Developing a digital literacy scale & measuring digital divide using PIAAC data

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Objectives

Work in progress

(1) Create a construct measuring digital literacy

- Validate the digital literacy scales for adult population
    - Confirmatory factor analysis (CFA)
    - Measurement invariance testing *<work in progress>*
    - Validation with PIAAC assessment- problem solving in technology rich environment (PSTRE)

(2) Identify the left-behind

- The extent of adults having low or high digital literacy skills use
- What characteristics are associated with low digital literacy?
- Do they vary across countries?

(3) Policy recommendations

- What have countries done to improve digital literacy?

Overview

1	Digital literacy
2	Methods
3	Results
4	Policies

Digital literacy

Why is it important?

- Inevitable that technology and the internet would change one's life (Paul Glister, 1997)
- The lack of digital skills has effectively become a barrier to social integration and personal development (European Commission, 2008)
- The importance of digital skills and the lack of it have generated a great deal of interest
  - Previous researches and definition used may not have kept up with time

Meaning…

"The ability to understand and to evaluate and integrate information in multiple format that the computer can deliver."

-Paul Glister, 1997

- U.K Skills for Life survey (2003) defines digital literacy as possessing basic skills required to perform basic operations like saving data and the use of word processor, spreadsheets and search engines

- Catts and Lau (2008), in a paper for UNESCO, refer digital literacy to the use of information technologies to locate and collect information, evaluate, analyze and create information and communication of ideas

- Spires and Barlett (2012) grouped digital literacy into 1) Finding and consuming digital content 2) Creating digital content 3) communicating or sharing digital content

- PIAAC PS-TRE is defined as of acquiring and evaluating information, communicating and performing tasks in the digital environment.

Overview

1   Digital literacy

2   Methods

3   Results

4   Policies

The digital literacy skills use construct

Construct

Parallel sets of survey questions on frequency of use of ICT at work and everyday life

Digital literacy

Locating digital content
- Use the internet
- Conduct transaction on internet
- Use calculator

Creating digital content
- Use word processor
- Use spreadsheet

Communicating digital content
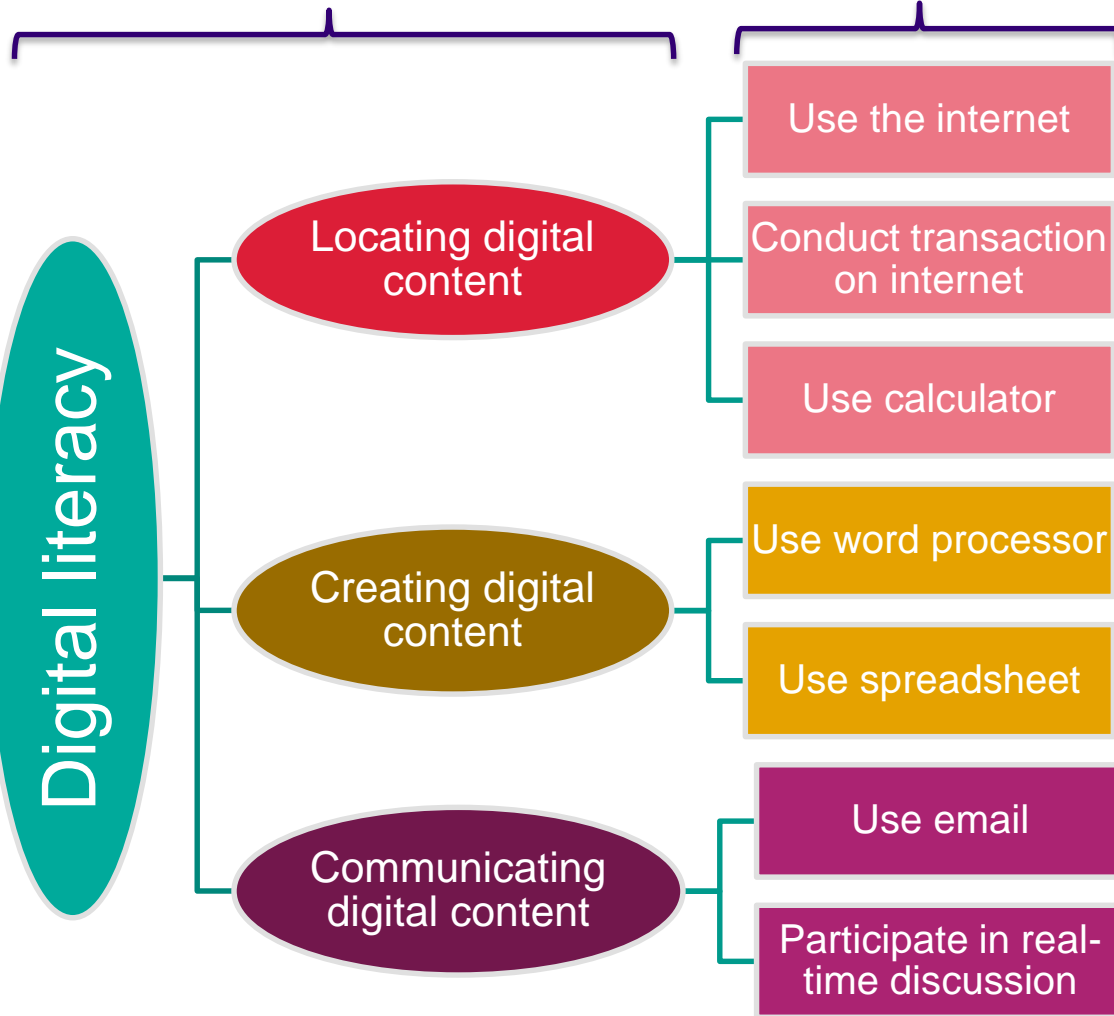- Use email
- Participate in real-time discussion

