The Impact of COVID-19 on Education for Students With Significant Cognitive Disabilities

Jennifer L. Kobrin, Amy K. Clark, Brianna Beitling, and W. Jake Thompson

Accessible Teaching, Learning, and Assessment Systems (ATLAS), University of Kansas

Author Note

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Abstract

In this study we investigated the impact of the COVID-19 pandemic on opportunity to learn (OTL) for students with significant cognitive disabilities, using data collected via an annual survey for teachers of students participating in the Dynamic Learning Maps® alternate assessment. Guided by the OTL literature, we developed a set of indicators from the survey data representing instructional content, coverage (including instructional breadth and depth), and school conditions. We compared the content and coverage OTL indicators for the years before and during the pandemic and examined relationships between the school conditions indicators and OTL. The findings showed negligible differences in instructional breadth and depth from 2019 to 2021, but several instructional topics received less emphasis or no emphasis during the pandemic. After accounting for the match of instruction to assessment and the number of hours of weekly instruction, instructional conditions during the pandemic did not show a significant relationship to students' breadth and depth of instruction. We discuss caveats to aid in the interpretation of these results.

Keywords: COVID-19 pandemic, students with significant cognitive disabilities, opportunity to learn

The Impact of COVID-19 on Education for Students With Significant Cognitive Disabilities

Students with the most significant cognitive disabilities (SCD) have historically faced barriers to accessing grade-level content. Even following the passage of numerous federal mandates in the 21st century, many students with SCD did not receive meaningful instruction on challenging academic standards (Karvonen et al., 2011). There is limited research evaluating the impact of the COVID-19 pandemic on their instruction, but students with special needs are unlikely to have those needs met through online learning (Young & Donovan, 2020). In a recent school-district survey, 73% of districts reported that COVID-19 school closures rendered instructional modifications and accommodations for students with disabilities more or substantially more difficult (Jackson & Bowdon, 2020). An analysis by NWEA (Dworkin & Carroll, 2021) showed that students with disabilities experience more learning loss than their peers without the structure and support they typically receive during a normal school year. Because students with SCD have more-extensive support needs than the general population of students with disabilities, they may be further affected by the pandemic.

Students with SCD taking alternate assessments showed reduced participation rates from 2018–2019 to 2020–2021, and there were small shifts in the composition of the population across years. Students from historically marginalized populations and students who typically have the lowest achievement participated in the Dynamic Learning Maps® (DLM) alternate assessment at lower rates than in previous years (Accessible Teaching, Learning, and Assessment Systems [ATLAS], 2021). In addition to the pandemic's impacts on assessment participation, the prevalence of remote instruction and students' support needs may have resulted in reduced opportunity for students with SCD to learn the full breadth of academic content. ATLAS (2021) reported that, while nearly half of students taking DLM assessments spent 75%–

100% of their instructional time in school, at least 60% of students spent some portion of the year receiving instruction from their teacher in home, 30% received instruction from a family member, and 6% received no in-school instruction.

Opportunity to learn (OTL) has been generally defined as opportunities that schools provide students to enable them to learn what is expected from them and to meet expectations set by content and performance standards (Banicky, 2000; Herman et al., 2000). Floden (2002) summarized the types of questions OTL is meant to address, which include the extent to which topics are emphasized in the curriculum, how much time teachers plan to spend teaching the topic, how much time teachers actually spend teaching the topic, how much of that time the student is present, and the degree to which the student engages in instructional activities.

Over the years, researchers have operationalized OTL in slightly different ways, but measures generally include one or more of the following dimensions: curriculum or what is taught (i.e., content); amount of exposure and/or emphasis (i.e., coverage); student engagement in instructional activities; and quality of instruction, including cognitive demand or performance expectations, instructional strategies, and resources (Herman & Abedi, 2004; Herman et al., 2000). Some researchers also include teacher background and school conditions in their OTL measures (e.g., Banicky, 2000). Opportunity to learn is most often measured with the use of teacher surveys (e.g., Blank et al., 2001; Karvonen et al., 2007, 2011) or instructional logs (e.g., Consortium for Policy Research in Education, n.d.; Kurz et al., 2015), although the construct has also been measured through classroom and teacher observations (Thurlow et al., 1984), coding of instructional materials (Wang, 1998), high school transcript review (Jones et al., 1986), and teacher interviews (Wang, 1998).

This study investigated instructional conditions during the COVID-19 pandemic for students with SCD. The research questions included:

1. How did OTL for students with SCD compare before and during the COVID-19 pandemic?
2. How did instructional conditions during COVID-19 relate to OTL for students with SCD?

Methods

Data Sources and Sample

The DLM alternate assessment measures academic content standards at a reduced depth, breadth, and complexity in English language arts (ELA), mathematics, and science for students with SCD who cannot meaningfully access general-education assessments, even with accommodations. Sixty-seven percent (67%) of students taking DLM assessments are identified as having autism, an intellectual disability, or multiple disabilities; 55% spend less than 40% of their instructional day in a general education classroom (Burnes & Clark, 2021).

The Dynamic Learning Maps® (DLM) Consortium administers an annual spring teacher survey to collect information about student and teacher experiences with the DLM assessment, OTL, accessibility, and other topics. One survey is assigned, per student, to be completed by the teacher to whom the student is assigned in the assessment system; survey completion is voluntary. The 2021 survey consisted of four blocks: three blocks were provided for all students, and the fourth block was spiraled so that each student was randomly assigned one of four item sets. The OTL survey items were included in three separate blocks, one for each subject (ELA [including writing], mathematics, and science). Table A1 in the appendix shows the survey blocks and number of respondents per block for the 2018, 2019, and 2021 teacher surveys.

