

# Addendum: The 2019 NAEP Data on Technology and Achievement Outcomes

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### SUMMARY

For this memo, Reboot researchers examined education technology outcomes using the most recent National Assessment of Educational Progress (NAEP) data. The analysis replicated the original Reboot paper, and showed that there's a very weak connection between outcomes and many education technologies in American schools.

In some cases, the results show a highly negative correlation between devices and student learning. For example, students who use a computer for English language-arts work for less than 30 minutes a day score 23 points higher on a reading exam than students who use a computer for English language-arts work for four or more hours a day.

This negative relationship in the 2019 data is over four standard deviations — a very large difference. Still, we cannot say that technology actually caused these outcomes, due to limitations in the data.

## BACKGROUND

In June, the Reboot Foundation released a paper that showed a weak link between technology and outcomes internationally. In the study, the researchers found little evidence of a positive relationship between students' performance on the Program for International Student Assessment (PISA) and their self-reported use of technology, and some evidence of a negative impact.

In the June paper, the researchers also showed that the relationship between technology and outcomes was mixed on the NAEP. The results of the NAEP analysis varied widely depending on grade level, assessment, and reported technology use.



The results from the June study were particularly worrisome with respect to tablet use in fourthgrade classes, and the data showed a clear negative relationship with testing outcomes.

Fourth-grade students who reported using tablets in "all or almost all" classes scored 14 points lower on the reading exam than students who reported "never" using classroom tablets. This difference in scores is the equivalent of a full grade level, or a year's worth of learning.

The June study used 2017 NAEP reading and math assessments to explore these correlations between technology use and student achievement. This memo is an update to those findings.

## **METHODS**

Reboot researchers downloaded state-level 2019 data from the NAEP's data explorer tool for grades 4 and 8, in both math and reading.

The NAEP asks questions of both teachers and students about their use of technology in the classroom. The data allowed researchers compare the average state scores to levels of in-class technology use.

Each question has a set of response options that range from using a given technology very little (i.e., "Never or hardly at all" or "Not used") to using the technology a lot (i.e., "Always or almost always" or "In almost all classes" or "As a basis for instruction"). This gives researchers correlations between scores and technology use, but little else.

As noted in the June report, the data come with many caveats. First, it's hard to know what these data mean without co-variation data, and this study could look only at correlation, not causation.

It's also unclear how teachers and students are interpreting these questions. For example, what's the difference between a "math enrichment activity," "researching math topics on the internet," and "reviewing or practicing math problems"? These categories may not be mutually exclusive.

### **FINDINGS**

*Replication of Results.* Broadly speaking, our researchers found the same trends as in the previous study, with wide variation across activities and outcomes.

For instance, there were hints of a technology ceiling effect. For many activities measured by the NAEP background questionnaire, the researchers found that the lowest-use category (i.e., "never" use technology or zero devices per student) had the lowest scores, while the next lowest-use category had the highest or very high scores. This suggests that a little technology can have some benefits. Our team saw this trend in the 2017 data as well.

But more technology use is often not associated with higher scores. Our research found this pattern to be true with activities like "using computers or digital devices for math enrichment



activities" (Grade 4 Math), "using computers or digital devices to research math topics on the internet" (Grade 4 Math), and "how often do students use a laptop or desktop computer during class" (Grade 4 Math).



In other cases, more technology use is clearly associated with worse scores. With "using computers or digital devices to practice or review math topics" (Grade 4 Math), scores decrease from 245 to 240 as students go from doing this activity a little to doing this activity a lot in school.

*Negative Relationships.* One of the striking trends we noted in our earlier work was that fourthgrade students who reported using tablets in "all or almost all" classes scored 14 points lower on the reading exam than students who reported "never" using classroom tablets. The same pattern holds in the 2019 data, but the difference is slightly larger at 15 points.

We also ran state level data. The overall negative relationship between using tablets and reading scores held true for all states. Fourth-grade students who reported using tablets in "all or almost all" classes in Georgia, for instance, also scored 15 points lower on the reading exam than students who reported "never" using classroom tablets.

In some states, the gap was very large. Fourth-grade students who reported using tablets in "all or almost all" classes in Rhode Island scored 38 points lower on the reading exam than students who reported "never" using classroom tablets. Other areas with more than a 26-point gap include Arkansas, Missouri, and the District of Columbia.

This trend regarding tablets held true across different school profiles, and while that approach does not fully account for different socio-economic needs, it suggests that student needs are not the driver of the issue.

Scores for tablet-related activities, like games and apps, are similarly dismal. For reading-related apps, educational games, and electronic textbooks, more usage is associated with worse scores. This raises questions about the value of these approaches as a basis for instruction.



Similarly, students who never used reading-related educational games outperformed students who used them as a basis for instruction by six points in Grade 4 and 11 points in Grade 8.

