0.020)
Home educational resources	0.099***	(0.017)	0.018	(0.015)
Cultural possessions	0.053**	(0.016)	−0.021	(0.014)
ICT resources	0.051**	(0.017)	−0.003	(0.017)
Students' reading engagement and strategies				
Enjoyment of reading	0.093***	(0.023)	−0.032	(0.020)
Diversity of reading	0.020	(0.017)	0.021	(0.013)
Online reading	0.114***	(0.020)	0.059***	(0.016)
Understanding and remembering	0.004	(0.015)	−0.007	(0.013)
Summarizing	0.038**	(0.013)	0.019	(0.012)
ICT factors				
Use of computer for entertainment/the Internet	0.124***	(0.025)	0.266***	(0.021)
Use of computer for schoolwork	0.055**	(0.020)	−0.014	(0.016)
Use of computer in school	−0.005	(0.018)	0.036*	(0.014)
Variance components				
Between-school		1.885		0.341
Within-school		63.868		54.103
% of variance explained				
Between-school		52.781%		8.824%
Within-school		10.332%		8.305%

Impact of students' reading engagement and strategies on confidence in and attitude toward computers

Of the five students' learning characteristics, students' enjoyment of reading, online reading and use of summarizing strategies are positively related to students' confidence in ICT tasks. Online reading is the only factor contributing significantly to students' attitude toward computers.

Impact of ICT activities on confidence in and attitude toward computers

Of the three ICT factors, computer use at home for entertainment/ the Internet is the strongest contributor to both confidence in ICT tasks and attitude toward computers. Using computer at home for schoolwork also contributes to higher confidence whereas computer use in school contributes to more positive attitude toward computers.

Overall, the HLM model explains about 53% of the between-school variance and only 10% of the within-school variance in students' confidence in ICT tasks. However, only about 9% of the between-school variance and 8% of the within-school variance in students' attitude toward computers can be explained by using the same factors.

Multilevel Analysis on Digital Reading Performance

Impact of family and student background on digital reading performance

Model 1 estimates the effect of students' characteristics and the family's socio-economic background on students' digital reading performance. Results indicate that gender is not a significant factor. Parent occupation and father education are not associated significantly with digital reading performance. However, maternal

education level, educational and ICT resources are positively related to students' digital reading literacy. The negative coefficient of cultural possessions, which is counter-intuitive, might be related to the multi-collinearity of other resources factors.

At the school level, school mean ESCS and percentage of girls in the school are positively associated with digital reading performance. In other words, the effect on digital reading literacy of ESCS at the school level is much greater than that at the individual level. Schools with more girls also tend to perform better in digital reading. These findings are consistent with the print reading literacy (Ho et al., 2011). Overall, the model explains about 36% of the between-school variance and only 2% of the within-school variance (see Table 24).

Impact of reading engagement and strategies

Model 2 estimates the effect of the five constructs of reading engagement and meta-cognition on digital reading performance after the family and student background have been taken into account. The results indicate that reading enjoyment is the strongest predictor of digital reading performance and online reading also has a positive relationship with digital reading performance, but reading diversity does not have significant relationship with digital reading performance.

Of the two constructs of meta-cognition, both meta-cognition strategies (understanding and remembering, and summarizing) have significant positive relationship with digital reading performance, with summarizing having a stronger impact. Overall, the model explains about 45% of the between-school variance and 12% of the within-school variance.