The current study is based on data collected from the spiraled survey blocks focusing on OTL (2018, 2019, and 2021) and instructional conditions during the COVID-19 pandemic (2021 only). In 2018, 19,144 teachers responded to the teacher survey (response rate of 78.0% of

teachers) about 59,543 students' experiences (66.1% of students); in 2019, 17,431 teachers responded (response rate of 77.2% of teachers) about 55,340 students' experiences (65.6% of students); and in 2021, 14,681 teachers responded (response rate of 63.1% of teachers) about 39,661 students' experiences (50.5% of students).

To account for shifts in the population, analyses to address the first research question (*How did OTL for students with SCD compare before and during the COVID-19 pandemic?*) were based on survey data matched for the same students in 2018 and 2019 (n = 26,110 students) and in 2019 and 2021 (n = 13,334 students). Analyses to address the second research question (*How did instructional conditions during COVID-19 relate to OTL for students with SCD?*) were based on all 2021 survey data (n = 39,661 students).

Tables 1 and 2 show the demographic characteristics and distribution of complexity band [1] for the 2018, 2019, 2021, and matched samples. There were virtually no demographic differences in the 2018 and 2019 samples, and slight differences in the 2019 and 2021 samples. The matched sample was similar to both total samples, although it had a slightly larger percentage of white students and slightly lower percentage of Black students, especially compared to the 2019 sample. The matched sample was also very similar to both total samples in the distribution of student complexity bands. Given the similarities between the matched samples and the total samples, we felt confident using the matched sample to evaluate changes in OTL before and during the COVID-19 pandemic.

[1] DLM complexity bands are calculated using teachers' responses to a First Contact survey (Nash et al., 2016) about students' expressive communication and academic skills. There are four complexity bands: Foundational, Band 1, Band 2, and Band 3. The bands are used for test assignment.

Table 1

Student Demographics for Total and Matched Samples

Subgroup	2018 sample (%)	2019 sample (%)	2021 sample (%)	2018/2019 matched sample (%)	2019/2021 matched sample (%)
Gender					
Male	66.5	66.1	67.2	66.0	66.3
Female	33.5	33.9	32.8	34.0	33.7
Race					
Alaska Native	0.4	0.2	0.2	0.2	0.3
American Indian	3.4	3.3	2.9	3.9	3.5
Asian	4.4	4.0	3.4	4.0	3.1
Black	19.5	19.6	15.6	16.8	14.1
Native Hawaiian or Pacific Islander	0.5	0.5	0.4	0.4	0.4
Two or more races	9.0	10.9	10.9	10.7	10.0
White	62.9	61.4	66.5	63.9	68.6
Hispanic ethnicity					
Yes	20.4	18.5	16.9	18.7	16.8
English learner participation					
English learner eligible or monitored	5.6	5.8	5.4	5.4	4.2

Table 2

Dynamic Learning Maps Complexity Band for Total and Matched Samples

DLM complexity band	2018 sample (%)	2019 sample (%)	2021 sample (%)	2018/2019 matched sample (%) [a]	2019/2021 matched sample (%) [a]
Foundational	7.5	7.6	6.8	7.1	6.7
Band 1	21.4	22.3	21.9	22.8	23.2
Band 2	22.8	23.4	23.4	24.2	24.9
Band 3	48.3	46.8	47.7	45.9	45.2

[a] The percentages for the matched samples are based on complexity band for the most recent year, i.e., 2019 for the 2018/2019 sample and 2021 for the 2019/2021 matched sample. Students' complexity bands may change from year to year.

Opportunity to Learn Indicators

We computed several OTL indicators from the DLM teacher survey data, which cover the dimensions of content, coverage, and school conditions. The indicators represent breadth and depth of instruction, total amount of instructional time, match of instruction to DLM assessment content, access to curriculum aligned with DLM assessment content, and instructional conditions during the COVID-19 pandemic. Several of the OTL survey items were asked in prior years to enable examination of trends before and during the pandemic. Table 3 shows the survey items that were used to compute the OTL indicators, which OTL dimension each indicator represents (i.e., content, coverage, and school conditions), and how the indicators were computed.

Content and Coverage Indicators

The DLM ELA and mathematics assessments measure conceptual areas representing conceptually related content standards (e.g., determine critical elements of text). The survey includes several items asking teachers to indicate the number of hours they provided instruction during the school year in each conceptual area in ELA and mathematics, and number of hours for various writing instructional practices, science core ideas, and science and engineering practices (henceforth these are collectively referred to as *topics*). We developed a set of indicators on breadth and depth of instruction using the data from these survey questions. Figure 1 depicts how the indicators were computed. Breadth of instruction in each subject was computed as the number of topics in which teachers indicated 6 or more hours of instruction during the school year. Depth of instruction was computed as the number of topics for which teachers indicated 16 or more hours of instruction during the school year. [2]

[2] Because the first response option is *0–5 hours* and teachers selecting this option may have provided no instruction, this option was not included in the breadth indicator. Additionally, because the response options differed, breadth for science in 2018 was defined as the number of topics with at least 1 hour of instruction and depth as the number of topics with at least 11 hours of instruction.