Five point Likert scale
1. Never*
2. Less than once a month
3. Less than once a week and at least once a month
4. At least once a week but not every day
5. Every day

Confirmatory factor analysis & measurement invariance testing

E.g., Singapore and Canada
- **RMSEA suggests scalar invariance**
- **CFI suggests metric invariance**

Model	RMSEA	CFI	SRMR	TLI
Configural	0.034	0.988	0.020	0.965
Metric	0.034	0.985	0.029	0.963
Scalar	0.047	0.967	0.042	0.931

*Recoded as never: respondents who have never used the computer were routed away from the questions.

Overview

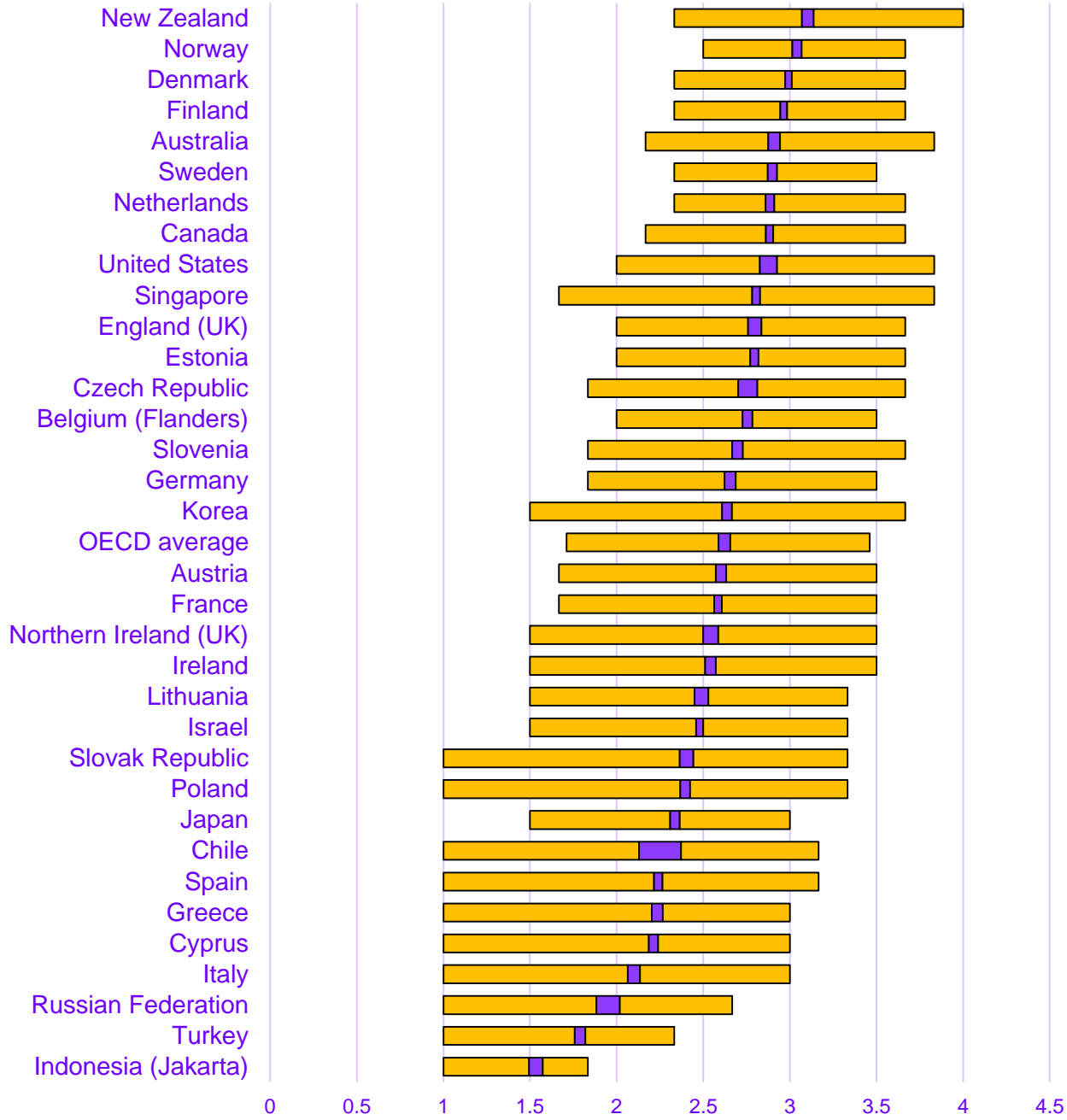|	
1	Digital literacy
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Locating digital content- internet searches, conduct online transaction

Over 25% of the population in a number of countries have never use technology for locating digital content

Chart categories (top to bottom): New Zealand, Norway, Denmark, Finland, Australia, Sweden, Netherlands, Canada, United States, Singapore, England (UK), Estonia, Czech Republic, Belgium (Flanders), Slovenia, Germany, Korea, OECD average, Austria, France, Northern Ireland (UK), Ireland, Lithuania, Israel, Slovak Republic, Poland, Japan, Chile, Spain, Greece, Cyprus, Italy, Russian Federation, Turkey, Indonesia (Jakarta)