Table 24. Multilevel Analysis of Digital Reading Performance

	Model 1		Model 2		Model 3	
	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*
Intercept	517.064	(3.512)	517.463***	(3.268)	517.748***	(3.172)
School-level factors						
Mean ESCS	45.506***	(5.826)	42.231***	(5.618)	40.209***	(5.282)
Percentage of girls	44.881**	(13.464)	43.781**	(12.845)	42.689**	(12.493)
Student background						
Girls	−2.658	(2.115)	−9.742***	(2.075)	−10.166***	(2.054)
Parent occupation	−0.081	(0.093)	−0.077	(0.092)	−0.067	(0.090)
Mother education	1.935*	(0.778)	1.581*	(0.736)	1.456*	(0.723)
Father education	−1.178	(0.873)	−1.426	(0.839)	−1.256	(0.840)
Family resources						
Material resources	−1.571	(1.518)	−0.733	(1.516)	−1.729	(1.502)
Home educational resources	6.682***	(1.567)	3.482*	(1.499)	3.263*	(1.449)
Cultural possessions	−3.101*	(1.501)	−5.814**	(1.455)	−6.152***	(1.409)
ICT resources	5.758**	(1.542)	5.438**	(1.564)	4.070*	(1.550)
Students' reading engagement and strategies						
Enjoyment of reading			15.374***	(1.740)	15.868***	(1.759)
Diversity of reading			1.145	(1.114)	1.265	(1.065)
Online reading			6.914***	(1.233)	1.986	(1.404)
Understanding and remembering			3.562***	(0.960)	3.974***	(0.915)
Summarizing			9.964***	(0.936)	9.437***	(0.888)
ICT factors						
Use of computer for entertainment/the Internet					8.683***	(1.568)
Use of computer for schoolwork					4.574**	(1.508)
Use of computer in school					−13.797***	(1.347)
Affective domain of ICT						
High confidence in ICT					7.455***	(1.149)
Attitude toward computers					5.771***	(1.269)
Variance components						
Between-school		1772.018		1528.514		1444.455
Within-school		3118.529		2805.461		2598.217
% of variance explained						
Between-school		36.44%		45.17%		48.19%
Within-school		2.12%		11.95%		18.45%

Impact of ICT-related factors

Of the five constructs related to ICT, using ICT for schoolwork and entertainment at home show significant positive impact on digital reading performance. It is interesting to find that using computer for leisure shows a stronger effect. The use of the Internet is not only for entertainment but also for educational purpose such as searching for information, which might be helpful to e-learning. However, computer use in school shows a negative association with digital reading performance. The finding is consistent with the observation in the previous section. Given almost all students in Hong Kong are accessible to computer and the Internet at home, computer use in school might not be that important in developed societies such as Hong Kong, Korea and Japan. Students with high confidence in IT tasks and positive attitude toward computer use tend to perform better in digital reading.

Overall, the final model explains about 48% of the between-school variance and 18% of the within-school variance. Nurturing enjoyment of reading is the most essential for promoting digital reading performance. This finding is consistent with that of print reading literacy. This is followed by learning strategies on summarizing and understanding; high confidence and positive attitude toward ICT; using ICT at home for both entertainment/the Internet and schoolwork; and providing sufficient educational and ICT resources.

These results suggest that reading engagement and learning strategies are the most important practices to be nurtured at home and in school to promote both digital and print reading literacy. Family investment in educational and ICT resources is important, yet the tasks to which ICT resource is used might be more important

for developing positive attitude toward ICT and then digital reading literacy.

Conclusions and Implications

Digital Reading Performance of Hong Kong in PISA 2009

Hong Kong gets a mean score of 515 in digital reading, which is significantly higher than the OECD average. While Hong Kong (having no significant differences with Japan, Iceland and Sweden) ranks 4th to 7th among the 19 participating countries/regions, its score is far below Korea's (568) and also significantly lower than New Zealand's (537) and Australia's (537). Further analysis is needed to explore which aspects of digital reading competencies are the weaknesses.

Distribution of Digital Reading Proficiency Levels

Digital reading scale is divided into 4 proficiency levels: Level 2 (baseline level), Level 3, Level 4, and Level 5 or above (top level). Among the participating OECD countries, an average of 83.1% of students reach Level 2 or above, 60.7% reach Level 3 or above, 30.4% reach Level 4 or above, and 7.8% reach Level 5 or above. Evidence in the present study indicates that, although 90.2% of Hong Kong students reach the baseline Level 2 or above, which is far more than the OECD average, only 6.3% reach Level 5 or above in digital reading, which is significantly lower than the OECD average of 7.8%. Hong Kong will have to learn from countries with higher percentage of high achievers, such as Korea (19.2%), New Zealand (18.6%), and Australia (17.3%). As Hong Kong students now have basically universal access to computer, government policy needs to turn its attention from hardware provision to the agenda of ensuring effective ICT use for learning.

