Spring 4-22-2020

Determinants of a Computer and Information Literacy Test Score: A Comparison across 19 Countries

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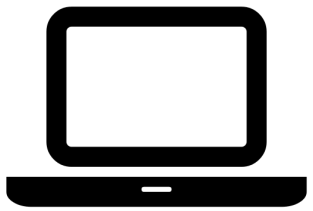

PROVIDENCE COLLEGE

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A Comparison across 19 Countries

By: Tishay Davis and Dr. Fang Dong

Introduction

- The International Computer and Information Literacy Study (ICILS) is the first international comparative study of student preparedness for life in the information age - the ability to use computers to investigate, create and communicate in order to participate effectively at home, at school, in the workplace and in the community.
- ICT Literacy is the ability to use digital technology, communication tools, and/or networks appropriately to solve information problems in order to function in an information society.
- Computer Information Literacy test is defined in the ICILS 2018 Assessment Framework as "an individual's ability to use computers to investigate, create, and communicate in order to participate effectively at home, at school, in the workplace, and in society" (Fraillon et al., 2018).

- Computer Literacy and Education
  - Major benefit
    - Improves teaching and learning methods
- The universal digital divide
- Objective: The objective of this paper was to examine 19 education systems with regard to the relevance of both student-level school-level factors for the use of ICT by teachers in teaching and learning as well as the effect of the latter on students' CIL, as measured in IEA ICILS 2013.
  - Socioeconomic factors
  - Gender based factors

Literature Review

Socioeconomics as a factor:

- Scherer, R., Rohatgi, A., & Hatlevik, O. E. (2017). Students' profiles of ICT use: Identification, determinants, and relations to achievement in a computer and information literacy test.
  - **Objective:** to answer to what extent do students' background and motivational characteristics differentiate the latent profiles of ICT use?
  - "In ICILS 2013, students' socioeconomic status is indicated by the highest education of parent(s), parent(s) occupation, and home literacy (number of books at home) resources in the family. These three variables have been reported by students, and ISCO coding has been used for coding the occupation for comparisons between countries. In the questionnaire, students were required to identify their parents' level of education on predefined categories based on the ISCED definitions (UNESCO, 2006)"
  - Important variables: background characteristics (i.e., gender, immigration status) and motivational constructs (i.e., self-efficacy, interest, and enjoyment in ICT)

- Law, NWY, Yuen, JKL & Lee, Y. “E-Learning Pedagogy and School Leadership Practices to Improve Hong Kong Students’ Computer and Information Literacy: Findings from ICILS 2013 and beyond”
  - **Objective:** “help families, educators and policy makers understand Hong Kong students’ levels of Computer Information Literacy (CIL) achievement in comparison with their international peers, and what e-learning pedagogy and e-leadership practices in schools will help to foster students’ ability to make use of ICT tools productively for lifelong learning in the 21st century.”
  - There were two questions in the student survey that collected personal background variables:
    - gender of the student, and the highest level of education that the student expected himself/herself to reach.
    - There were four kinds of family background variables elicited by the survey: whether the student has recent immigrant status, language spoken at home with respect to the language used in the CIL assessment, socioeconomic status (SES) and the availability of ICT resources at home.

Gender as a factor:

- Hatlevik, O. E., Throndsen, I., Loi, M., & Gudmundsdottir, G. B. (2018). Students' ICT self-efficacy and computer and information literacy: Determinants and relationships. *Computers and Education*, *118*
  - **Objective:** explores how self-efficacy can be contextualized with information and communication technology in 15 countries. How do students' personal characteristics and background contextual variables affect their ICT self-efficacy and CIL?
  - In the present study, students' personal factors are represented by their ICT experiences (number of years) and ICT uses (at home and in school), in addition to gender and autonomous learning.
- Kiss, G., & Gastelú, C. A. T. (2015b). Comparison of the ICT Literacy Level of the Mexican and Hungarian Students in the Higher Education. *Procedia - Social and Behavioral Sciences*,
  - **Objective:** find the communication barriers which teachers' candidates face when they utilize technology.

