Learning and Assessment for DIGITAL CITIZENSHIP

Faculty of Education The University of Hong Kong

Digital Citizenship Plus Seminar Series #6

Digital Literacy — Conceptualization, Measurement and Policy Implications

SPEAKERS:

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27 January 2022 (Thu)
DATE

4:00pm - 6:00pm (HKT)
9:00am - 11:00am (CET)
TIME

Online via Zoom

DISCUSSANT:

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UNESCO

Rundown

Talk 1:	HK students' digital literacy development from primary to secondary before and after the onset of the pandemic
Talk 2:	Defining and measuring digital competence in a rapidly changing world: Perspectives from the DigComp framework
Talk 3:	Defining and measuring digital competence in a rapidly changing world: Monitoring the global education goal to invite policy responses
Discussant	

Learning and Assessment for Digital Citizenship

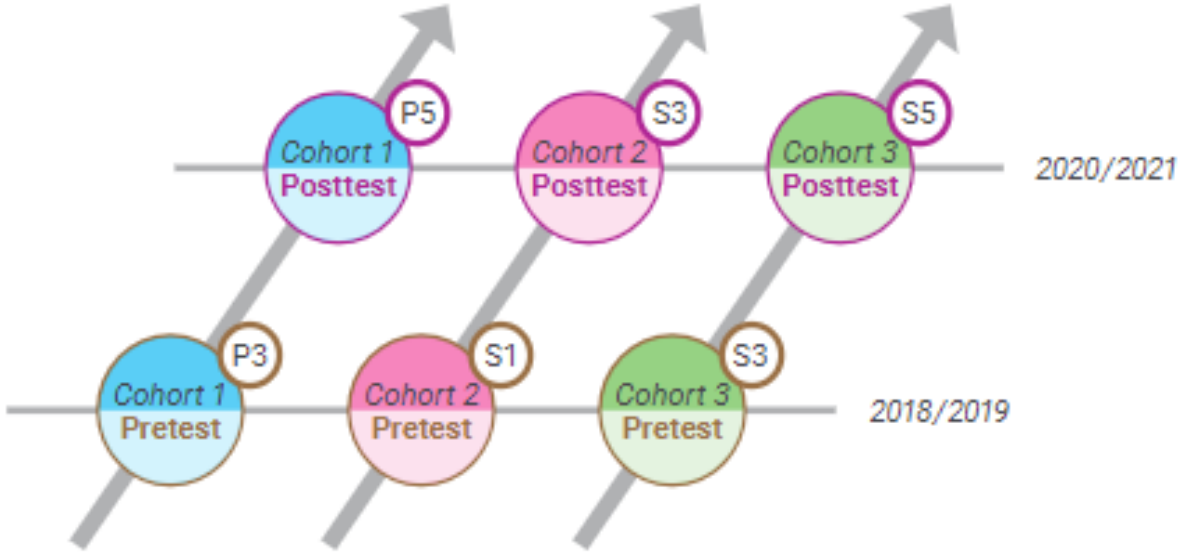
HK students' digital literacy development from primary to secondary before and after the onset of the pandemic

Research Questions

- What is the **normative developmental trajectory** from childhood to early adulthood in key aspects important for digital citizenship?
- How do **personal, family and school factors** contribute to the development of digital citizenship?

Study design

- A longitudinal cross-cohort panel study design is adopted to examine performance differences among students in three different age cohorts in Hong Kong.
- Wave-1(Pretest): 2018/19 school year
- Wave-2(Posttest): 2020/21 school year



	Wave 1 (2018-19)		Wave 2 (2020-21)	
Cohort	grade level	age	grade level	age
1	P3	8 - 9	P5	10 - 11
2	S1	12 -13	S3	14 - 15
3	S3	14 -15	S5	16 - 17

Digital Literacy Assessment (DLA) framework (from DigComp 2.0)

Competence Areas (dimension 1)	Competences (dimension 2)
1. Information and data literacy	1.1 Browsing, searching, filtering data, information and digital content
	1.2 Evaluating data, information and digital content
	1.3 Managing data, information and digital content
2. Communication and collaboration	2.1 Interacting through digital technologies
	2.2 Sharing through digital technologies
	2.3 Engaging in citizenship through digital technologies
	2.4 Collaborating through digital technologies
	2.5 Netiquette
	2.6 Managing digital identity
3. Digital content creation	3.1 Developing digital content
	3.2 Integrating and re-elaborating digital content
	3.3 Copyright and licenses
	3.4 Programming
4. Safety	4.1 Protecting devices
	4.2 Protecting personal data and privacy
	4.3 Protecting health and well-being
	4.4 Protecting the environment
5. Problem solving	5.1 Solving technical problems
	5.2 Identifying needs and technological responses
	5.3 Creatively using digital technologies
	5.4 Identifying digital competence gaps

Wave-1 DLA test design

Competence Areas	Competences	Wave-1
(dimension 1)	(dimension 2)	
1. Information and data literacy	1.1 Browsing, searching, filtering data, information and digital content	5
	1.2 Evaluating data, information and digital content	4
	1.3 Managing data, information and digital content	6
2. Communication and collaboration	2.1 Interacting through digital technologies	5
	2.2 Sharing through digital technologies	8
	2.3 Engaging in citizenship through digital technologies	3
	2.4 Collaborating through digital technologies	0
	2.5 Netiquette	4
	2.6 Managing digital identity	2
3. Digital content creation	3.1 Developing digital content	4
	3.2 Integrating and re-elaborating digital content	0
	3.3 Copyright and licenses	3
	3.4 Programming	0
4. Safety	4.1 Protecting devices	8
	4.2 Protecting personal data and privacy	11
	4.3 Protecting health and well-being	5
	4.4 Protecting the environment	1
5. Problem solving	5.1 Solving technical problems	11
	5.2 Identifying needs and technological responses	0
	5.3 Creatively using digital technologies	0
	5.4 Identifying digital competence gaps	1