ICT Accessibility at Home

Almost all 15-year-old students have access to computer and the Internet at home in Hong Kong. The accessibility rate improved from 94.5% to 99.0% for access to computer and from 84.8% to 98.0% for access to the Internet from 2000 to 2009. Although the number of students lacking access to ICT appears to be small, results from the present study indicate that there is a large discrepancy of digital reading performance of students who have access to computer at home versus those who do not, and the gap is 61 score points. Therefore, schools have to be sensitive to the needs of these disadvantaged students. Future investigation is needed to examine the background of these disadvantaged students and to identify if they cluster in certain schools within certain communities.

Digital Divide Between Schools

Although the input, that is, the accessibility of computers and the Internet in school reach over 98%, the discrepancy of output is large, especially between schools. Results from the present study indicate that the percentage of between-school variance in digital reading performance of Hong Kong is 45.5%, which is higher than the OECD average of 38.0%. These findings suggest that not only the availability but also the ways of using computer to support learning is essential. Further investigation is needed to address how extending computer use within schools can contribute to higher standard and greater equality in performance for all students. A preliminary analysis by the author indicates that: (1) 16% of schools reported shortage of educational software; (2) 11.3% of schools reported shortage of computers; and (3) 4.0% of schools reported shortage of Internet access. The shortage of these ICT resources influences teaching in schools.

Effective Ways of Using ICT at Home

Although computer use at home appears to have highly positive relationship with digital reading performance, not all activities contribute equally to student learning. Hong Kong students who engage in computer use most frequently (every day or almost every day) for online forum, using e-mail, communicating with other students about schoolwork, and browsing the Internet for schoolwork perform better in digital reading. However, frequent users of computers who engage in maintaining blog, and downloading entertainment materials perform slightly worse on average than moderate users.

Improving Ways of Using ICT in School

No significant advantage of computer use in school can be found in Hong Kong. The mean performance in digital reading for students with ICT access in school is 516 and for those without access in school is 513. The 3-point advantage is not significant statistically. This pattern is not unique for Hong Kong. No significant difference is found in 6 other countries/regions either, including Korea and Macao. However, performance advantage is significant in 8 countries including Belgium, Spain, Japan, New Zealand, Iceland, Norway, Sweden and Australia. Further studies are needed to investigate how these countries make good use of ICT in school and how they design different ICT activities so that ICT can be beneficial to all students at school.

ICT Confidence and Attitude

Hong Kong students' confidence in performing ICT tasks is above the OECD average and their attitude index is about the OECD average. These positive affective outcomes of ICT might be related

to the proactive ICT policies in education since 1997. Evidence from the present study also indicates that ICT confidence and attitude are significantly and positively associated with students' digital reading performance. While the investment in hardware can be regarded as a successful first step, we will have to focus on the improvement of software as the next — how to use computers to the best effect.

Multilevel Factors Related to Digital Reading Performance

Results from multilevel analysis indicate that the disparity in digital reading performance can be explained by the school mean ESCS, home educational resources and ICT resources, use of computer at home for schoolwork or leisure, and students' confidence in and attitude toward computer use. Social segregation between schools has always been a significant problem in Hong Kong education system. To alleviate the issue, positive discrimination policies should be developed further so that extra educational or ICT resources can be reached by disadvantaged students and schools accumulated with socially disadvantaged student population.

A further analysis comparing the high achievers (Level 5 or above) and low achievers (Level 2 or below) indicates that low achievers are more likely to possess much less family resources, lack access to computers at home, have less confidence in and poorer attitude toward computer use, and have less affinity for reading (see Figures 20 to 22).