- Lau, W. W. F. (2017). Effects of social media usage and social media multitasking on the academic performance of university students. *Computers in Human Behavior*, *68*, 286–291.
  - **Objective:** examine how social media usage and social media multitasking influence the academic performance of university students.
  - A gender difference in academic performance was found in which female students generally attained a higher CGPA than that of male students.
  - “There are arguably various cognitive and noncognitive factors that explain academic gender differences” (Cooper, 2014)

Methods

- Data sources

IEA's ICILS 2013: examine Grade 8 students CIL

computer-based testing

information on teaching and learning with ICT

21 education systems

Within each of the selected schools, a random sample of 20 students and 15 teachers was chosen.


Australia


Argentina


Canada


Chile


Croatia


Czechia


Denmark


Germany


Hong Kong


South Korea


Lithuania


Netherlands


Norway


Poland


Russia


Slovakia


Slovenia


Switzerland


Thailand


Turkey

Table 2 Analysis sample in the selected 19 education systems					
	Education System/Country	**Abbreivation**	**Student sample size**	**Number of schools**	**Average number of students per school**
1	Australia	AUS	4699	287	16.4
2	Chile	CHL	2924	174	16.8
3	Newfoundland and Labrador, Canada	CNL	1219	102	12
4	Ontario, Canada	COT	2404	152	15.8
5	Czech Republic	CZE	2947	170	17.3
6	Germany	DEU	1693	117	14.5
7	Denmark	DNK	1278	78	16.4
8	Hong Kong, SAR	HKG	1376	103	13.4
9	Croatia	HRV	2710	170	15.9
10	Korea, Republic of	KOR	2781	150	18.5
11	Lithuania	LTU	2471	161	15.3
12	Netherlands	NLD	1649	95	17.4
13	Norway	NOR	1929	116	16.6
14	Poland	POL	2691	156	17.3
15	Russian Federation	RUS	3042	187	16.3
16	Slovak Republic	SVK	2758	167	16.5
17	Slovenia	SVN	3420	213	16.1
18	Thailand	THA	3155	183	17.2
19	Turkey	TUR	2088	141	14.8

- # Variables

ordinal integer variables

All others:
Transformed scores

9 school-level variables

Table 1 Descriptive Statistics

		(1)	(2)	(3)	(4)	(5)
	VARIABLES	N	mean	sd	min	max
1	S_BASEFF	54,451	50.20	9.932	9.470	58.86
2	S_ADVEFF	54,464	49.81	10.14	21.38	71.74
3	IS1G02	54,852	1.507	0.500	1	2
4	IS1G03	54,672	1.838	1.043	1	5
5	IS1G13A	54,848	1.174	1.152	0	9
6	IS1G13B	54,848	2.276	2.115	0	9
7	S_TSKLRN	54,456	50.41	9.863	24.08	60.14
8	S_USEAPP	54,698	50.10	9.917	22.82	95.64
9	S_USELRN	54,080	50.86	9.937	35.53	76.62
10	S_USEREC	54,519	49.90	9.941	20.88	80.21
11	S_USESTD	54,508	50.56	9.833	23.92	83.46
12	S_USECOM	54,589	49.97	9.942	27.04	75.27
13	S_INTRST	54,437	49.85	10.04	10.40	68.79
14	S_USEINF	54,511	49.60	10.03	36.79	88.39
15	S_NISB	49,409	0.0328	1.021	-3.750	3.070
16	T_USELRN	51,331	50.21	4.786	35.59	77.52
17	T_USEAPP	51,331	50.19	4.667	34.95	69.47
18	T_USETCH	51,331	50.19	4.794	35.60	75.80
19	T_EFF	51,331	50.71	4.421	18.56	64.19
20	T_EMPH	51,331	49.96	4.536	35.45	70.42
21	T_VWPOS	51,331	49.63	4.967	31.39	76.88
22	T_VWNEG	51,331	48.99	4.881	10.56	70.72
23	T_RESRC	51,331	50.04	6.273	24.95	77.03
24	T_COLICT	51,331	48.64	5.712	19.88	75.62
Y1	PV1CIL	55,129	508.7	96.23	7.060	805.4
Y2	PV2CIL	55,129	508.7	96.02	21.32	777.4
Y3	PV3CIL	55,129	508.5	95.85	4.270	796.3
Y4	PV4CIL	55,129	508.7	95.88	21.63	802.6
Y5	PV5CIL	55,129	508.7	96.11	9.760	785.8