Table 3

Dynamic Learning Maps Teacher Survey Items, Opportunity to Learn (OTL) Dimensions, and Indicators

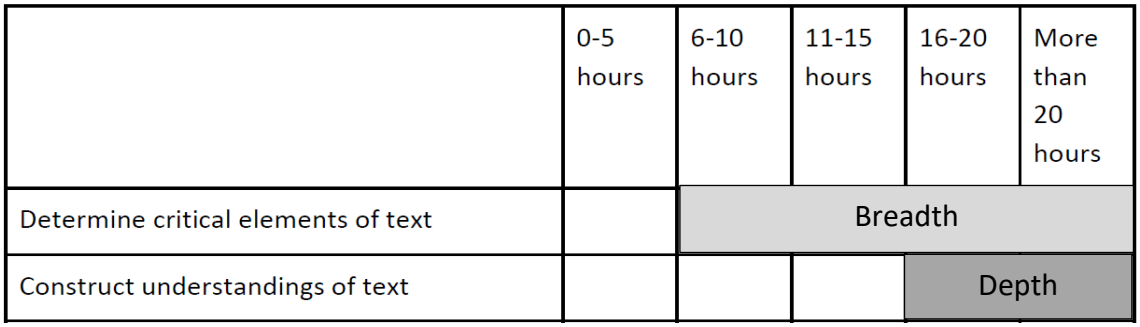
Survey item	Original response options	OTL dimension	Indicator
How many of the student's testlets had content that matched his or her instruction this year (ELA, writing, mathematics, science)? Response options: None, Some, Most, All, N/A	0 = None 1 = Some 2 = Most 3 = All	Content	Original items (range = 0–3) and sum across content areas (range = 0–12)
Across all subjects, on average, number of hours student was engaged in academic instruction each week. Response options: None, 1–5 hours, 6–10 hours, 11–15 hours, 16–20 hours, 21–30 hours, more than 30 hours	0 = None 1 = 1–5 hours 2 = 6–10 hours 3 = 11–15 hours 4 = 16–20 hours 5 = >21 hours	Coverage	Original item (range = 0–5)
Number of hours of instruction in each conceptual area (ELA, writing, and math) core idea (science) and science and engineering practice. Response options: 0–5 hours, 6–10 hours, 11–15 hours, 16–20 hours, more than 20 hours	0 = 0–5 hours 1 = 6–10 hours 2 = 11–15 hours 3 = 16–20 hours 4 = >20 hours	Coverage	Breadth and depth of instruction [b]
Teacher has access to curriculum aligned with content measured by DLM assessments. Response options: strongly disagree, disagree, agree, strongly agree	0 = strongly disagree 1 = disagree 2 = agree 3 = strongly agree	Coverage	1 = yes, 0 = no
Across the school year, about what percentage of the student's academic instructional time was…? Response options: in school, at home with 1:1 remote instruction, at home with group remote instruction, at home with teacher present in the home, at home with family member providing instruction, or absent (no	0 = none 1 = 1%–25% 2 = 26%–50% 3 = 51%–75% 4 = 76%–100%	School conditions (COVID-19)	For each instructional condition: 0 = ≤50%, 1 = >50%

Survey item	Original response options	OTL dimension	Indicator
formal instruction)[a]			
Which of the following applied to this student's schedule this year? Response options: delayed start of school year, lengthened spring semester, extended school year, change(s) between remote and in-person learning[a]	0 = yes 1 = no	School conditions (COVID-19)	0 = none applied; 1 = at least one applied

Note. [a] Items included on 2021 survey only.
[b] Breadth of instruction in each subject was computed as the number of topics in which teachers indicated six or more hours of instruction during the school year. Depth of instruction was computed as the number of topics for which teachers indicated 16 or more hours of instruction during the school year.

Figure 1

Computation of Breadth and Depth Indicators



We also developed an OTL indicator from the set of survey items on the number of testlets matching students' instruction. These items asked teachers to think about the content of the DLM testlets (i.e., short, 3–9-item assessments measuring the content standards) their students took and indicate how many of the testlets had content that matched the student's instruction in reading, writing, mathematics, and science. The indicator summed the responses across the four subject areas. Two survey questions served as additional OTL indicators: the question on how many hours a week the student was engaged in academic instruction each week (an ordinal variable ranging from 0 to 5 representing the response options ranging from 0 to

more than 21 hours) and the Likert-type question "I have access to curriculum aligned with the content measured by DLM assessments," which was recoded to a binary variable with 0 = disagree and 1 = agree.

School Conditions Indicators

Indicators related to school conditions during the COVID-19 pandemic included time the student spent in various instructional formats (e.g., in person, remote) and whether any school scheduling changes took place (e.g., delayed start to the school year, changes between in-person and remote instruction). To simplify analyses and aid in interpretation, we recoded some of the original survey items for some of the analyses. The survey items on instructional conditions were recoded into binary variables indicating whether the student spent up to 50% or more than 50% in each instructional format.[3] The original survey item on school scheduling scenarios included four potential scheduling scenarios, and teachers were asked to select all that applied. This item was recoded into a variable representing whether the student experienced at least one of the scenarios described in the item.

Analyses

To answer the first research question, about evaluating changes to OTL for students with SCD during COVID-19, we examined mean differences and effect sizes for the indicators in 2018 and 2019 (i.e., before COVID-19) and in 2021 (i.e., during COVID-19) for students with survey data in both years; we then examined changes in the median and mode of instructional time spent on topics in ELA, mathematics, and science. Cohen's *d* was used as a measure of effect size, using the criteria ≥ .2 = small, ≥ .5 = median, and ≥ .8 = large. Note that because of the spiraling of the survey blocks, teachers may not have completed the same survey items for the same students in both years.

[3] The original survey item was used in correlation analyses.

To answer the second research question, about relationships between instructional conditions during COVID-19 and OTL, we included all students with 2021 survey data and used descriptive statistics and partial correlations to examine the breadth and depth indicators in relation to the indicators on school conditions during the pandemic.