Future Research and Development

The present analysis focuses on digital reading performance. Further analysis can also be done to examine to what extent and how ICT-related factors affect other learning outcomes such as performance in mathematics and science. Moreover, information about how teachers use ICT in their teaching is not available in the present study.

Figure 20. Indices of Family Resources of High Achievers and Low Achievers in Hong Kong

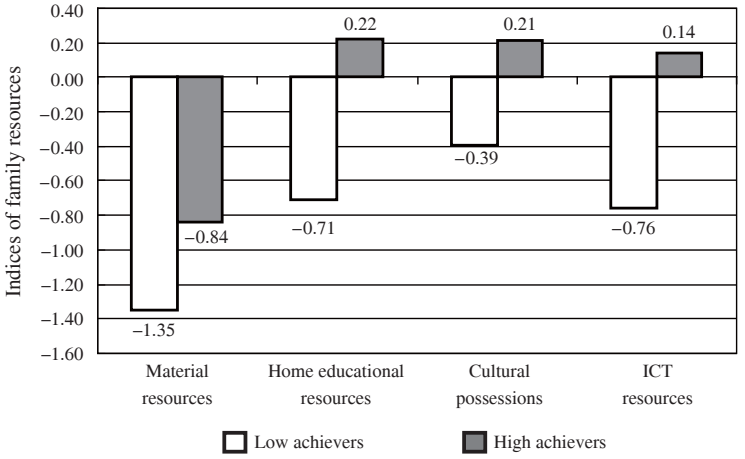


Figure 21. Indices of ICT-Related Factors of High Achievers and Low Achievers in Hong Kong

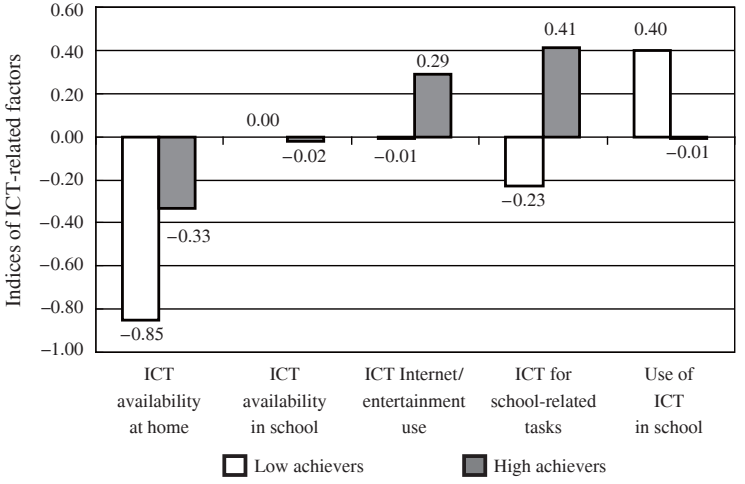
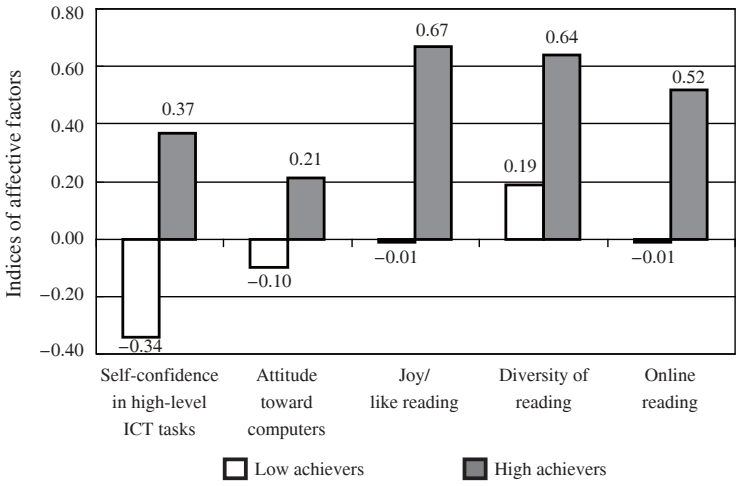


Figure 22. Indices of Affective Factors of High Achievers and Low Achievers in Hong Kong



To better understand why computer use in school does not show significant benefit to students in Hong Kong, in-depth case study and longitudinal study are needed to provide further information and insights for improving efficiency and effectiveness in using ICT resources both at home and in school, especially for the low achievers.