Wave-2 DLA Development

GOALS:

- Test coverage extension
  - Content coverage extension
  - Difficulty coverage extension

- New items were developed to fill in the gap between the Wave-1 DLA test design and the assessment framework.
- Increase item difficulties to adjust for greater cognitive maturity of the students

PROCEDURES:

- Cognitive interview
  - New grade level students: Primary 5 & Secondary 5 students
  - To understand students' cognitive process in some specific sub-domains (e.g., programming)
  - To update item design (e.g., replacing outdated items with currently popular Apps in the item)
- Pilot study (Jan 2021)
  - To test newly developed and revised items
  - To trial fully online testing environment (to cater to school scheduling due to COVID social distancing)

- Simplify testing platforms for P5 students to log on
- Remove and revise too easy & hard items

Wave-2 DLA Administration

- Time: March to July 2021
- Items: Primary 5: 50; Secondary 3: 51; Secondary 5: 53 items
- Test forms: 2 forms for P5 and S3, 4 forms for S5
- Multi-mode administration*: onsite, online support, self-directed

	Primary 5		Secondary 3		Secondary 5	
Testing Mode	N	%	N	%	N	%
Online support	111	21.89	288	34.45	250	40.00
Onsite support	388	76.53	441	52.75	300	48.00
Self-directed	8	1.58	107	12.80	75	12.00
Total	507		836		625	

Wave-2 DLA Psychometric Analysis

- **Item types:**
  - Multiple-choice items, technology enhanced items (e.g., drag-and-drop items, short response items, click-image items)
- **Scoring methods:**
  - 7 polytomous items (0, 1, 2) and 88 dichotomous items (0, 1)
- **Calibration models:**
  - A multiple-group two-parameter logistic with Graded Response model (2PL-GRM MG-IRT)
    → acceptable model fit and item discriminations after removing some misfit and low item discrimination items
- **Test quality:**
  - Examine differential item functioning (DIF) between genders, SES status and testing modes
    → no non-ignorable DIF items
- **Vertical scaling:**
  - Conduct measurement invariance test for common items→30 invariant items
  - Apply Stocking-Lord method to transform item parameters and wave-2 DL scale scores to the scale of wave-1 DL scores.

Final Wave-2 DLA

Competence Areas	Competences	Wave-1	Wave-2
(dimension 1)	(dimension 2)		
1. Information and data literacy	1.1 Browsing, searching, filtering data, information and digital content	5	4
	1.2 Evaluating data, information and digital content	4	4
	1.3 Managing data, information and digital content	6	4
2. Communication and collaboration	2.1 Interacting through digital technologies	5	3
	2.2 Sharing through digital technologies	8	6
	2.3 Engaging in citizenship through digital technologies	3	4
	2.4 Collaborating through digital technologies	0	5
	2.5 Netiquette	4	3
	2.6 Managing digital identity	2	4
3. Digital content creation	3.1 Developing digital content	4	1
	3.2 Integrating and re-elaborating digital content	0	4
	3.3 Copyright and licenses	3	3
	3.4 Programming	0	11
4. Safety	4.1 Protecting devices	8	6
	4.2 Protecting personal data and privacy	11	6
	4.3 Protecting health and well-being	5	2
	4.4 Protecting the environment	1	4
5. Problem solving	5.1 Solving technical problems	11	7
	5.2 Identifying needs and technological responses	0	6
	5.3 Creatively using digital technologies	0	4
	5.4 Identifying digital competence gaps	1	4
Total		**81**	**95**