Legend: 25th percentile — Mean and 95% confidence interval for mean — 75th percentile

X-axis: 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5

Creating digital content- use of spreadsheet and word processor

A significantly lesser use of technology in creating content for most countries
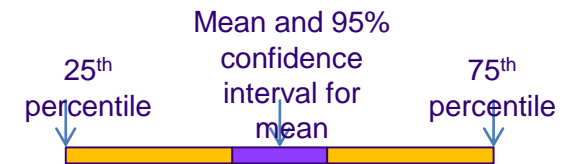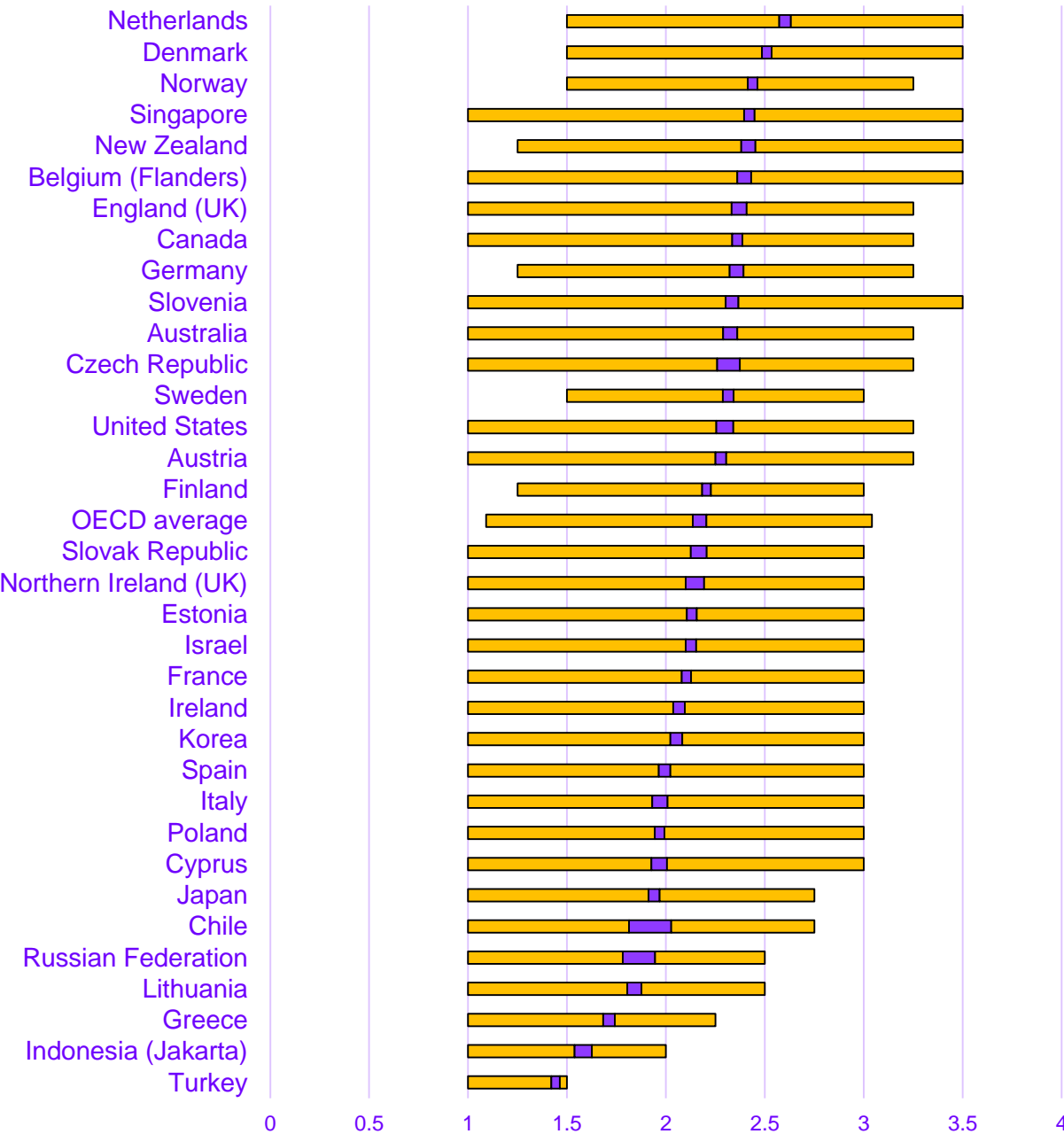
Communicating digital content- email, real-time discussion