- # Analysis Model

- Level-1 model (Student level):
- $Y_{ij} = \beta_{0j} + \sum_{q=1}^{15} \beta_{qj}(X_q)_{ij} + e_{ij}, \qquad e_{ij} \sim N(0, \sigma^2)$

- Level-2 model (School-level):
- $\beta_{0j} = \gamma_{00} + \sum_{s=1}^{9} \gamma_{0s}(W_s) + u_{0j}, \qquad u_{0j} \sim N(0, \sigma^2)$

- $\beta_{1j} = \gamma_{10} \ldots \beta_{qj} = \gamma_{q0}.$

- “Within this analysis, weighting variables are included to account for the complex structure of the ICILS 2013 data: As teacher data is aggregated to the school level, providing information about the teaching staff in a participating school, and is defined as characteristic of the respective school, the weighting variable at the school level is conducted by combining the school base weight with the school nonparticipation adjustment for the teacher survey (WGTFAC1 × WGTADJ1T, Meinck and Cortes 2015). The full information maximum likelihood method (FIML) was likewise applied (e.g. Enders 2006). Thus, missing values were not imputed, while population parameters and standard errors were estimated based on the data available (e.g. Enders 2006). Additionally, a robust maximum likelihood estimator (MLR) was used to account for the complex data structure (Muthén 2004).” (Gerick, Eickelmann, and Bos, 2017).

Results

VARIABLES	(1) Australia
S_BASEFF	1.999***
	(0.000)
S_ADVEFF	-0.570***
	(0.000)
2.IS1G02	-17.419***
	(0.000)
2.IS1G03	-21.657***
	(0.000)
3.IS1G03	-27.760***
	(0.000)
4.IS1G03	-54.173***
	(0.000)
5.IS1G03	-46.139***
	(0.000)
IS1G13A	-1.959**
	(0.021)
IS1G13B	0.870*
	(0.096)
S_TSKLRN	0.399**
	(0.031)
S_USEAPP	-0.209
	(0.149)
S_USELRN	-0.034
	(0.880)
S_USEREC	-0.111
	(0.457)
S_USESTD	0.107
	(0.432)
S_USECOM	0.097
	(0.528)
S_INTRST	0.694***
	(0.000)
S_USEINF	-0.548***
	(0.000)
S_NISB	10.884***

With regard to student context variables, student's ICT self-efficacy basic skills increase the CIL score by 1.999 points whereas student's ICT self-efficacy advanced skills lower the CIL score by 0.570 point. The CIL literacy test score of boy students was 17.419 points lower than that of girl students. As student's expected education level drops from ISCED Level 5A or 6 (which is the base level) to ISCED Level 4 or 5B, ISCED Level 3, ISCED Level 2, and I do not expect to complete [ISCED Level 2], the CIL score drops by 21.657, 27.760, 54.173, and 46.139 points, respectively. Each additional more desktop computer at home lowers the CIL score by 1.959 points whereas each additional more portable computer at home increases the CIL score by 0.870 points. As the scale index for learning ICT tasks at school increases by 1 unit, the CIL score increases by 0.399 point. As the scale index for interest and enjoyment in using ICT increases by 1 unit, the CIL score increases by 0.694 points. As the scale index for use of ICT for exchanging information increases by 1 unit, the CIL score decreases by 0.548 points. Finally, as the national index of students' socioeconomic background increases by 1 unit, the CIL score increases by 10.884 points.