Results

Opportunity to Learn Before and During the Pandemic

Table 4 shows average instructional breadth and depth in each subject in 2018, 2019, and 2021, as well as the effect sizes for the mean differences for students with survey responses in both years. Because of the impacts of the pandemic on learning, we expected to see a decline in breadth and depth of instruction; in all subjects from 2019 to 2021, there were negligible declines with effect sizes (Cohen's *d*), ranging from approximately -0.05 to -0.13. In comparison, the effect sizes for the differences from 2018 to 2019 in mean breadth and depth were 0.03 and 0.0, respectively, for ELA and -.06 and 0.0, respectively, for mathematics.

Tables 5 and 6 show mean breadth and depth by student complexity band and grade band in 2019 and 2021. In ELA and mathematics, there were negligible differences in breadth and depth for most students, with the exception of a small decline in mathematics breadth for students in Band 2 (d = -.20) and in ELA breadth for grades 6–8 (d = -.27). In science, there were negligible differences in breadth for all students but small declines in depth for students at the foundational level and Band 2 (d = -.42 and -.23, respectively), as well as for students in grades 3–5 (d = -.33). For comparison, the effect sizes for the 2018 to 2019 mean differences in breadth and depth by student level and grade band (not shown in the tables) were all negligible, with the exception of grades 9–12, which showed a small decline (d = -.26) in mathematics breadth from 2018 to 2019.

Table 4

Mean and Standard Deviation of Breadth and Depth of Instruction with Effect Sizes: 2018, 2019, and 2021

Breadth/Depth	Max	2018		2019		*d*	2019		2021		*d*
		n	*M* (*SD*)	*n*	*M* (*SD*)		*n*	*M* (*SD*)	*n*	*M* (*SD*)	
Breadth											
English language	9	2,622	7.0 (3.0)	2,742	7.1 (3.0)	.03	1,455	6.8 (3.1)	2,463	6.6 (3.1)	-.08
arts	7	---[a]	---	---	---	---	1,446	4.5 (2.8)	2,457	4.3 (2.8)	-.08
Writing	9	2,599	6.4 (3.1)	2,807	6.2 (3.2)	-.06	1,497	6.1 (3.1)	2,614	5.8 (3.2)	-.07
Mathematics	10	---[b]	---	---	---	---	336	5.2 (4.2)	1,057	5.0 (3.9)	-.03
Science core ideas	7	---[b]	---	---	---	---	336	3.8 (2.9)	1,056	3.6 (2.9)	-.05
Science & engineering practices											
Depth											
English language	9	2,622	4.4 (3.7)	2,742	4.4 (3.7)	.00	1,455	4.2 (3.6)	2,463	3.8 (3.4)	-.11
arts	7	---	---	---	---	---	1,446	2.6 (2.8)	2,457	2.3 (2.6)	-.11
Writing	9	2,599	3.4 (3.2)	2,807	3.4 (3.3)	.00	1,497	3.2 (3.1)	2,614	2.8 (3.0)	-.13
Mathematics	10	---	---	---	---	---	336	1.7 (3.4)	1,057	1.5 (2.8)	-.07
Science core ideas	7	---	---	---	---	---	336	1.3 (2.4)	1,056	1.1 (2.0)	-.11
Science & engineering practices											

[a] Writing is excluded because the writing questions were not present in the 2018 survey. [b] Science is excluded because the survey item response options changed between 2017–2018 and 2018–2019, making it difficult to compare the breadth and depth indicators across the two years.

Table 5

Mean and Standard Deviation of Breadth of Instruction by Student Characteristics with Effect Sizes: 2018, 2019, and 2021

Student characteristics	English language arts			Mathematics			Science		
	2019	2021	*d*	2019	2021	*d*	2019	2021	*d*
Student level									
Foundational	4.1 (3.7)	4.5 (3.8)	0.11	4.2 (3.5)	3.9 (3.4)	-0.09	5.2 (4.0)	4.6 (4.3)	-0.14
Band 1	5.7 (3.4)	5.3 (3.3)	-0.12	4.8 (3.3)	4.4 (3.3)	-0.12	4.2 (4.4)	4.2 (4.0)	0
Band 2	7.2 (2.7)	6.7 (2.9)	-0.18	6.4 (2.8)	5.8 (3.1)	-0.20 [a]	5.4 (4.1)	4.9 (3.9)	-0.13
Band 3	7.8 (2.4)	7.5 (2.5)	-0.12	7.0 (2.6)	6.9 (2.7)	-0.04	5.6 (4.2)	5.5 (3.8)	-0.02
Grade band									
3–5	6.6 (3.1)	6.3 (3.2)	-0.10	6.0 (3.1)	5.4 (3.2)	-0.19	5.1 (4.3)	4.4 (3.9)	-0.17
6–8	7.4 (2.8)	6.6 (3.1)	-0.27 [a]	6.3 (3.1)	5.9 (3.2)	-0.13	5.6 (4.0)	5.5 (4.0)	-0.02
9–12	6.5 (3.2)	7.0 (2.8)	0.17	5.7 (3.2)	5.9 (3.2)	0.06	4.7 (4.5)	4.8 (3.7)	0.02

Note. Maximum breadth in English language arts = 9, mathematics = 9, and science (core ideas) = 10.

[a] Small (*d* = .2) effect size.