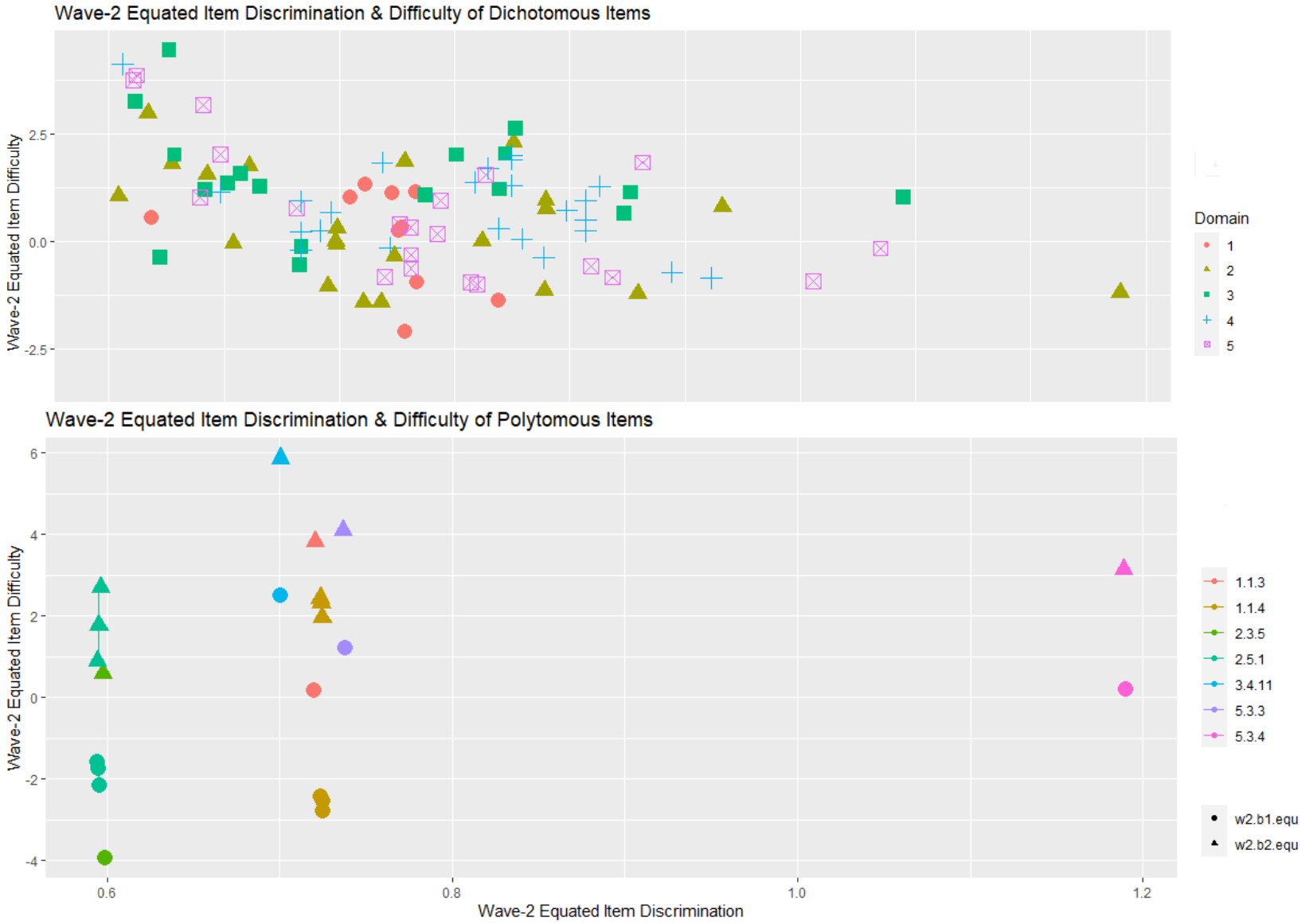
Final Wave-2 DLA (Cont.)

Number of DL items in different cohorts by domain.

	Cohort 1	Cohort 2	Cohort 3
	P5	S3	S5
1. Information and data literacy	8	7	8
2. Communication and collaboration	10	11	12
3. Digital content creation	8	11	10
4. Safety	10	10	10
5. Problem solving	9	9	11
Total	**45**	**48**	**51**

Wave-2 DLA test (Cont.)

- After transformation to Wave-1 scale, Wave-2 item discriminations ranged from .24 to 2.44.
- Item difficulties ranged from -4.51 to 5.87.
- The EAP reliability of Wave-2 DLA was .91.



Summary about DL Assessment instrument

- We have constructed an instrument that provides us with test forms suited to assess students' digital literacy competence from grade 3 (age 8-9) to secondary 5 (age 16-17) for comparison of achievement.

- The results from both wave-1 and wave-2 assessment show that the DL competence assessed is a unidimensional construct.