Higher usage of technology for communication than creating digital data

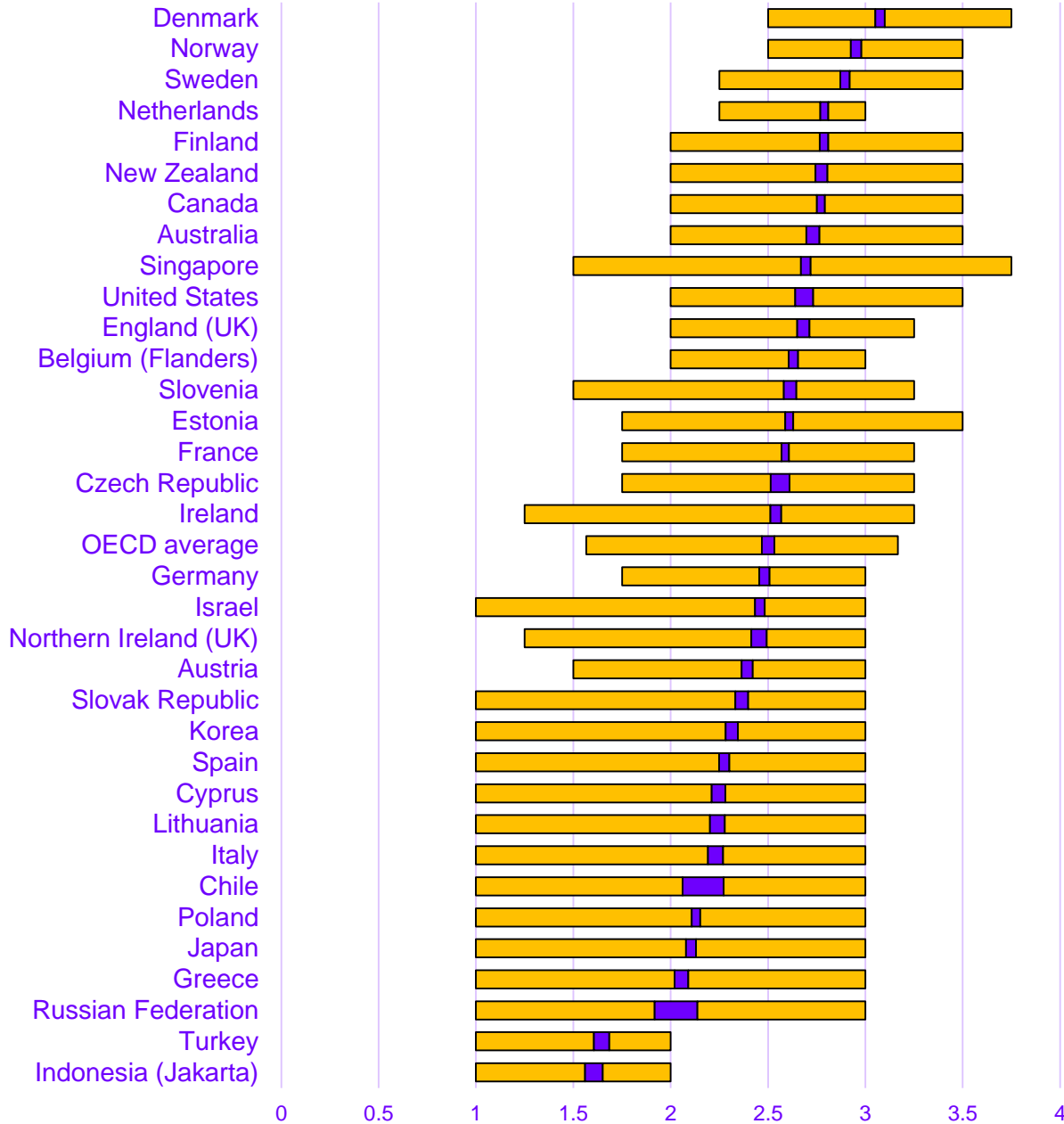Denmark, Norway, Sweden, Netherlands, Finland, New Zealand, Canada, Australia, Singapore, United States, England (UK), Belgium (Flanders), Slovenia, Estonia, France, Czech Republic, Ireland, OECD average, Germany, Israel, Northern Ireland (UK), Austria, Slovak Republic, Korea, Spain, Cyprus, Lithuania, Italy, Chile, Poland, Japan, Greece, Russian Federation, Turkey, Indonesia (Jakarta)

0   0.5   1   1.5   2   2.5   3   3.5   4

25th percentile   Mean and 95% confidence interval for mean   75th percentile

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High digital literacy is associated with high level of internet access*

Overall means

Country	Overall mean	Loc	Creat	Comm
Denmark	2.88	3	2	1
Norway	2.84	2	3	2
New Zealand	2.81	1	5	6
Netherlands	2.78	7	1	4
Sweden	2.73	6	13	3
Canada	2.70	8	8	7
Finland	2.70	4	16	5
Australia	2.69	5	11	8
Singapore	2.66	10	4	9
United States	2.66	9	14	10
England (UK)	2.64	11	7	11
Belgium (Flanders)	2.62	14	6	12
Czech Republic	2.58	13	12	16
Slovenia	2.57	15	10	13
Estonia	2.55	12	19	14
Germany	2.52	16	9	18
OECD Average	2.47	-	-	-
Austria	2.45	18	15	21
France	2.45	19	21	15
Ireland	2.41	21	22	17
Northern Ireland (UK)	2.40	20	18	20
Korea	2.38	17	23	23
Israel	2.37	23	20	19
Slovak Republic	2.32	24	17	22
Lithuania	2.23	22	31	26
Poland	2.20	25	26	29
Spain	2.18	28	24	24
Japan	2.16	26	28	30
Cyprus	2.15	30	27	25
Chile	2.13	27	29	28
Italy	2.10	31	25	27
Greece	2.03	29	32	31
Russian Federation	1.95	32	30	32
Turkey	1.65	33	34	33
Indonesia (Jakarta)	1.57	34	33	34