Table 6

Mean and Standard Deviation of Depth of Instruction by Student Characteristics with Effect Sizes: 2018, 2019, and 2021

Student characteristics	English language arts			Mathematics			Science		
	2019 *M* (*SD*)	2021 *M* (*SD*)	*d*	2019 *M* (*SD*)	2021 *M* (*SD*)	*d*	2019 *M* (*SD*)	2021 *M* (*SD*)	*d*
Student level									
Foundational	2.2 (3.2)	2.2 (3.1)	0	1.9 (2.7)	1.7 (2.4)	-0.08	2.7 (4.3)	1.2 (2.8)	-0.42 [a]
Band 1	3.1 (3.3)	2.8 (3.1)	-0.09	2.5 (2.9)	2.1 (2.6)	-0.15	1.3 (3.1)	1.4 (2.6)	0.04
Band 2	4.4 (3.5)	4.0 (3.4)	-0.12	3.2 (3.1)	2.7 (2.9)	-0.17	2.0 (3.5)	1.3 (2.7)	-0.23 [a]
Band 3	5.0 (3.6)	4.4 (3.5)	-0.17	3.9 (3.1)	3.4 (3.1)	-0.16	1.7 (3.3)	1.8 (2.9)	0.03
Grade band									
3–5	4.0 (3.5)	3.5 (3.4)	-0.14	3.1 (3.1)	2.7 (2.9)	-0.13	1.7 (3.4)	0.8 (2.1)	-0.33 [a]
6–8	4.5 (3.7)	3.8 (3.5)	-0.19	3.5 (3.2)	2.9 (3.0)	-0.19	1.8 (3.4)	1.7 (2.9)	-0.03
9–12	3.8 (3.5)	3.9 (3.3)	0.03	2.8 (3.0)	2.6 (3.0)	-0.07	1.4 (3.3)	1.8 (2.8)	0.13

Note. Maximum depth in English language arts = 9, mathematics = 9, and science (core ideas) = 10.
[a] Small (*d* = .2) effect size.

Although declines in instructional breadth and depth from 2019 to 2021 were relatively minor, we also investigated the topics on which teachers spent the most time on in 2021 compared to 2019 (median and modal survey responses for the matched sample for each conceptual area/topic are in Table A2 in the appendix). From 2019 to 2021, teachers spent less instructional time on several conceptual areas, more so in ELA than in the other subject areas. Examining changes in the modal response showed that several conceptual areas went from 4 (>30 hours) in 2019 to 0 (0–5 hours) in 2021. These topics included determining critical elements of text, integrating ideas and information from text, using writing to communicate, and spelling grade- and ability-appropriate words. On the other hand, teachers spent a comparable amount of time in ELA on constructing understandings of text, using language to communicate with others, clarifying and contributing in discussion, and representing spoken sounds with appropriate letters. In mathematics, teachers spent less time on comparing, composing, and decomposing numbers and steps; teachers spent a comparable amount of time on understanding number structures, and calculating accurately and efficiently using simple arithmetic operations.

Table 7 compares the other OTL indicators on content and coverage for the matched sample. The results show negligible changes from 2019 to 2021 in access to curricula aligned to the DLM assessment. [4] The indicator on total hours of academic instruction showed an unexpected finding. There was a small decline in the percentage of students receiving 6–20 hours of instruction each week and a small increase in the percentage of students receiving more than 20 hours of weekly instruction. [5] However, the effect sizes for these differences were negligible.

[4] The survey item on the match of DLM testlets to instruction was not available in 2018.
[5] This unexpected finding may have been at least partly caused by the change in response options for this survey question. The 2019 response options are shown in Table 3, but the 2021 survey included the additional options *21–30 hours* and *more than 30 hours*.

This same trend appeared from 2018 to 2019 (not shown in Table 7). In the matched samples, the mean of the indicator for the match of DLM testlets to instruction was virtually the same in 2019 (M = 6.0, SD = 3.1) and 2021 (M = 6.2, SD = 3.2), as well as in 2018 (M = 5.7, SD = 3.0) and 2019 (M = 6.2, SD = 3.2).

Table 7

Opportunity to Learn (OTL) Indicators Based on Matched Sample

OTL indicator		2019		2021		Difference
		n	%	*n*	%	
Access to aligned curricula [a]	Disagree	539	14.1	517	12.4	-1.7
	Agree	3,284	85.9	3,642	87.6	1.7
Total hours of academic instruction each week [b]	0	76	0.6	118	0.9	0.3
	1–5 hours	1,081	8.4	1,241	9.7	1.3
	6–10 hours	1,696	13.2	1,466	11.4	-1.8
	11–15 hours	1,788	13.9	1,521	11.8	-2.1
	16–20 hours	3,094	24.0	2,491	19.4	-4.6
	> 20 hours	5,148	40.0	6,011	46.8	6.8

[a] $X^2(1, 1{,}460) = 27.6$; $p < .001$, $V = .14$. [b] $X^2(25, 12{,}443) = 399.5$, $p < .001$, $V = .08$.

Relationships During the Pandemic Between Instructional Conditions and OTL

Table 8 shows mean breadth and depth by time spent in each instructional setting in 2021. There were moderate to large effect sizes in mean breadth and depth for several instructional formats, and the results varied by subject. Note that the sample sizes for students spending more than 50% of their time in instructional settings other than in school were relatively small, so these results should be interpreted with caution. In ELA and to a lesser extent in mathematics, students spending more than 50% of their instructional time with their families providing instruction had less instructional breadth and depth than students spending less than 50% with their families providing instruction (d = -.42 and -.32, respectively). However, there was no difference in breadth and depth in science for students receiving instruction from their

families. As would be expected, in mathematics and to a lesser extent in ELA and science, students who were absent more than 50% of the time had substantially lower breadth and depth of instruction than students who were absent less than 50% of the time (*d* ranged from -.90 for mathematics breadth to -.24 for ELA depth). Notably, instructional breadth and depth in science were low for all students in 2019, even before the COVID-19 pandemic.