*Beyond Tablets.* Other areas of technology use that also appeared to have negative ties to outcomes were extensive use of computers for English language-arts work. Students who use a computer for English language-arts work for less than 30 minutes a day score 23 points higher than students who use a computer for English language-arts work for four or more hours a day. This is over four standard deviations — a very large difference.

The overall negative relationship between using a computer for English language-arts work and reading scores held true for all states. In Georgia, students who use a computer for English language-arts work for less than 30 minutes a day score 22 points higher than students who use a computer for English language-arts work for four or more hours a day.

In some states, the gap was very large. Students who use a computer for English languagearts work for less than 30 minutes a day in DC score 37 points higher than students who use a computer for English language-arts work for four or more hours a day. Other states with more than a 29-point gap include Wisconsin, Pennsylvania, and Michigan.

### CONCLUSION

As in our previous study, the results underscore the complexity of the relationship between classroom technology and student learning. Furthermore, there are many caveats, given the correlational nature of the data. Still, the results do highlight some worrying trends, and far more needs to be done to deepen our understanding of how technology affects learning outcomes across the board.



#### Appendix A: Summaries of state-level scores

	Never or hardly ever	Once or twice a year	Once or twice a month	Once or twice a week	Every day or almost every day		
	Gra	de 4 Math					
Students use computers or digital devices for math enrichment activities	238 (6.57)	241 (6.61)	241 (5.36)	241 (4.52)	241 (5.17)		
Students use computers or digital devices to research math topics on the internet	238 (6.64)	241 (6.66)	241 (5.41)	241 (4.57)	241 (5.22)		
Students use computers or digital devices to practice or review math topics	239 (6.85)	245 (6.06)	242 (6.82)	241 (4.62)	240 (4.78)		
Grade 4 Reading							
Students access reading related websites	218 (8.18)	222 (6.11)	222 (5.96)	222 (5.01)	218 (6.27)		
	Gra	de 8 Math					
Students use computers or digital devices for math enrichment activities	283 (8.28)	286 (6.07)	284 (6.64)	279 (6.20)	277 (8.76)		
Students use computers or digital devices to research math topics on the internet	282 (5.99)	284 (5.91)	281 (6.82)	278 (9.78)	275 (7.72)		
Students use computers or digital devices for online resources to help with math assignments	283 (7.76)	289 (8.11)	287 (6.85)	280 (5.99)	274 (5.49)		



	Never	In some classes	About half the classes	Grea- ter than half the classes	All or almost all			
	Gra	de 4 Math						
How often do students use a laptop or desktop during class	230 (7.02)	241 (5.44)	241 (4.98)	241 (5.98)	240 (5.26)			
How often do students use a tablet during class	243 (4.38)	240 (5.64)	231 (8.09)	229 (9.16)	232 (7.70)			
How often did students use computers or tablets at school this year	226 (6.10)	242 (5.16)	241 (5.14)	240 (6.37)	240 (5.01)			
	Grad	e 4 Reading						
How often do students use a laptop or desktop during class	205 (8.88)	223 (5.14)	221 (5.73)	220 (6.67)	221 (5.50)			
How often do students use a tablet during class	224 (4.57)	220 (5.03)	207 (8.48)	206 (9.70)	209 (8.71)			
How often did students use computers or tablets at school this year	203 (7.09)	223 (5.06)	221 (5.65)	219 (6.97)	220 (5.43)			
	Gra	de 8 Math						
How often do students use a laptop or desktop during class	261 (11.3)	272 (6.17)	278 (6.54)	283 (6.71)	286 (6.99)			
How often do students use a tablet during class	283 (6.10)	279 (7.02)	269 (7.97)	271 (10.6)	279 (11.9)			
How often did students use computers or tablets at school this year	275 (11.4)	274 (6.84)	279 (6.43)	284 (6.55)	286 (6.79)			
Grade 8 Reading								
How often do students use a laptop or desktop during class	256 (8.85)	255 (5.90)	262 (6.07)	265 (5.48)	268 (5.69)			
How often do students use a tablet during class	264 (5.61)	260 (5.83)	249 (8.53)	254 (8.46)	261 (9.13)			
How often did students use computers or tablets at school this year	248 (8.77)	254 (5.80)	261 (6.28)	264 (5.59)	267 (5.76)			



	Zero devices	Greater than five students per device	Three to five students per device	Two to three students per device	One to two students per device	Less than one student per device		
		Grade 4 M	ath					
Ratio of students to combined number of laptops and tablets	231 (6.06)	238 (6.21)	238 (7.49)	240 (6.74)	239 (6.31)	240 (4.89)		
	Ģ	irade 4 Rec	ading					
Ratio of students to combined number of laptops and tablets	210 (9.09)	217 (7.85)	218 (8.34)	219 (6.58)	220 (6.77)	220 (5.50)		
		Grade 8 M	ath					
Ratio of students to combined number of laptops and tablets	270 (26.1)	279 (7.09)	280 (9.11)	282 (12.2)	282 (8.47)	281 (6.78)		
Grade 8 Reading								
Ratio of students to combined number of laptops and tablets	255 (11.3)	262 (7.55)	262 (8.11)	262 (7.95)	264 (8.14)	263 (5.80)		