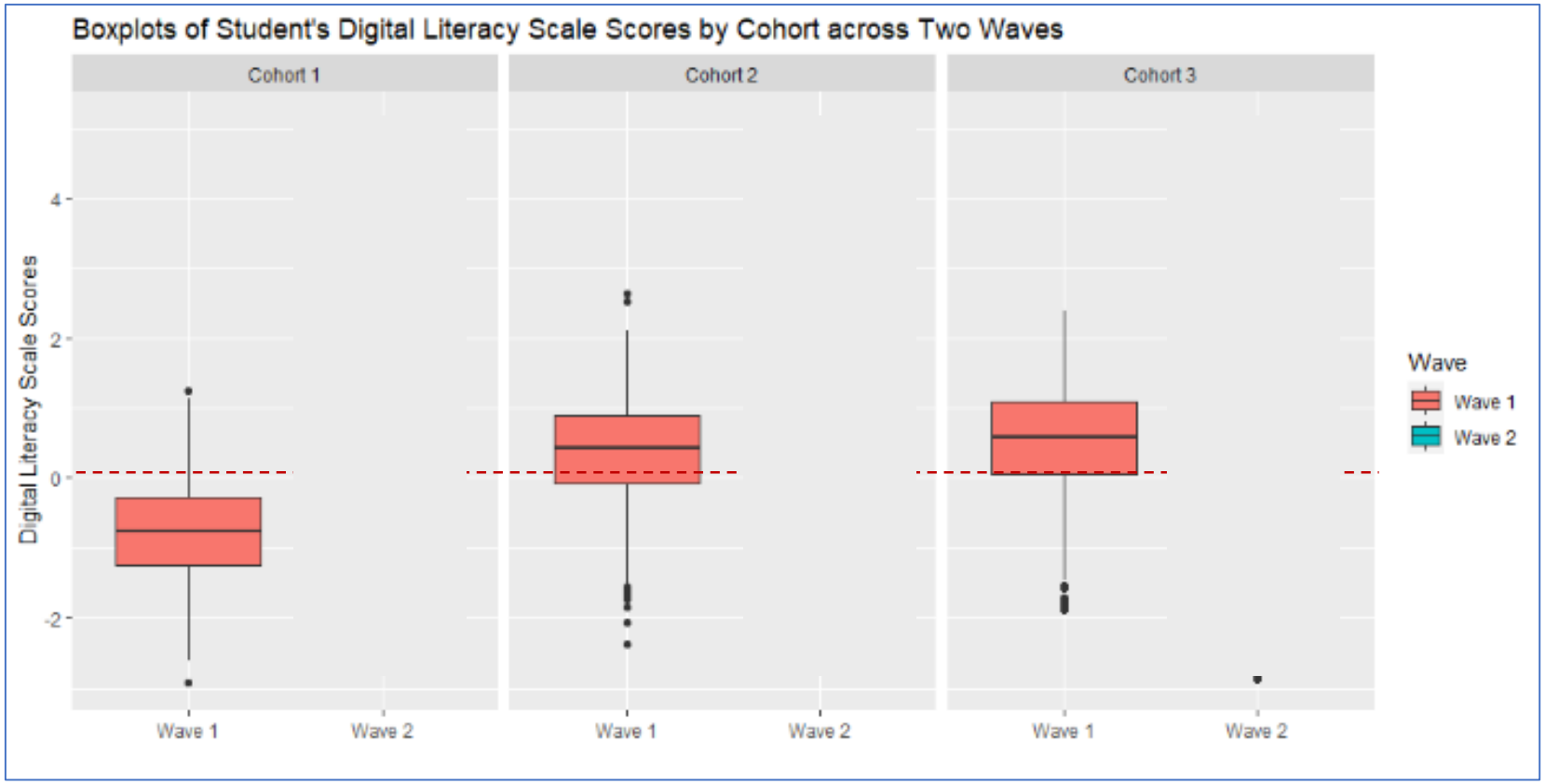
Findings

Number of Participating Schools, Classes, & Students

Cohort	Schools		Classes		DLA		
Wave 1 or wave 2	w1	w2	w1	w2	w1	w2	matched
C1	18	12	39	48	750	507	234
C2	14	11	27	39	715	839	389
C3			29	38	581	625	264

Wave 1 data collection: first half of 2019
Wave 2 data collection: second half of 2021

Boxplots of Digital Literacy scale scores



Findings:

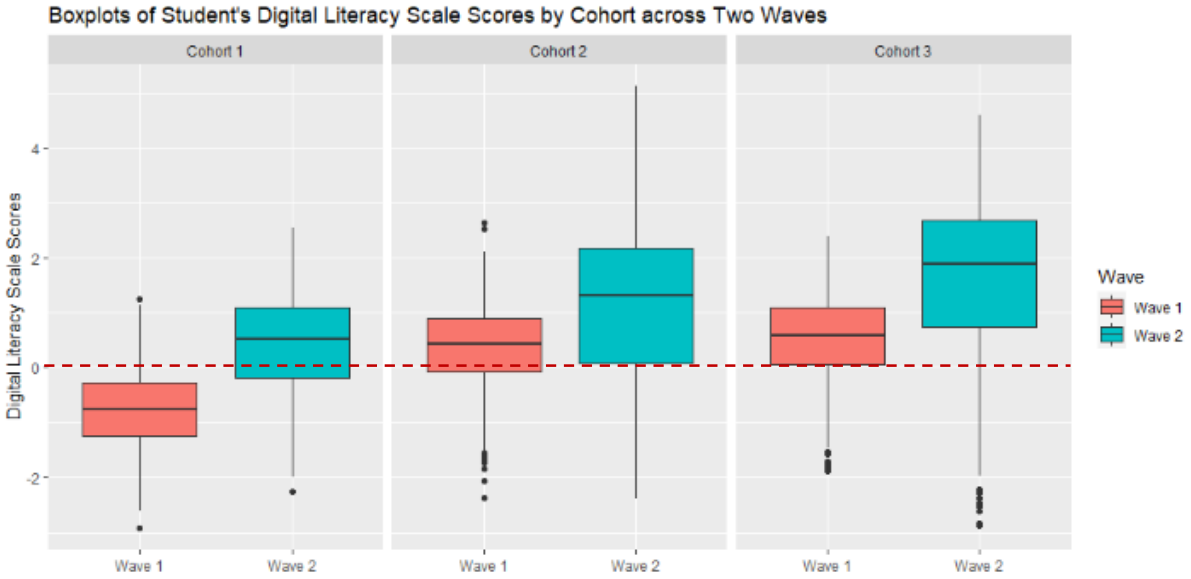
<u>Wave-1</u>

<u>Wave-2</u>

0 on Y-axis = average of Wave-1 scores across all 3 age cohorts

Boxplots of Digital Literacy scale scores

Full sample for both Wave-1 & Wave-2



Matched sample for both Wave-1 & Wave-2

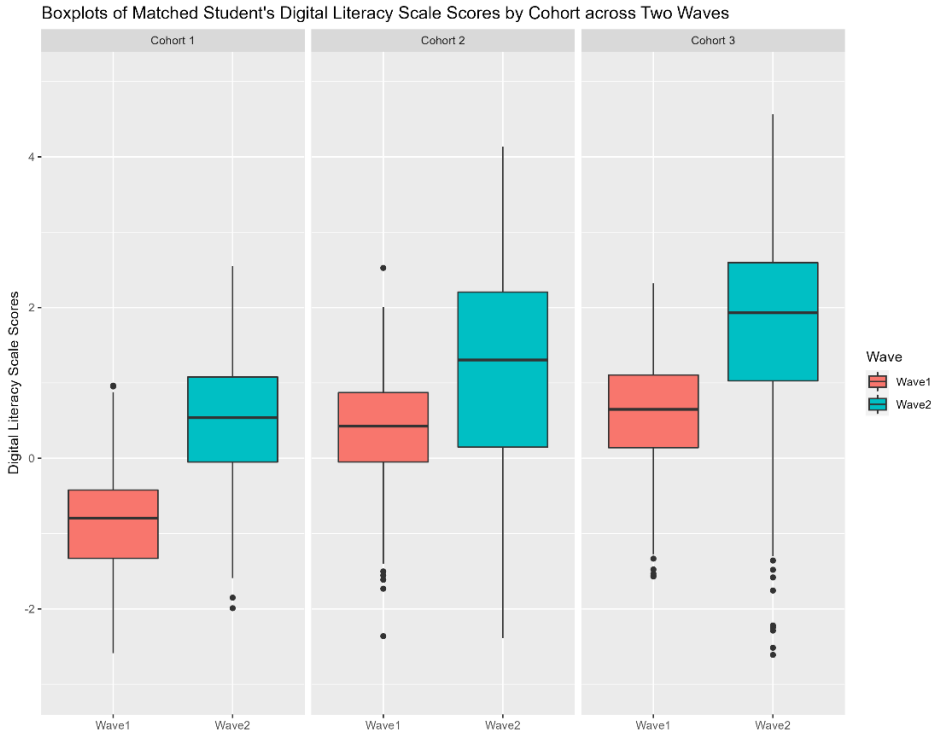
0 on Y-axis = average of Wave-1 scores across all 3 age cohorts

Growth (Wave-2 – Wave-1)

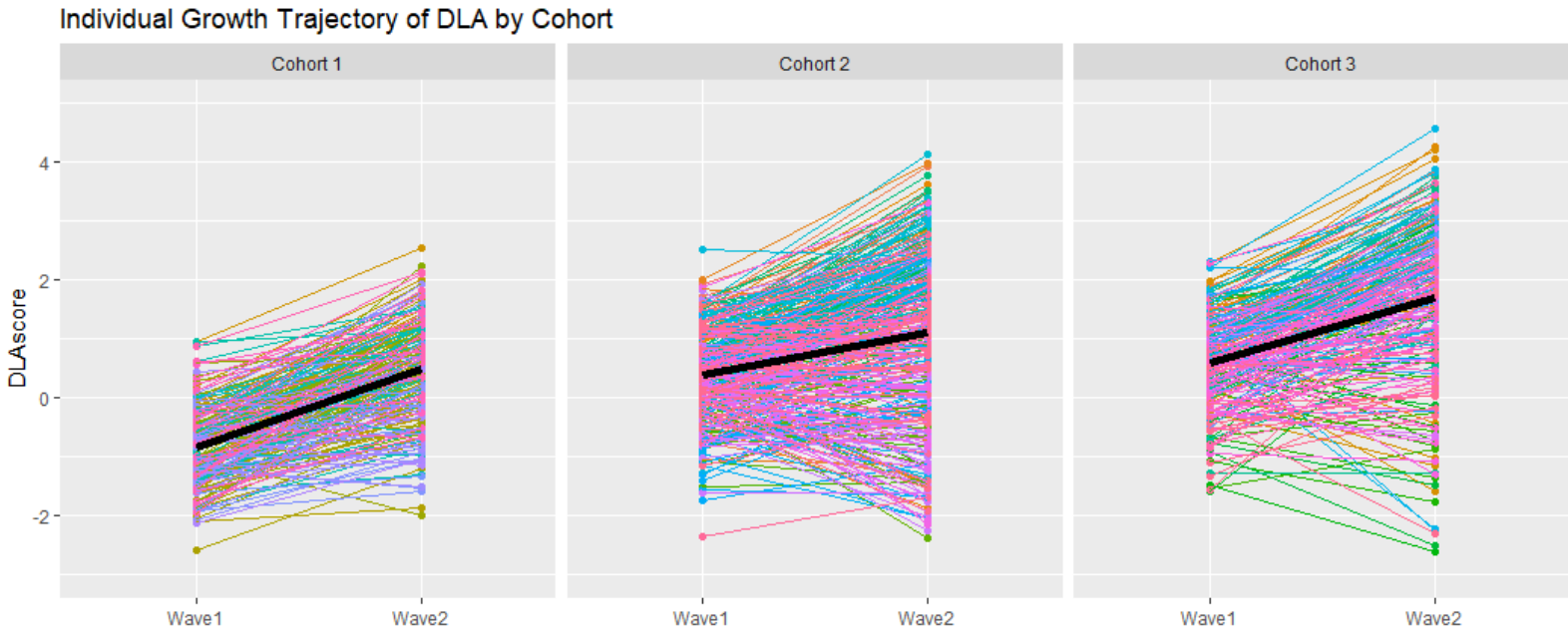
- Students in all 3 cohorts improved in their DL scores
- Difference statistically significant for all 3 cohorts

