

# Mathematics Learning Loss due to Interruptions in Formal Education

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# Overview

- School interruptions due to the COVID-19 pandemic
- The need to look into student performance in different domains of math
- Results from benchmark assessments before and during the pandemic
- Implications to learning



# School Interruptions

2018-19  
Full School Year

2019-2020  
Interrupted

2020-2021  
Interrupted



# The need

- Declining performance in reading and math during the pandemic
- Performance got worse as the pandemic continued (fall vs. spring results)
- Math is significantly affected
- Lower grade levels are significantly affected



# The need

- Early results from benchmark assessments focused on overall performance
- There is need to look into different domains of math (instructional areas) to maximize the use of resources



# Definition of terms

- Math Domains also known as instructional areas or math strands
  - Operations and Algebraic Thinking
  - Number and Operations
  - Measurement and Data
  - Geometry
  - The Real and Complex Numbers
  - Statistics and Probability



# Definition of terms

- RiT score - Rasch UniT
  - An equal interval scale developed to interpret test scores
  - Ranges from 100-350
  - Vertical Scale



# Definition of terms

- SIFE == Students with Interrupted Formal Education – [who are these students?](#)
- Historically associated with immigrants with limited English proficiency, limited formal schooling and at risk of failing (Costodio & O’Loughlin, 2020, Decapua & Marshall, 2011)





# SIFE continued...

- Students who speak an additional language(s), have entered a US school after second grade and are two years behind their peers in math and reading (Hos, 2020)
- Perspective is reflected in intervention e.g., for NY State Education Department, a student must first be an ELL before they can be identified as a SIFE



# SIFE continued...

- Effects of learning loss are not limited to immigrants
- Interruptions to formal Schooling are caused by several factors:
  - Inclement weather (Marcotte & Hemelt, 2008)
  - Natural disasters e.g., EBOLA outbreak (Bakrania et al., 2020, earthquake in Pakistan (Andrabi, Daniels & Das, 2021)
  - Juvenile justice facilities, chronic health issues, and housing instability



# SIFE continued...

- We move away from the traditional notion and conceptualize SIFE as students with significant interruption to their formal schooling (similar to Chang-Bacon, 2021)
- Important to know, who needs help? In what? How much help do they need? (Betebenner & Wenning, 2021)



# Methods

- Data is from 48 schools in grades 3-5 who administer fall and spring assessments from Northwest Evaluation Association (NWEA)
- Performance comparisons for 2018-2019, 2019-2020 (prior to COVID-19) and 2020-2021 (during the pandemic) – mean score comparisons using one way ANOVA



# Research Questions

- Are students experiencing declines in math performance across all math domains within grade levels?
- Which specific grade levels and domains are of high concern?



# Domains Tested by Grade

Grades 3-5	Grades 6-8
Operations and Algebraic Thinking (OA)	Operations and Algebraic Thinking (OA)
Number and Operations (NO)	The Real and Complex Numbers (RCN)
Measurement and Data (MD)	Geometry
Geometry	Statistics and Probability (SP)



# Grade Three Performance

	2018-2019			2019-2020			2020-2021		
Domain	N	Mean	SD	N	Mean	SD	N	Mean	SD
Operations and Algebraic Thinking	2394	187.3	15.2	2457	187.1	15.5	2233	180.3	17.8
Number and Operations	2394	186.6	14.5	2457	186.1	14.4	2233	184.0	17.1
Measurement and Data	2394	186.6	15.2	2457	185.9	15.0	2233	185.6	16.1
Geometry	2394	188.3	15.5	2457	188.1	15.1	2233	187.1	16.4
Overall	2394	187.2	13.7	2457	186.8	13.6	2233	184.2	14.7

Grade 3 Fall Norm Score = 188.5



# Performance Summary: Grade 3

- Significant difference in performance for 2020-21 school year in:
  - Operations and Algebraic Thinking
  - Number and Operations
  - Geometry
- Post hoc analysis indicate that the performance in 2018-2019 and 2019-2020 were similar





# Grade Four Performance

	2018-2019			2019-2020			2020-2021		
Domain	N	Mean	SD	N	Mean	SD	N	Mean	SD
Operations and Algebraic Thinking	2232	198.8	15.4	2389	198.6	15.8	2297	194.3	18.3
Number and Operations	2232	197.4	14.4	2389	197.5	15.0	2297	194.2	17.0
Measurement and Data	2232	197.0	16.0	2389	196.5	15.9	2297	193.3	16.7
Geometry	2232	198.3	15.7	2389	198.5	15.7	2297	194.7	14.9
Overall	2232	197.9	14.1	2389	197.8	14.4	2297	194.1	14.8

Grade 4 Fall Norm Score = 199.6



# Performance Summary: Grade 4

- Significant difference in performance for 2020-21 school year in all four domains:
  - Operations and Algebraic Thinking
  - Number and Operations
  - Measurement and Data
  - Geometry
- Post hoc analysis indicate that the performance in 2018-2019 and 2019-2020 were similar



# Grade Five Performance

	2018-2019			2019-2020			2020-2021		
Domain	N	Mean	SD	N	Mean	SD	N	Mean	SD
Operations and Algebraic Thinking	2252	207.6	16.2	2230	206.7	16.2	2166	203.9	17.4
Number and Operations	2252	208.0	16.6	2230	207.3	16.8	2166	206.3	18.0
Measurement and Data	2252	206.2	17.7	2230	205.2	17.4	2166	202.1	17.9
Geometry	2252	207.9	16.6	2230	207.3	16.9	2166	201.7	16.5
Overall	2252	207.4	15.7	2230	206.6	15.7	2166	203.5	15.8

Grade 5 Fall Norm Score = 209.1



# Performance Summary: Grade 5

- Significant difference in performance for 2020-21 school year in all four domains:
  - Operations and Algebraic Thinking
  - Number and Operations
  - Measurement and Data
  - Geometry
- Post hoc analysis indicate that the performance in 2018-2019 and 2019-2020 were similar



# Conclusions: Effects of School Interruptions

- Grade 3: The effects are in OA, Number, Geometry **but not in MD.**
- Grade 4-5: Performance declined in all domains.
- MD is the lowest performed domain, and its low scores have not gone lower during the pandemic.
- Pattern is unclear: only grade 4 to 6 had declines in all domains. Grades 7 and 8 had declines in some domains but not all.



# Conclusions

- This study has not analyzed the data for different demographic groups.
- In a predictive study of the effects of school interruptions due to COVID-19 that was based on data from 174 countries, Azevedo (2021) wrote that the effects will likely be exacerbated for marginalized and vulnerable groups, such as girls, ethnic minorities, and persons with disabilities.
- NWEA assessment reports and Store et al. (2022) indicate that the COVID-19 pandemic has higher effects on students from low SES, ethnic minorities, and students who were not performing well before the pandemic.



# Performance Changes – 2017-2020

Grade	No Changes	Changes
3	MD	OAT, NO, Geometry
4		OAT, NO, MD, Geometry
5		OAT, NO, MD, Geometry
6		OAT, RCN, Stats and Probability, Geometry
7	RCN	OAT, Stats and Probability, Geometry
8	OAT, RCN	Stats and Probability, Geometry



# Questions?

Are these results consistent with what we using 2021-2022 data?



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