Ranking: Loc, Creat, Comm

Internet penetration rate: Above 85%
Internet penetration rate: 72%- 86%
Internet penetration rate: below 72%

Axis: 4.00 3.00 2.00 1.00 0.00

*source: Data on 2014 internet penetration rate extracted from www.internetlivestats.com.
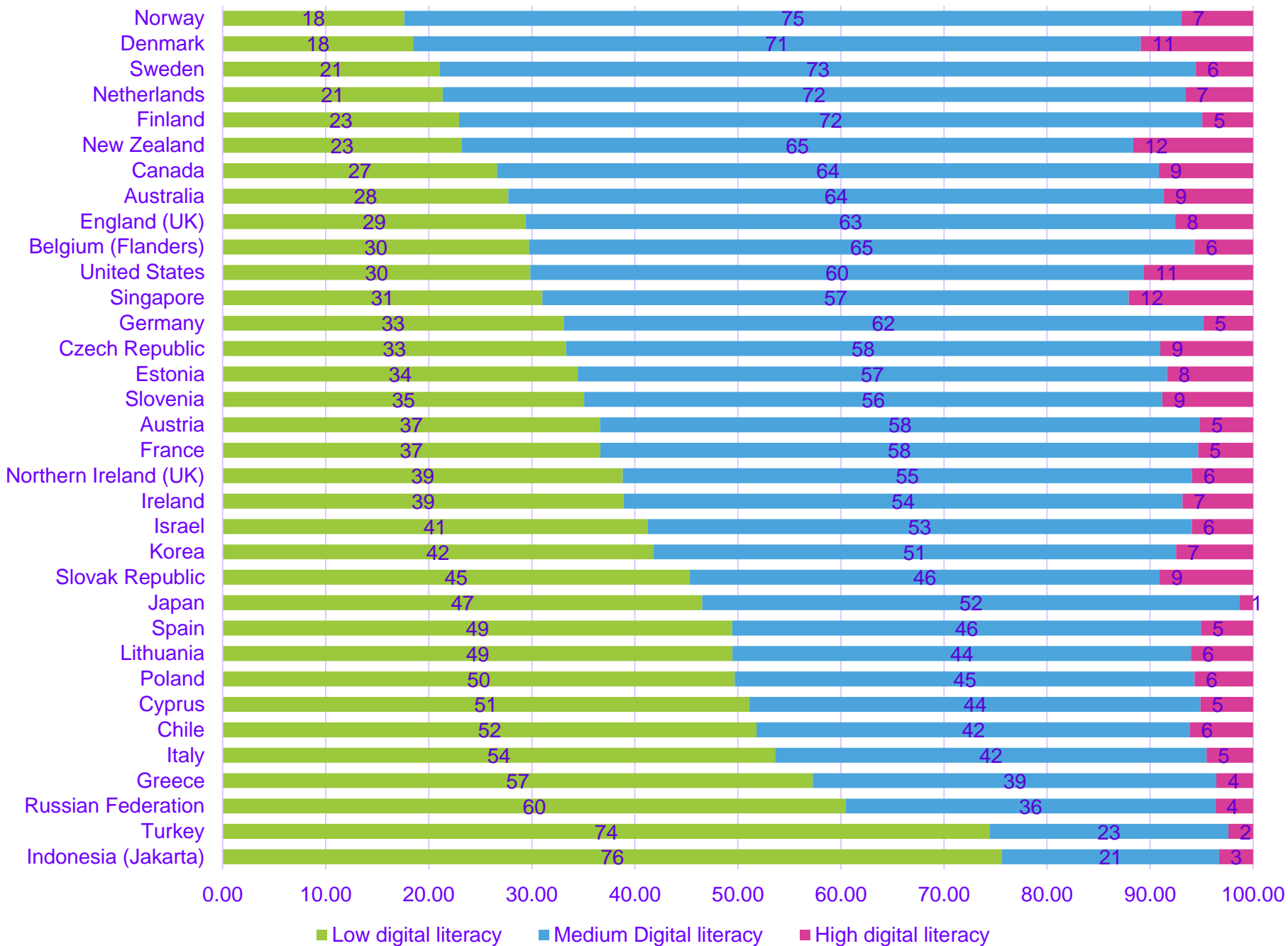
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Overall, digital literacy score is correlated with problem solving in technology rich environment (PS-TRE) assessment score