Encouraging More Qualitative Trans-national Research into ICT Impact

International comparisons should move beyond the present baseline data analysis and give more qualitative insights into ICT use by learners as well as teachers in outstanding countries such as Korea, New Zealand and Australia. For instance, looking into the pattern of Korean students' use of computer at home and in school, we found that higher percentage of Hong Kong students reported regular

(at least once a week) engagement in all kinds of ICT activities both at home and in school compared with Korean students. Moreover, higher percentage of Hong Kong students reported that they had "confidence" in completing different kinds of ICT tasks (e.g., creating a presentation with or without multimedia; using a spreadsheet to plot a graph; creating a database), and had "positive attitude" toward computer use (e.g., interested in using computer; having fun using computer; and feeling important in using computer). Therefore, in such a complex issue as ICT in education, qualitative methods are necessary to investigate any impact that can go beyond pure observations and to evaluate more concretely school contexts, learning environments and teaching processes to show under what circumstances ICT activities can enhance students' learning and improve their competencies and skills.

Notes

1. PISA 2009 constructs an overall scale by drawing on all the questions in the digital reading assessment. The metric for the digital reading scale is set such that the mean and the standard deviation of the 16 equally weighted OECD countries participating in this assessment are the same as the respective statistics for the same group of countries in the print reading assessment. The mean was 499 score points with a standard deviation of 90 (OECD, 2011).
2. The Netherlands have missing data in the construct of "using computer for leisure/the Internet."

References

Balanskat, A., Blamire, R., & Kefala, S. (2006). *The ICT impact report: A review of studies of ICT impact on schools in Europe*. Retrieved from http://ec.europa.eu/education/pdf/doc254_en.pdf

Halpern, D. F. (1989). *Thought and knowledge: An introduction to critical thinking* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Ho, S. C., Cheung, S. P., Chun, K. W., Lau, K. C., Lau, K. L., Wong, K. L., … Tsang, W. K. (2011). *The fourth HKPISA report: PISA 2009*. Hong Kong, China: Hong Kong Centre for International Student Assessment, The Chinese University of Hong Kong.

Kulik, J. A. (2003). *Effects of using instructional technology in elementary and secondary schools: What controlled evaluation studies say*. Retrieved from http://www.sri.com/policy/csted/reports/sandt/it/Kulik_ITinK-12_Main_Report.pdf

Light, D., Strother, S., & Polin, D. K. (2009). *Emerging changes in ICT-rich learning environments: The Intel® Teach Essentials Course and changing teacher practice in India, Turkey, and Chile*. Retrieved from http://cache-www.intel.com/cd/00/00/44/06/440682_440682.pdf

Organisation for Economic Co-operation and Development. (2005). *Are students ready for a technology-rich world? What PISA studies tell us*. Retrieved from http://www.oecd.org/dataoecd/28/4/35995145.pdf

Organisation for Economic Co-operation and Development. (2010). *PISA 2009 results: Overcoming social background — Equity in learning opportunities and outcomes (Volume II)*. Paris, France: Author.

Organisation for Economic Co-operation and Development. (2011). *PISA 2009 results: Students on line — Digital technologies and performance (Volume VI)*. Paris, France: Author.

Shetzer, H., & Warschauer, M. (2000). An electronic literacy approach to network-based language teaching. In M. Warschauer & R. Kern (Eds.), *Network-based language teaching: Concepts and practice* (pp. 171–185). Cambridge, England; New York, NY: Cambridge University Press.

Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research*, *81*(1), 4–28. doi: 10.3102/0034654310393361

Trucano, M. (2005). *Knowledge maps: ICT in education — What do we know about the effective uses of information and communication technology in education in developing countries?* Washington, DC: infoDev/World Bank.

Warschauer, M. (1999). *Electronic literacies: Language, culture and power in online education*. Mahwah, NJ: Lawrence Erlbaum.

Appendix

Description of Proficiency Levels of Digital Reading

Proficiency at Level 5 or above (scores higher than 626)

Students proficient at Level 5 or above on the digital reading scale are skilled readers in this medium. They are able to evaluate information from several web-based sources, and to assess the credibility and utility of what they read using criteria that they have generated themselves. They are also able to work out a pathway across multiple sites to find information without explicit direction; that is, they are able to navigate autonomously and efficiently. These two capabilities — critical evaluation and expertise in locating relevant information — are key skills in a medium in which there is virtually unlimited material available, and in which the integrity of the sources is often dubious. Dealing with semi-technical material as well as with more popular and idiomatic texts, students performing at Level 5 or above assimilate the broad sense of the material they encounter and also notice fine distinctions in the detail of the texts, allowing them to draw inferences and form plausible hypotheses. Those performing at Level 5 or above can be regarded as "top performers" in digital reading.

Proficiency at Level 4 (scores higher than 553 but lower than or equal to 626)

Students at this level can perform challenging reading tasks in the digital medium. They evaluate the authority and relevance of sources of information when provided with support, and can explain the criteria on which their judgments are based. They can locate and synthesize information across several sites when navigation between the sites requires the exercise of low-level inference. Dealing with a range of text formats and text types, including those in more formal registers and written in technical language, students at this level are able to compare and contrast the information they find on different sites, and

to hypothesize and form opinions about what they read drawing on information from everyday life. Students who proficient at Level 5 or above can also successfully complete Level 4 tasks.

Proficiency at Level 3 (scores higher than 480 but lower than or equal to 553)

Students performing at this level can cope with digital reading tasks of moderate complexity. They respond to digital texts in both authored and message-based environments. When given explicit guidance, they navigate across several pages to locate relevant material, and compare and contrast information from a number of web-based texts when the criteria for comparison or contrast are clearly stated. They evaluate information in terms of its usefulness for a specified purpose or in terms of personal preference.

Proficiency at Level 2 (scores higher than 407 but lower than or equal to 480)

Students proficient at this level navigate successfully using conventional navigation tools and features. When provided with explicit instructions, they locate links even when they are not prominent and scroll to find required information. Using predefined criteria, they select relevant material from a list of search results or a drop-down menu. They can locate several pieces of information in one text and transfer them to another format (such as an order form). They form generalizations such as recognizing the intended audience of website, or figuring out a common requirement of two correspondents in an e-mail exchange.

PISA 2009 中香港學生的數碼科技態度行爲與數碼閱讀表現

何瑞珠

摘要

本文根據2009年學生能力國際評估計劃（PISA 2009）的數據，首次從國際視域分析香港學生數碼閱讀的表現，以及他們在家中及校內使用資訊科技的態度和行為對其表現有何影響。

香港學生的數碼閱讀平均分為515分，顯著高於OECD平均值，但卻遠低於韓國的568分，亦顯著低於紐西蘭和澳洲的537分。儘管幾乎所有香港15歲學生都可以在家中和校內使用電腦和接通互聯網，數碼閱讀成績的校間差異卻很大。研究結果顯示，香港的校間差異達45.5%，高於OECD的平均校間差異38.0%。結果亦顯示，學生經常使用電腦（每天或幾乎每天）參與網上論壇、發送或接收電郵、與同學討論功課、瀏覽有關學校功課的網頁，數碼閱讀成績較好；但學生經常使用電腦發表或更新個人網頁、網誌或博客，又或下載娛樂資訊，數碼閱讀成績則較一般使用者為差。