Table 9 compares mean breadth and depth of instruction for students affected by various instructional scheduling scenarios during the pandemic. Students who had an extended school year tended to have less breadth of instruction than students not having an extended school year. However, the effect sizes in all three subjects were small, and it is unknown how many of those students typically participate in an extended school year or whether students participating in extended schools differ in some way from those who do not, making it difficult to attribute these results to impacts from the COVID-19 pandemic. There were no impacts to breadth or depth of instruction for all other scheduling scenarios.

Table 10 presents partial correlations for the OTL variables with breadth and depth. In ELA, mathematics, and science, the match of assessment to instruction and total hours of weekly instruction are correlated with breadth and depth, after accounting for the effects of the other OTL indicators. However, the correlation coefficients are relatively small, ranging from .09 to .38. Access to aligned curricula, COVID-19 schedule impacts, and the percentage of time the student spent in school had negligible relationships with breadth and depth after accounting for the other OTL indicators.

Table 8

Mean Instructional Breadth and Depth by Percentage of Student's Instructional Time in Various Formats in 2021

Instructional format	≤ 50%			> 50%			Breadth *d*	Depth *d*
	n	Breadth *M* (*SD*)	Depth *M* (*SD*)	*n*	Breadth *M* (*SD*)	Depth *M* (*SD*)		
English language arts (ELA)								
In school	1,464	5.9 (3.4)	2.9 (3.2)	3,608	6.5 (3.1)	3.7 (3.3)	0.19	0.24 [b]
Remote, direct instruction 1:1	4,972	6.3 (3.2)	3.5 (3.3)	100	5.0 (3.4)	2.9 (3.2)	0.19	-0.18
Remote, direct instruction, group, or class	4,752	6.3 (3.2)	3.5 (3.3)	320	6.8 (3.0)	3.5 (3.2)	-0.41 [b]	0.00
Teacher in the home	5,060	6.3 (3.2)	3.5 (3.3)	12	--- [a]	---	---	---
Family provide instruction	4,985	6.3 (3.2)	3.5 (3.3)	87	5.3 (3.5)	2.0 (2.6)	-0.87 [d]	-0.46 [b]
Absent (no formal instruction)	5,009	6.3 (3.2)	3.5 (3.3)	63	5.3 (3.7)	2.7 (3.4)	-0.31 [b]	-0.24 [b]

Instructional format	≤ 50%			> 50%			Breadth	Depth
	n	Breadth *M* (*SD*)	Depth *M* (*SD*)	*n*	Breadth *M* (*SD*)	Depth *M* (*SD*)	*d*	*d*
Mathematics								
In school	1,546	5.2 (3.3)	2.3 (2.7)	3,750	5.9 (3.1)	2.9 (2.8)	0.22 [b]	0.22 [b]
Remote, direct instruction 1:1	5,169	5.7 (3.1)	2.7 (2.8)	127	5.3 (3.2)	2.5 (2.7)	-0.13	-0.07
Remote, direct instruction, group, or class	4,961	5.7 (3.2)	2.7 (2.8)	335	6.4 (2.8)	3.0 (2.9)	0.22 [b]	0.11
Teacher in the home	5,282	5.7 (3.1)	2.7 (2.8)	14	---	---	---	---
Family provide instruction	5,217	5.7 (3.1)	2.7 (2.8)	79	4.4 (3.3)	1.8 (2.6)	-0.42 [b]	-0.32 [b]
Absent (no formal instruction)	5,241	5.7 (3.1)	2.7 (2.8)	55	2.9 (3.4)	1.2 (2.3)	-0.90 [d]	-0.54 [c]
Science								
In school	568	3.7 (3.8)	1.0 (2.3)	1,451	4.7 (3.9)	1.4 (2.6)	0.26 [b]	0.16
Remote, direct instruction 1:1	1,988	4.5 (3.9)	1.3 (2.5)	31	2.4 (3.2)	.55 (1.9)	-0.54 [c]	-0.30 [b]
Remote, direct instruction, group, or class	1,894	4.5 (3.9)	1.3 (2.5)	125	3.8 (3.8)	1.3 (2.6)	-0.18	0.00

Instructional format	≤ 50%			> 50%			Breadth	Depth
	n	Breadth *M* (*SD*)	Depth *M* (*SD*)	*n*	Breadth *M* (*SD*)	Depth *M* (*SD*)	*d*	*d*
Teacher in the home	2,015	4.4 (3.9)	1.3 (2.5)	4	---	---	---	---
Family provide instruction	1,986	4.4 (3.9)	1.3 (2.5)	33	3.7 (4.1)	1.2 (2.7)	-0.18	-0.04
Absent (no formal instruction)	1,998	4.4 (3.9)	1.3 (2.5)	21	3.0 (3.3)	0.2 (0.6)	-0.36 [b]	-0.44 [b]

Note. Maximum breadth and depth in ELA = 9, mathematics = 9, and science (core ideas) = 10.
[a] Effect sizes (*d*) were not computed when $n < 25$ for at least one group. [b] Small ($d \geq .2$) effect size; [c] medium ($d \geq .5$) effect size;
[d] large ($d \geq .8$) effect size.