r= 0.68
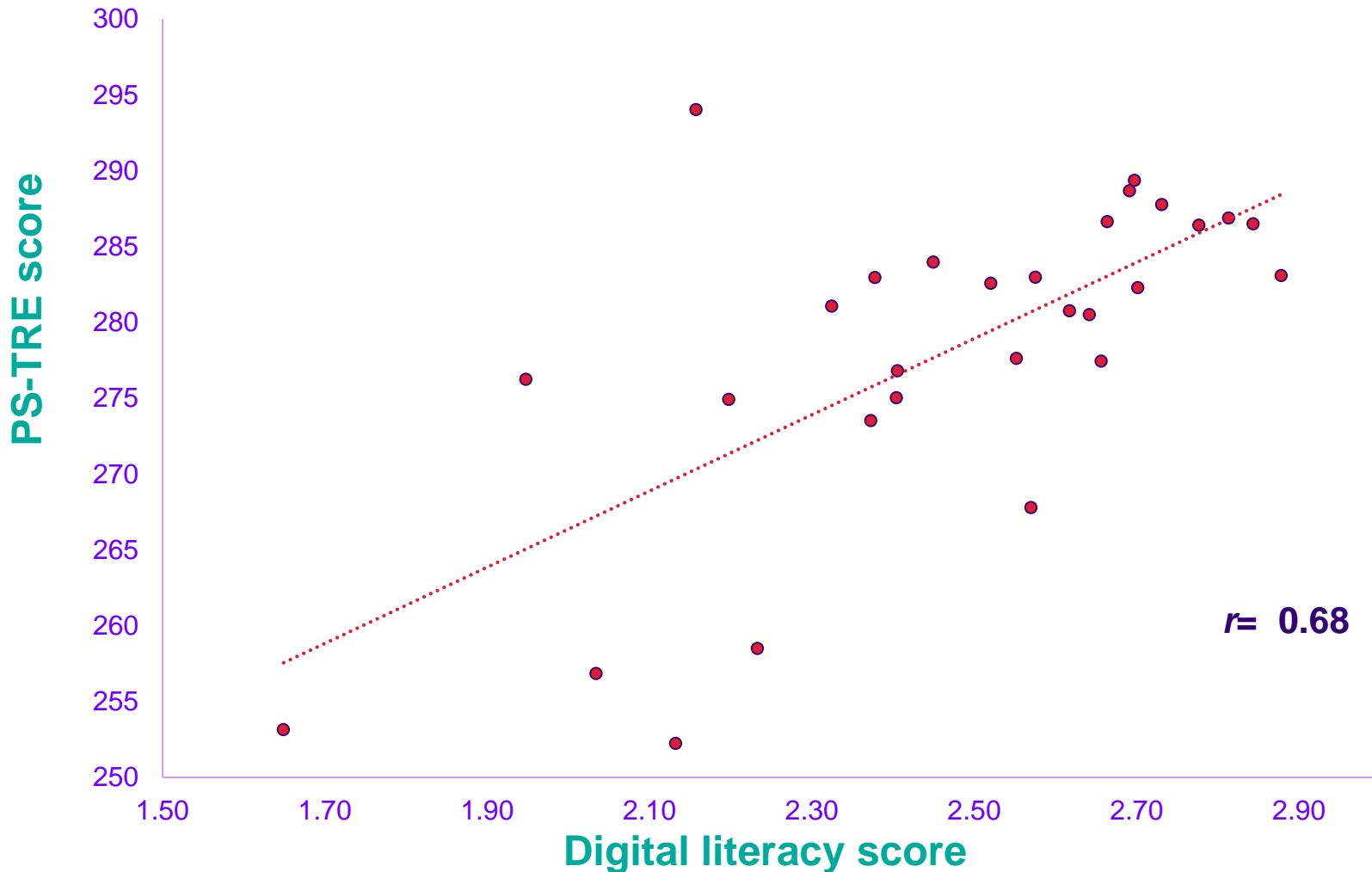
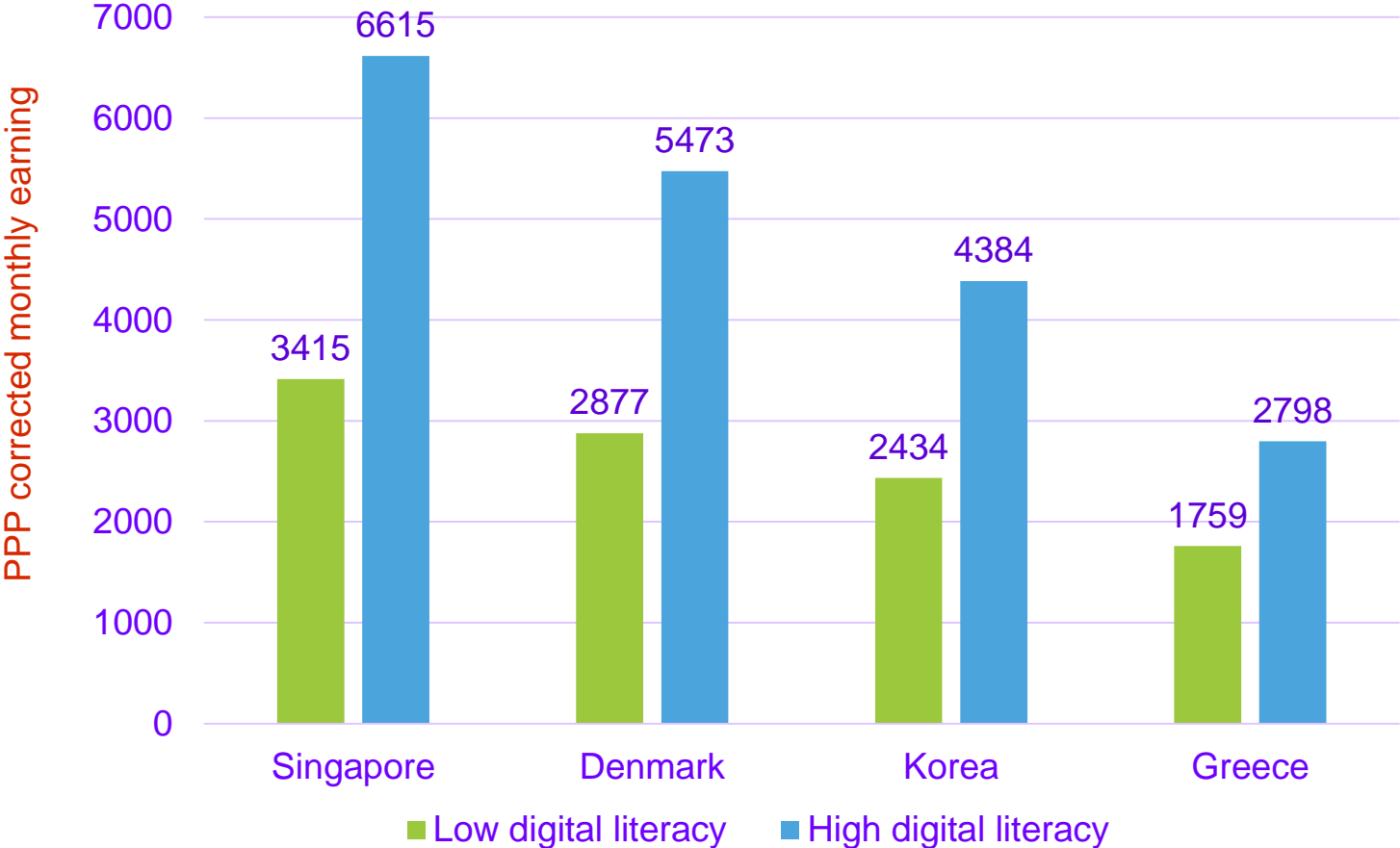# Proportion of adults in high and low digital literacy level