	Never L or hardly that ever the		About half the time	Greater than half the time	All or most of the time				
Grade 4 Math									
Teacher used computer235242242245or digital device to teach math(5.72)(5.29)(4.32)(4.95)					241 (4.98)				
	Gra	de 8 Math							
Teacher used computer or digital device to work out math problems	279 (7.59)	284 (6.55)	277 (6.40)	284 (5.95)	282 (6.80)				
Student used the internet for math work	282 (6.74)	285 (5.97)	278 (6.03)	282 (6.70)	280 (8.89)				



	Not used	Supplement	Basis for instruction					
Grade 4 Reading								
Student use of reading-related educational games	223	220	217					
	(6.46)	(5.02)	(7.92)					
Student use of reading-related websites or apps	219	221	219					
	(7.84)	(4.93)	(7.23)					
Student use of electronic textbooks	221	221	218					
	(5.20)	(5.65)	(2.62)					
	Grade 8 Read	ing						
Student use of reading-related educational games	266	262	255					
	(5.29)	(4.79)	(8.05)					
Student use of reading-related websites or apps	264	264	260					
	(8.15)	(4.81)	(5.96)					
Student use of electronic 264		262	259					
textbooks (5.32)		(4.69)	(6.04)					

	Less than 30 minutes	About 30 minutes	About 1 hour	About 2 hours	About 3 hours	4 or more hours		
Grade 8 Reading								
Time per day spent on a computer or digital device for English language-arts work	268 (5.14)	264 (6.38)	262 (6.13)	259 (6.96)	256 (4.84)	245 (5.38)		



#### Appendix B: Georgia's average scores on the same variables

	Never or hardly ever	Once or twice a twice a year month		Once or twice a week	Every day or almost every day
	Grad	e 4 Math			
Students use computers or digital devices for math enrichment activities	231	231 -		239	241
Students use computers or digital devices to research math topics on the internet	238	240	241	237	234
Students use computers or digital devices to practice or review math topics	236	- 236		240	238
	Grade	4 Reading			
Students access reading		222	228	221	215
	Grad	le 8 Math			
Students use computers or digital devices for math enrichment activities	268	287	281	278	277
Students use computers or digital devices to research math topics on the internet	281	282	279	273	283
Students use computers or digital devices for online resources to help with math assignments	284	291	285	277	273



	Never	In some classes	About half the classes	Greater than half the classes	All or almost all				
Grade 4 Math									
How often do students use a laptop or desktop during class	226	238	237	238	240				
How often do students use a tablet in class	240	241	229	223	227				
How often did students use computers or tablets at school this year	228	238	238	236	239				
	Gi	ade 4 Readin	9						
How often do students use a laptop or desktop during class	203	218	218	218	222				
How often do students use a tablet in class	221	222	206	198	204				
How often did students use computers or tablets at school this year	210	219	218	215	220				
	(	Grade 8 Math							
How often do students use a laptop or desktop during class	272	272	274	284	285				
How often do students use a tablet in class	280	282	268	275	280				
How often did students use computers or tablets at school this year	260	271	272	283	285				
	Gi	rade 8 Readin	9						
How often do students use a laptop or desktop during class	257	253	261	261	268				
How often do students use a tablet in class	262	263	263	260	264				
How often did students use computers or tablets at school this year	249	252	260	261	268				



	Zero devices	Greater than five students per device	Three to five students per device	Two to three students per de vice	One to two students per device	Less than one student per device			
Grade 4 Math									
Ratio of students to combined number of laptops and tablets	-	-	236	241	237	238			
	G	irade 4 Rec	nding						
Ratio of students to combined number of laptops and tablets	-	-	220	223	215	219			
		Grade 8 M	ath	·					
Ratio of students to combined number of laptops and tablets	277	282	286	294	278	278			
Grade 8 Reading									
Ratio of students to combined number of laptops and tablets	260	266	263	270	261	262			



	Not used	Supplement	Basis for instruction					
Grade 4 Reading								
Student use of reading-related educational games	225	219	216					
Student use of reading-related websites or apps	221	220	216					
Student use of electronic textbooks	220	218	217					
	Grade 8 Re	ading						
Student use of reading-related educational games	265	263	255					
Student use of reading-related websites or apps	257	262	265					
Student use of electronic textbooks	265	261	261					

	Less than 30 minutes	About 30 minutes	About 1 hour	About 2 hours	About 3 hours	4 or more hours		
Grade 8 Reading								
Time per day spent on a computer or digital device for English language-arts work	267	263	262	259	254	245		