Matched students' growth in DL

Boxplots of matched students' DL growth



Individual growth trajectory of DL across two waves



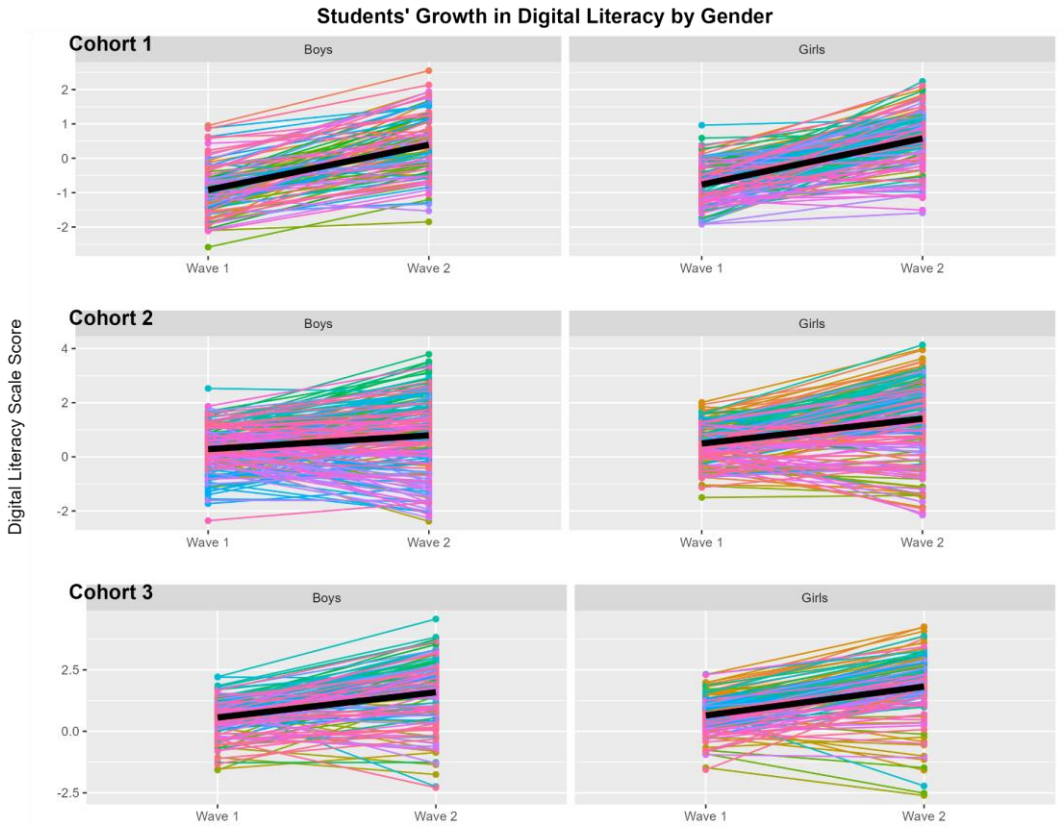
- $\beta_{c1} = 1.32; \beta_{c2} = .72; \beta_{c1} = 1.10;$
- *Growth rates were estimated from a 3-level model and all were significantly larger than 0.*

Level 1: time (W1, W2); Level 2: student; Level 3: school

Matched students' growth in DL by gender

Average matched students' growth in DL by gender

Individual growth trajectory in DL by gender



- *No gender differences of growth rates in Cohort 1 &3.*
- *Girls had a significantly larger growth rates in Cohort 2* ($\beta_{diff} = .41, p < .01$)

Type of Large Screen Devices (LSD) used & mode of access @home

Cohort	cohort & wave	PC & Tablet	PC only	Tablet only	no LSD	Missing
1	wave 1 (P3)	55.9	16.1	12.8	12.5	2.8
	wave 2 (P5)	52.1	4.3	14.4	3.2	26.0
2	wave 1 (S1)	59.5	20.1	7.2	9.7	3.6
	wave 2 (S3)	64.6	14.0	10.8	4.2	6.5
3	wave 1 (S3)	52.1	28.4	7.2	7.4	4.9
	wave 2 (S5)	63.0	19.0	8.5	3.0	6.4

N.B. Figures are percentages

More C2 & C3 students have access to both PC & Tablet at home in Wave 2, and only very small % had no LSD

Cohort	cohort & wave	Shared+own	own only	shared only	no LSD	Missing
1	wave 1 (P3)	20.9	29.4	34.4	12.5	2.79
	wave 2 (P5)	17.6	24.3	29	3.16	26
2	wave 1 (S1)	20.5	22.2	44.1	9.69	3.55
	wave 2 (S3)	28.9	41.1	19.3	4.19	6.46
3	wave 1 (S3)	20.8	26.7	40.2	7.38	4.92
	wave 2 (S5)	28.6	45.9	16	3.04	6.4

For C2 & C3 students, a big increase in % of students having own access or shared+own LSD in Wave 2.