Countries comparison

- Adults with a mean of "2" and below are identified as having low digital literacy

- Adults with a mean of "4" and above are identified as having high literacy

- Those with a mean between "2" and "4" are identified as having medium digital literacy

Country	Low digital literacy	Medium Digital literacy	High digital literacy
Norway	18	75	7
Denmark	18	71	11
Sweden	21	73	6
Netherlands	21	72	7
Finland	23	72	5
New Zealand	23	65	12
Canada	27	64	9
Australia	28	64	9
England (UK)	29	63	8
Belgium (Flanders)	30	65	6
United States	30	60	11
Singapore	31	57	12
Germany	33	62	5
Czech Republic	33	58	9
Estonia	34	57	8
Slovenia	35	56	9
Austria	37	58	5
France	37	58	5
Northern Ireland (UK)	39	55	6
Ireland	39	54	7
Israel	41	53	6
Korea	42	51	7
Slovak Republic	45	46	9
Japan	47	52	1
Spain	49	46	5
Lithuania	49	44	6
Poland	50	45	6
Cyprus	51	44	5
Chile	52	42	6
Italy	54	42	5
Greece	57	39	4
Russian Federation	60	36	4
Turkey	74	23	2
Indonesia (Jakarta)	76	21	3

Evidence showing adults with low digital literacy earning lesser than their counterparts with high digital literacy

PPP corrected monthly earning including bonuses comparison of high and low digital literacy of adults with tertiary education

Chart: PPP corrected monthly earning

Country	Low digital literacy	High digital literacy
Singapore	3415	6615
Denmark	2877	5473
Korea	2434	4384
Greece	1759	2798

Logistic regression- age and individual's educational level have significant impacts on level of digital literacy

Explanatory variables include age and educational qualifications controlled for gender, parents' educational qualifications and language spoken, industry and occupation.

	Singapore	Denmark	Korea	Greece
Gender				
Female	-0.41**	-0.48**	0.21*	0.16
Age (reference: 24 or less)				
25- 34	-0.05	0.47*	0.38*	0.18
35- 44	0.40*	0.83**	0.79**	0.38
45-54	1.08**	1.08**	1.64**	0.63**
Above 55	1.57**	1.47**	2.16**	0.93**
Education (reference: below upper secondary)				
Upper Secondary	-1.72**	-0.97**	-1.57**	-1.28**
Tertiary	-3.10**	-1.82**	-2.99**	-2.27**

*p< 0.05, **p<0.01

Logistic regression- continued

	Singapore	Denmark	Korea	Greece
Parents' Education (reference: Neither parent has attained upper secondary)				
At least one parent has attained secondary and post-secondary, non-tertiary	-0.44**	-0.25**	-0.38**	-0.30*
At least one parent has attained tertiary	-0.70**	-0.68**	-0.65**	-0.93**
Born language(reference: Native-born and native language				
Native-born and foreign language	-0.00	-0.29	-0.42	-0.11
foreign-born and native language	-0.02	0.50	1.09**	0.16
Foreign-born and foreign language	0.61**	0.57**	2.51**	0.70*
Intercept	-0.57	-2.17**	-0.20	0.91**
Pseudo-r^2	0.45	0.23	0.36	0.29

Association between years of education, age and digital literacy

Singapore

Probability of low digital literacy (y-axis)

Years of education (x-axis): 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Legend: 16-25, 26-35, 36-45, 46-55, 55-65

Denmark

Years of education (x-axis): 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Legend: 16-25, 26-35, 36-45, 46-55, 55-65

Greece

Years of education (x-axis): 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Legend: 16-25, 26-35, 36-45, 46-55, 55-65