T_USELRN	0.894
	(0.307)
T_USEAPP	-3.504**
	(0.048)
T_USETCH	3.862*
	(0.064)
T_EFF	-0.377
	(0.398)
T_EMPH	-1.897
	(0.213)
T_VWPOS	0.177
	(0.848)
T_VWNEG	-1.198*
	(0.080)
T_RESRC	-1.233***
	(0.001)
T_COLICT	-0.114
	(0.823)
Constant	645.002***
	(0.000)
Observations	4,699
Number of groups	287

With regard to teacher context variables at the school level, the use of specific ICT applications can lower the CIL test score by 3.504 points whereas the use of ICT for teaching at school increases the CIL score by 3.862 points. A more negative views on using ICT in teaching and learning can lower the CIL score by 1.198 points. A more pessimistic perspective on the lack of computer resources at school can lower the CIL score by 1.233 points.

Table 4 standardized beta coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
	Australia	Chile	Newfoundland and Labrador, Canada	Ontario, Canada	Czech Republic	Germany	Denmark	Hong Kong, SAR	Croatia	Korea, Republic	Lithuania	Netherlands	Norway	Poland	Russian Federation	Slovak Republic	Slovenia	Thailand	Turkey
	AUS	CHL	CNL	COT	CZE	DEU	DNK	HKG	HRV	KOR	LTU	NLD	NOR	POL	RUS	SVK	SVN	THA	TUR
S_BASEFF	0.231***	0.257***	0.263***	0.280***	0.181***	0.126***	0.230***	0.211***	0.211***	0.391***	0.281***	0.149***	0.271***	0.228***	0.250***	0.238***	0.265***	0.178***	0.195***
	(11.03)	(12.57)	(7.88)	(8.32)	(8.94)	(3.83)	(6.44)	(6.27)	(9.78)	(15.60)	(12.82)	(6.97)	(9.82)	(9.90)	(12.12)	(11.84)	(11.68)	(7.19)	(9.62)
S_ADVEFF	-0.074***	-0.087***	-0.199***	-0.052	-0.016	-0.017	-0.165***	-0.080*	-0.018	-0.134***	-0.098***	-0.072**	-0.139***	-0.066**	-0.096***	-0.086***	-0.160***	-0.151***	-0.093***
	(-3.85)	(-4.30)	(-4.35)	(-1.83)	(-0.74)	(-0.57)	(-4.97)	(-2.56)	(-0.84)	(-5.75)	(-3.93)	(-2.67)	(-3.91)	(-2.60)	(-4.44)	(-4.17)	(-6.19)	(-7.20)	(-3.82)
1.IS1G02	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
2.IS1G02	-0.121***	-0.037	-0.189***	-0.155***	-0.035	-0.107***	-0.046	-0.017	-0.001	-0.110***	0.001	-0.131***	-0.126***	-0.022	0.011	0.005	-0.108***	-0.028	0.013
	(-8.01)	(-1.84)	(-5.78)	(-6.47)	(-1.72)	(-4.63)	(-1.89)	(-0.67)	(-0.05)	(-5.44)	(0.05)	(-5.44)	(-5.65)	(-1.04)	(0.68)	(0.25)	(-5.82)	(-1.47)	(0.88)