Table 9

Mean Instructional Breadth and Depth by School Scheduling Scenarios in 2021

School Scheduling Scenario	Did not occur for the student			Did occur for the student			Breadth	Depth
	n	Breadth *M* (*SD*)	Depth *M* (*SD*)	*n*	Breadth *M* (*SD*)	Depth *M* (*SD*)	***d***	***d***
English language arts								
Delayed start	4,078	6.4 (3.1)	3.6 (3.3)	1,491	6.5 (3.1)	3.5 (3.3)	0.03	-0.03
Lengthened spring semester	5,331	6.4 (3.1)	3.6 (3.3)	238	6.3 (3.3)	3.3 (3.4)	-0.03	-0.09
Extended school year	3,318	6.7 (3.0)	3.7 (3.3)	2,251	6.0 (3.2)	3.4 (3.2)	-0.23 [a]	-0.09
Change(s) between remote and in-person	1,646	6.4 (3.2)	3.7 (3.4)	3,923	6.4 (3.1)	3.5 (3.3)	0	-0.06
Mathematics								
Delayed start	4,343	5.8 (3.1)	2.8 (2.8)	1,628	5.7 (3.1)	2.7 (2.9)	-0.03	-0.04
Lengthened spring semester	5,745	5.8 (3.1)	2.8 (2.8)	226	5.8 (3.1)	2.9 (3.1)	0.00	0.04
Extended school year	3,695	6.1 (3.0)	3.0 (2.9)	2,276	5.3 (3.2)	2.5 (2.7)	-0.26 [a]	-0.18
Change(s) between remote and in-person	1,702	5.8 (3.2)	2.9 (2.9)	4,269	5.8 (3.1)	2.8 (2.8)	0	-0.04
Science								
Delayed start	1,619	4.6 (3.9)	1.3 (2.5)	564	4.6 (3.9)	1.5 (2.7)	0.00	0.08
Lengthened spring semester	2,073	4.6 (3.9)	1.3 (2.6)	110	5.3 (3.7)	1.6 (2.8)	0.18	0.11
Extended school year	1,474	4.9 (4.0)	1.4 (2.6)	709	3.9 (3.7)	1.1 (2.5)	-0.26 [a]	-0.12
Change(s) between remote and in-person	685	4.7 (3.9)	1.4 (2.7)	1,498	4.5 (3.9)	1.3 (2.5)	-0.05	-0.04

Note. Maximum breadth and depth in English language arts = 9, mathematics = 9, and science (core ideas) = 10.
[a] Small (*d* = .2) effect size.

Table 10

Partial Correlations of Opportunity to Learn Indicators With Breadth and Depth of Instruction by Subject

Variable	English language arts		Mathematics		Science	
	Breadth	Depth	Breadth	Depth	Breadth	Depth
Match of instruction to assessment	.38 [a]	.25 [a]	.37 [a]	.23 [a]	.33 [a]	.23 [a]
Weekly hours of instruction	.20 [a]	.18 [a]	.28 [a]	.26 [a]	.09	.13 [a]
Access to aligned curricula	.08 [a]	.03	.06 [a]	.04	.07	.01
COVID-19 schedule impact	.02	.03	-.04	-.05	-.10	-.04
COVID-19 time in school	.03	.09 [a]	.03	.03	.10	.03

[a] t is statistically significant at $p < .01$.

Discussion

It is important to collect data on instructional conditions and OTL to understand the potential impact of the pandemic on students with SCD. This study's findings provide contextual information to consider when determining how to best meet these students' needs in coming years. The indicators developed in this study can be used in future years to monitor OTL for students with SCD. This information can be used to help teachers provide meaningful instruction on challenging academic standards. Overall, the findings suggest no major changes in instructional breadth and depth from 2019 to 2021, but there were some noticeable declines for particular subgroups in science, including students at the lowest level of achievement.

Although the number of topics and length of time spent on instruction were similar across the 2 years, teachers focused on different topics in 2021. Importantly, the findings reveal that, even before the pandemic, students with SCD may not have received adequate breadth and depth of academic instruction aligned to high expectations. This is especially true in science, where on average, students received instruction on only about half of the science core ideas and science

and engineering practices measured by DLM assessments. This finding corroborates research showing that teachers of SCD may approach curriculum broadly at the expense of depth or complexity (Karvonen et al., 2009) and instruct on skills that are not aligned with challenging standards (Karvonen et al., 2013).

After accounting for the match of instruction to assessment and the number of hours of weekly instruction, specific instructional conditions during the COVID-19 pandemic did not show a significant relationship to students' breadth and depth of instruction. However, it appears that, for at least some students, instructional conditions during the pandemic may have had some impact on OTL as measured in this study. Although there was a small proportion of students who spent more than half of their instructional time receiving instruction from family members or were absent more than 50% of the time, these students had substantially lower breadth and depth of instruction compared to other students. However, we did not examine whether students spending more than half of their time absent or at home differed systematically from other students. For instance, this group may have included medically fragile students whom we would expect to have lower breadth and depth of instruction in a typical year because of frequent absences or other circumstances.

There are several other caveats to keep in mind when interpreting the findings. We recognize that the data from the DLM teacher survey do not represent all dimensions of OTL described in the literature, particularly the dimensions of quality of instruction and student engagement. In an open-ended survey item (not described in this paper), teachers described a variety of factors affecting students' instruction during the pandemic that were not captured in the survey items we used in this study, including difficulties with remote learning (e.g., technology issues, lack of access to materials, lack of student engagement, parental support),

COVID-19 safety protocols and social distancing, students' mental and physical health, and family hardships (ATLAS, 2021). Furthermore, although teacher surveys are typically the most economical way to measure OTL and impose the smallest burden on teachers, they rely on teacher self-reporting and recollection of instructional practice for the year. Teachers may have difficulty recalling their instructional practice over extended periods of time (Blank et al., 2001).