Korea

Years of education (x-axis): 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Legend: 16-25, 26-35, 36-45, 46-55, 55-65
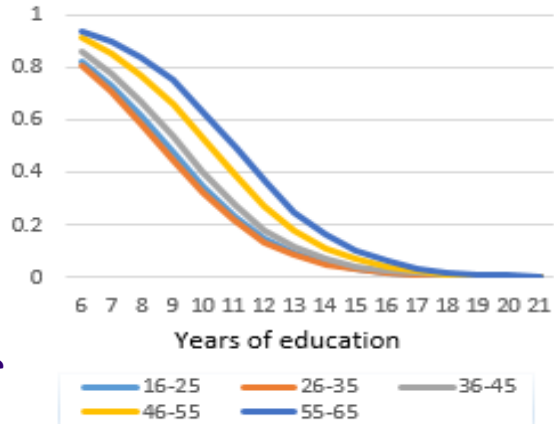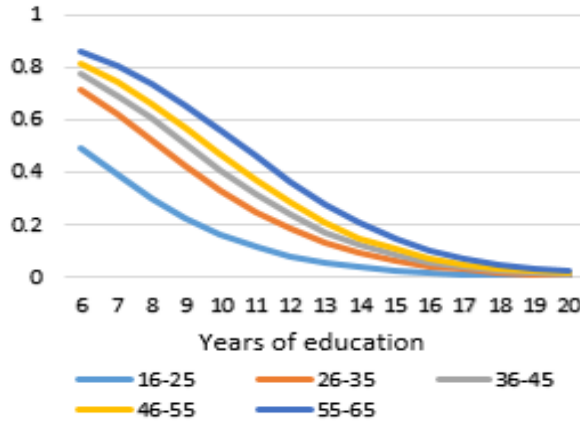
Lower years of education is associated with low level of digital literacy

Greece and Korea have relatively higher probability of having low digital literacy for older adults who had undertaken more years of education
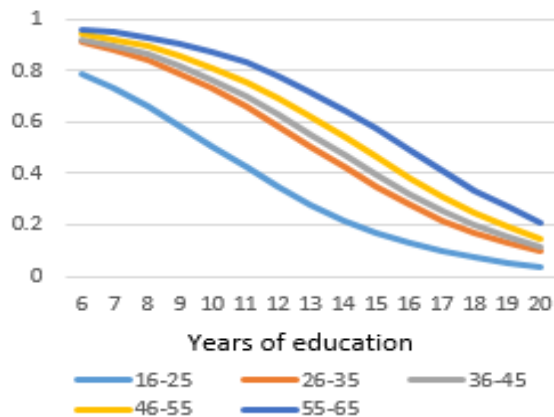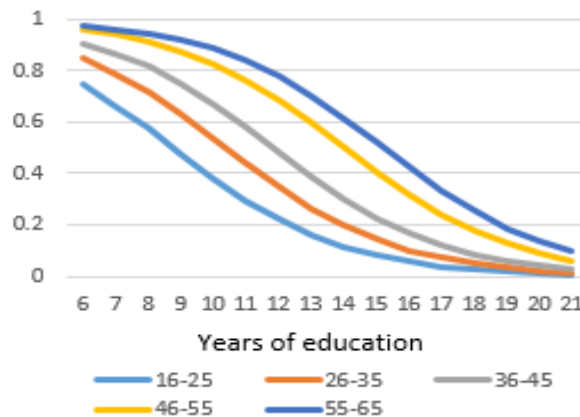
16- 25 years old in Denmark who had six years of education have a lower probability of having low digital literacy

In Singapore, the probability of having low digital literacy is rather similar for adults 45 years old and below

Selected countries comparison- controlled for gender, parents' educational qualifications and language spoken.

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Policies should focus on public and private sectors as well as ICT infrastructure

Singapore

Public sector and private firms

- Efforts to computerize public agencies and encouraged usage of computers in businesses to improve efficiency in the 1980s

General public

- Promote interactive distance learning- participation of lectures delivered by schools outside of Singapore
- Internet is made readily available to the general public

Denmark

Public sector and private firms

- One of the first countries to digitalize its public services
- worked closely with its stakeholder in the private sector to conceptualize ideas

General public

- access to high speed broadband internet for all citizen by 2020

Implementation of ICT in schools may have impacted the digital literacy of the younger generation

Singapore

Schools

- Equipped students with computer knowledge through new subject and extra-curricular activities

- Schools were equipped with basic ICT infrastructure

- Teachers were trained and made use of technology to delivery lessons

- Baseline ICT standards for students were established

Denmark

Schools

- Students have access to the internet

- Teachers' ICT development and compulsory for the use of ICT in all curricula

- Blended learning are introduced

- Digital format homework

- Use of ICT are allowed in examination

Promote awareness among the elderly

Singapore

Specific group- Senior citizens

- Initiative to promote infocomm awareness among the elderly
- Customized hands-on training programmes in various languages
- Senior citizen ambassadors who have an active IT lifestyle to encourage their peers
- 160,000 seniors have benefited through the ICT courses and activities organized

Denmark

Specific group- Senior citizens

- Campaigns to raise awareness on the benefits of ICT- informal IT tuitions for seniors run by ICT centers and libraries
- Involvement of NGOs, local communities and local businesses together with the government to train seniors on e-services like online banking, e-ticketing etc.

Overview

Limitations

- Score of adults who are not working would be solely based on frequency of ICT use in their everyday life

- Cut- off values for adults with high and low digital literacy

- Scales did not cover awareness of cyber-security

Overview

Conclusion

- Elderly with lesser years of education are more likely to have lower level of digital literacy

- Policies and initiatives implemented by countries have impacted their populations' digital literacy level

- Further validation and improvement is needed for the proposed digital literacy scale

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Thank You