Changes of devices @home & access @home

W1 \ W2	PC & Tablet	PC Only	Tablet Only	No LSD	AllMissing
PC & Tablet	345	44	**50**	**17**	56
PC Only	**108**	44	17	**7**	11
Tablet Only	**39**	8	24	**6**	13
No LSD	**43**	**18**	13	7	9
All Missing	5	0	1	0	2

N—improved LSD device

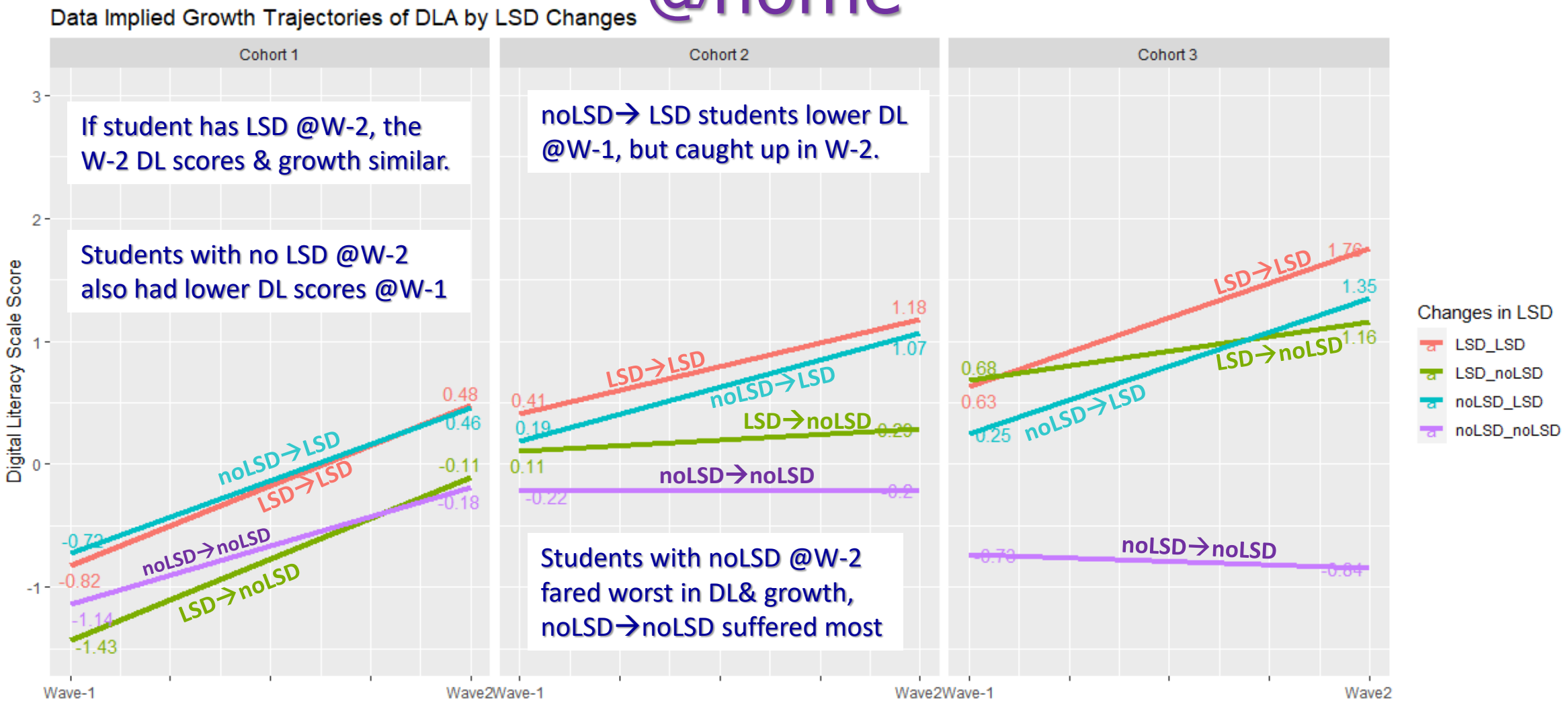
N—worsened LSD device

W1 \ W2	Own Only	Shared+Own	Shared Only	No LSD	AllMissing
Own Only	**118**	41	34	6	29
Shared+Own	74	**59**	27	9	20
Shared Only	118	110	**98**	15	31
No LSD	**29**	**14**	**31**	**7**	9
All Missing	2	1	3	0	**2**

N—improved LSD device

N—worsened LSD device

Factors influencing DL & growth—LSD devices @home



If students cannot use a LSD @home after the pandemic hits, his/her DL competence would be greatly affected. Students with no LSD before pandemic can still catch up if they were given LSD after online learning started.

Factors influencing DL & growth—LSD access @home

W-1 access predict W-1 DL score?	W-2 access predict W-2 DL score?	W-1 access predict W-2 DL score? (common students only)
Cohort 1	Cohort 1	Cohort 1
Shared only > * own only * share+own * no LSD;	Shared only, own only, shared+own > * no LSD No other significant difference due to W-2 access	**Shared only** > * shared+own No other significant difference due to W-1 access
Cohort 2	Cohort 2	Cohort 2
no significant difference across all 4 access modes	Shared only, own only, shared+own > * no LSD No other significant difference due to W-2 access	no significant difference across all 4 access modes
Cohort 3	Cohort 3	Cohort 3
shared+own > * own only * no LSD shared only > * no LSD	Shared+own, own only > * no LSD No other significant difference due to W-2 access	Shared + own > * own only * no LSD No other significant difference due to W-1 access

4 modes of LSD access @home:

- Shared only
- Own only
- Shared+own
- No LSD

Importance of access mode depends on:

- grade level
- before/after online learning

Before COVID: shared access most advantageous for Cohort 1, Ownership of LSD for Cohort 3, although shared+own > own only

After online learning: all forms of LSD access (i.e. except no LSD) are similar in predicting W-2 DL for Cohorts 1 & 2. For Cohort 3, ownership is important.