Although this study's findings provide evidence suggesting that the COVID-19 pandemic may have affected OTL for students with SCD, additional research is needed to understand the full impact of the pandemic. The 2021 survey had a lower response rate and different participating states than in previous years, and survey data mostly represent students who took the DLM assessment. It is reasonable to assume that students who were not assessed this past year were those most affected by the pandemic and experienced the greatest impact to their OTL, and research indicates that participation in DLM assessments in 2021 differed from prepandemic years (ATLAS, 2021). The comparison of 2019 and 2021 data is also affected by changes in the DLM assessment's blueprint and administration model during this time frame, which may have affected students' OTL. These changes are detailed in ATLAS (2021). Finally, it is well known that the pandemic had different impacts on communities according to their population density or locale (e.g., urban or rural); however, we did not collect this data to incorporate into the analyses. Future work will continue to evaluate OTL for students with SCD to better understand their experiences and needs so that we can determine how to best support these students in the future.

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Appendix A: Supplementary Tables

Table A1

Survey Blocks for Teacher Survey With Number and Percentage of Respondents

	2018		2019		2021	
Block [a]	*n*	%	*n*	%	*n*	%
A: Fixed	56,634	95.1	53,353	96.4	38,502	97.1
B: Accessibility	13,183	22.1	14,770	26.7	19,866	50.1
B: Technology	12,584	21.1	13,388	24.2	---	---
B: OTL—ELA	5,495	9.2	5,736	10.4	7,647	19.3
B: OTL—Mathematics	5,463	9.2	5,741	10.4	8,058	20.3
B: OTL—Science	1,929	3.2	2,273	4.1	2,919	7.4
B: Teacher experience	12,457	20.9	---	---	---	---
N: COVID-19 instructional conditions	---	---	---	---	38,401	96.8
C: Teacher background	50,062	84.1	2,347	4.2	39,661	100.0
Total	59,543	100.0	55,340	100.0	39,661	100.0

[a] Blocks A, C, and N (where relevant) were assigned to all teachers. One Block B option is randomly assigned per survey. The *n*s and percentages are based on the number who responded to at least one question in the survey block.

Table A2

Median and Mode of Instructional Time Spent on English Language Arts, Mathematics, and Science in 2019 and 2021

Topic	2019			2021		
	n	Median	Mode	*n*	Median	Mode
English language arts						
Determine critical elements of text	1,446	2	4	2,443	2	0
Construct understandings of text	1,444	3	4	2,424	3	4
Integrate ideas and information from text	1,438	2	4	2,408	2	4
Use writing to communicate	1,444	2	4	2,424	2	0
Integrate ideas and information in writing	1,438	2	0	2,410	2	0
Use language to communicate with others	1,445	4	4	2,430	3	4
Clarify and contribute in discussion	1,442	3	4	2,421	2	4
Use sources and information	1,446	1	0	2,422	1	0
Collaborate and present ideas	1,443	2	0	2,424	1	0
Writing						

Topic	2019			2021		
	n	Median	Mode	*n*	Median	Mode
Represent spoken sounds with appropriate letter(s)	1,440	3	4	2,440	2	4
Spell grade- and ability-appropriate words	1,438	2	4	2,426	2	0
Use different sentence types in writing	1,430	1	0	2,416	1	0
Organize information using a specific text structure when writing	1,437	1	0	2,416	1	0
Identify or correct errors in writing	1,434	1	0	2,418	1	0
Identify or remove gaps in writing	1,437	1	0	2,413	1	0
Elaborate on or focus content in writing	1,437	1	0	2,406	1	0
Mathematics						
Understand number structures counting place value fraction	1,490	3	4	2,607	3	4
Compare, compose, and decompose numbers and steps	1,477	2	4	2,581	2	0
Calculate accurately and efficiently	1,483	3	4	2,575	2	4
Solve problems involving area perimeter and volume	1,482	0	0	2,574	0	0
Understand and use measurement principles and units of measure	1,481	1	0	2,571	1	0
Represent and interpret data displays	1,472	1	0	2,560	1	0
Use operations and models to solve problems	1,479	2	0	2,573	1	0
Understand patterns and functional thinking	1,487	2	0	2,583	2	0
Science core ideas						
Physical science matter and its interactions	334	1	0	1,043	0	0
Physical science motion and stability: Forces and interactions	334	1	0	1,035	0	0
Physical science energy	333	1	0	1,031	0	0
Life science: From molecules to organisms: Structure and processes	329	0	0	1,030	0	0
Life science: Ecosystems: Interactions, energy, and dynamics	334	1	0	1,035	1	0

Topic	2019			2021		
	n	Median	Mode	*n*	Median	Mode
Life science: Heredity: Inheritance and variation of traits	334	0	0	1,030	0	0
Life science: Biological evolution: Unity and diversity	326	0	0	1,027	0	0
Earth and space science: Earth's place in the universe	332	1	0	1,038	1	0
Earth and space science: Earth's systems	333	1	0	1,034	1	0
Earth and space science: Earth and human activity	334	1	0	1,040	1	0
Science and engineering practices						
Developing and using models	333	0	0	1,049	0	0
Planning and carrying out investigations	334	1	0	1,047	1	0
Analyzing and interpreting data	334	1	0	1,046	1	0
Using mathematics and computational thinking	334	1	0	1,044	1	0
Constructing explanations and designing solutions	333	1	0	1,044	0	0
Engaging in argument from evidence	333	0	0	1,046	0	0
Obtaining, evaluating, and communicating information	335	1	0	1,050	1	0

Note. 0 = 0–5 hours, 1 = 6–10 hours, 2 = 11–15 hours, 3 = 16–20 hours, and 4 = more than 20 hours. The data in this table are based on the same group of students in 2019 and 2021; however, the *n*s and descriptive statistics for each topic are not based on the same students. Although all students represented in this table had survey data in both years, because of the spiraling of the survey blocks, not all students had responses to these particular items.