Table 5 Rank on the absolute value of Beta coefficients

Rank	VAR	AVE	**Absolute**	MIN	Country	MAX	Country
1	S_BASEFF	0.23	0.23	0.13	Germany	0.39	Korea, Republic
2	3.IS1G03	-0.15	0.15	-0.33	Croatia	-0.03	Newfoundland and Labrador, Cananad
3	4.IS1G03	-0.11	0.11	-0.23	Netherlands	-0.03	Newfoundland and Labrador, Cananad
4	S_NISB	0.11	0.11	-0.04	Hong Kong, SAR	0.18	Denmark
5	S_ADVEFF	-0.09	0.09	-0.20	Newfoundland and Labrador, Canada	-0.02	Czech Republic, Germany, Croatia
6	T_USELRN	0.09	0.09	-0.20	Lithuania	0.59	Germany
7	2.IS1G03	-0.08	0.08	-0.16	Lithuania	-0.01	Slovak Republic
8	T_RESRC	-0.07	0.07	-0.18	Turkey	0.02	Ontario, Canada
9	2.IS1G02	-0.06	0.06	-0.19	Newfoundland and Labrador, Canada	0.01	Russian Federation, Slovak Republic, Turkey
10	T_EMPH	-0.06	0.06	-0.40	Turkey	0.41	Thailand
11	S_USEINF	-0.06	0.06	-0.15	Turkey	0.01	Newfoundland and Labrador, Cananad; Hong Kong, SAR;
12	5.IS1G03	-0.05	0.05	-0.10	Netherlands	0.00	Hong Kong, SAR
13	T_VWPOS	-0.05	0.05	-0.28	Netherlands	0.03	Thailand
14	S_USESTD	-0.04	0.04	-0.16	Newfoundland and Labrador, Canada	0.01	Australia
15	S_INTRST	0.04	0.04	-0.03	Czech Republic	0.11	Netherlands
16	S_USECOM	0.03	0.03	-0.06	Denmark	0.15	Turkey
17	T_USETCH	-0.03	0.03	-0.29	Netherlands	0.15	Australia
18	IS1G13B	0.03	0.03	-0.02	Germany	0.10	Thailand
19	S_USEREC	0.03	0.03	-0.02	Australia	0.10	Newfoundland and Labrador, Canada; Poland
20	S_USEAPP	0.02	0.02	-0.04	Denmark	0.10	Korea, Republic
21	S_USELRN	-0.02	0.02	-0.09	Chile	0.10	Denmark
22	IS1G13A	-0.02	0.02	-0.08	Netherlands	0.06	Thailand
23	S_TSKLRN	0.01	0.01	-0.06	Germany	0.07	Ontario, Canada
24	T_COLICT	0.01	0.01	-0.13	Lithuania	0.17	Russian Federation
25	T_VWNEG	-0.01	0.01	-0.19	Netherlands	0.35	Germany
26	T_USEAPP	0.01	0.01	-0.49	Germany	0.30	Russian Federation
27	T_EFF	0.00	0.00	-0.14	Netherlands	0.10	Chile

Implications and Conclusions

- Students' ICT self-efficacy in basic skills has a very large and significant positive effect on students' CIL test scores.
- National Index of Students Socioeconomic Background also has very large and significant positive impact on students' CIL test scores except for Hong Kong, SAR, China, where it has a slightly significant negative impact on students' CIL test scores, and Thailand, where it has an insignificant coefficient, while Netherlands is excluded due to the lack of data on this variable.
- Another important finding is that in most countries there is a gender gap in which male students usually have a statistically and significantly lower CIL test scores than female students.

- Our results agree with many other researches using ICILS 2013. Students' socioeconomic backgrounds are important for understanding variations in students' CIL, and in some countries, their ICT self-efficacy. This means that family background may explain digital inequity and the digital divide. To prevent and dismiss the digital divide, schools should take action to help students develop ICT literacy.
- Girls obtain higher CIL scores than boys, and in many countries, they report higher ICT self-efficacy. This result may indicate a change in previous gender stereotypes. Despite profound results, the present study does not provide any information about why these changes occurred. Therefore, it would be interesting to scrutinize the gender differences in CIL to gain more knowledge about what implications gender may have for instruction in schools.

- A positive relationship between ICT self-efficacy in basic skills and CIL was found, however there was also a negative relationship between ICT self-efficacy in advanced skills and CIL, though this varies from low in some countries to moderate in others. We do not know if increased ICT self-efficacy will increase CIL in general, and it is still uncertain if more emphasis in schools on the development of students' ICT will strengthen and increase their CIL. This requires longitudinal studies scrutinizing the relationship between ICT self-efficacy and CIL.

Future improvement

- This study opens several opportunities for future research based on the limitations and results found through our analyses. The model is partly supported in 19 countries. However, in the future we could also explore the insight into the national school system in these countries.