- **The advantage of shared access before COVID** carried over to W-2 DL achievement for Cohorts 1 & 3
- For Cohort 2, W1-access mode does not seem to matter for DL achievement.

Factors influencing DL growth—SES factors

- Academic social capital (ACAD-CAP):
  3 items (parental education levels and numbers of books at home.)
- Home resources (HOME-RES):
  3 items (whether a student had a desk, a quiet place to study, a room.)

ACAD-CAP

HOME_RES

Scale scores of SES factors were computed via an IRT model with a mean of 0 and standard deviation of 1.

Wave-2 DL & SES—correlations

N.B. ACAD_CAP & HOME_RES are significantly correlated (p<0.001) for all 3 cohorts, correlation ~0.5.

		Full Wave-2 Samples		Matched Sample	
		ACAD_CAP	HOME_RES	ACAD_CAP	HOME_RES
Cohort 1	Wave-2 DL	.17**	.14**	.20**	.13
Cohort 2	Wave-2 DL	.13**	.06	.19**	.09
Cohort 3	Wave-2 DL	.08	.02	.19**	.06

Note. ** p< .01

Interpretations:

1. HOME_RES (dependent strongly on family financial status) is much less important for students' learning than the priority (ACAD_CAP) given by the family to support the child's learning. The latter is more malleable.
2. ACAD_RES has a higher correlation with DL achievement in Wave-2 (after online learning triggered by COVID), while HOME_RES correlations are not significant except for the full Wave-2 sample.

Students' DL growth can be enhanced by provided better e-learning support even for students from low financial SES families.

(Wave-1 & Wave-2) DL & SES factors—Multilevel impact

		Cohort 1	Cohort 2	Cohort 3
wave-2 DL				
	Individual ACAD_CAP impact (within-school effects)	.07	.01	-.07
	School ACAD_CAP (between-school effects)	1.22**	1.12*	1.75*
	Individual HOME_RES impact (within-school effects)	.08	-.02	-.03
	School HOME_RES (between-school effects)	1.17*	2.84*	3.09
wave-1 DL				
	Individual ACAD_CAP impact (within-school effects)	.07	-.01	-.07
	School ACAD_CAP (between-school effects)	.09	.80**	1.01**

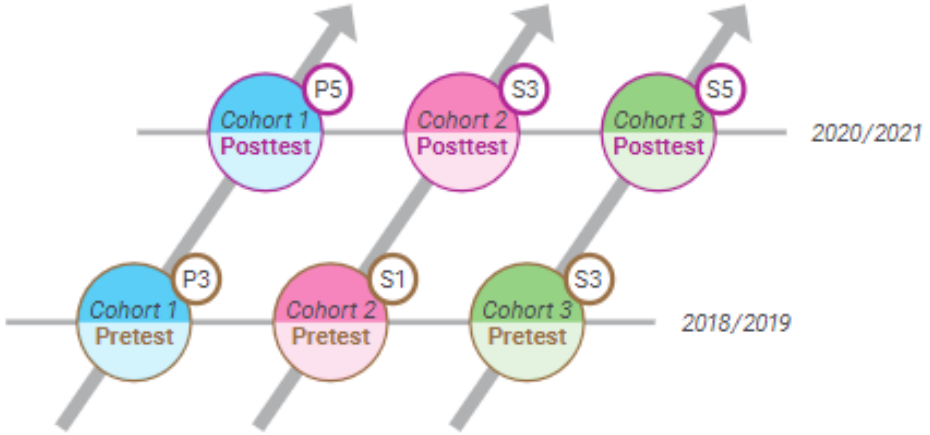
Note. ** p< .01, *p<.05

Interpretations:

1. Students' SES, whether ACAD_CAP or HOME_RES, does not predict their DL scores in both Wave-1 & Wave-2 after accounting for school level differences in SES .
2. The mean ACAD_CAP at the school level is a significant positive predictor of a student's DL score in both Waves 1 & 2. The coefficient is even higher for Wave-2 for all three cohorts, and most prominent for Cohort 3.
3. The mean HOME_RES at the school level is also a significant positive predictor of a student's DL score in Cohorts 1 & 2, not 3.

1. The DL of students studying in the same school is not affected by the students' family SES.
2. A student would most likely achieve a higher DL school if s/he studies in a school with higher mean SES.

Summary



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The DL instrument developed allowed us to compare DL development across age groups and over time

DL growth

- The online learning experience advanced students' DL to beyond those demonstrated by older students before the pandemic
- All three age cohorts demonstrated significant growth in DL from Wave-1 to Wave-2
- Cohort 3 students demonstrated greater growth than cohort 2 students, leading to significant differences in DL between the two cohorts in Wave-2.
- Students without access to large screen devices (LSD) during online learning are significantly disadvantaged.
- Students without LSD in Wave-1 are still able to catch up if given LSD during online learning.
- Before the pandemic, shared use of LSD was an important channel for gaining competence in DL
- For Cohort 3 students, having their own LSD is important to gain maximum benefit from online learning

Impact of SES

- Academic capital provided by the family is much more important than the family's financial SES.
- Students' DL growth can be enhanced by providing better e-learning support even for students from low financial SES families
- Students studying in schools with higher mean SES gain more
- DL of students from the same school not affected by