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Zaner-Bloser Kickstart: Number Sense

Efficacy Study in Oregon, Fall 2021 to Spring 2023

Authors:

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JUNE, 2024

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MODERATE EVIDENCE

LXD Research Recognition for Zaner-Bloser Kickstart: Number Sense

Zaner-Bloser

KICKSTART Number Sense

This product has been rigorously evaluated and is hereby acknowledged for meeting the educational impact criteria of the Every Student Succeeds Act (ESSA), warranting a **Level 2** for "**Moderate Evidence**." This recognition is based on its proven effectiveness in enhancing grade-level learning outcomes.

REVIEWED BY THE LXD RESEARCH EXPERT REVIEW PANEL

CERTIFIED BY:

Rachel Schechter, Ph.D.
Founder of LXD Research

June 25, 2024

DATE

Understanding ESSA Evidence

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Educators search for high-quality research and evidence-based interventions to strengthen grant applications, to support comprehensive and targeted schools, or to implement new programming in their schools. Evidence requirements under the Every Student Succeeds Act (ESSA) are designed to ensure that states, districts, and schools can identify programs, practices, products, and policies that work across various populations.

Educational programs document their evidence of design, effectiveness, and impact in order to be eligible for federal funding. While there is no singular authority that determine's a program's tier, the Department of Education's Office of Educational Technology provides standards to assess the varying levels of strength of research for education products.

The categories for ESSA Evidence are: strong (Tier 1) , moderate (Tier 2), and promising (Tier 3) evidence of effectiveness, or demonstrates a rationale to be effective (Tier 4).

This product meets the requirements for Tier 2:

- In a quasi-experimental design, students who used the program are examined against a comparison group through matching.
- At least one quasi-experimental study with the proper design and implementation with at least two teachers and a multi-site sample of 350 students showed statistically significant, positive findings.
- The study uses a program implementation that could be replicated.
- A third-party research organization has reviewed the documentation for ESSA validation.

When product designers leverage learning sciences to design and evaluate the effectiveness of their programs, educators can better target instruction, and students' skills soar. A matched, quasi-experimental study design using standardized assessment data, an analysis of student growth, and educator feedback demonstrates this product's efficacy, meeting the criteria for LXD Research's ESSA Tier 2 Evidence.

– Rachel Schechter, Ph.D., Founder of LXD Research

EFFICACY STUDY SUMMARY 2022-2023

PROGRAM DESCRIPTION

Zaner-Bloser Kickstart: Number Sense enhances foundational mathematical thinking to deepen their conceptual understanding of numbers (number sense), bolstering proficiency in grade-level skills and strengthening their identity as mathematicians to build community, curiosity, and confidence in math learning.

STUDY DETAILS

Analysis Sample Sizes

One School, Kickstart Users, 2 years
- 130 1st Graders, 163 2nd Graders

Two Schools, All Students, 3 years
- 538 3rd Graders

Comparison schools, 3 years
- 2,639 3rd Graders

Time Frame

Spring 2019 - Spring 2023

Implementation Description

- Two schools used Kickstart: Number Sense daily for 20 minute group lessons.
- Instructors without math instruction experience (music, art, P.E., Spanish) led pull-out.
- Classroom teachers led push-in group lessons.

Methodology

- Math skill progress for grades 1-2 were analyzed over two years.
- Publicly available third grade proficiency scores were compared for three time points.
- Instructors were interviewed.

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Zaner-Bloser

STUDY SUMMARY

Kickstart: Number Sense

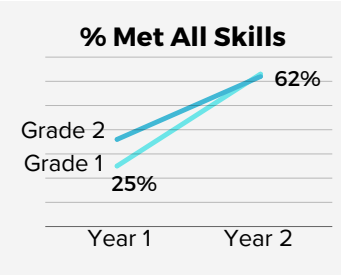
Knowing students were missing essential pre-requisite skills, a school district in Oregon started training with Jen Hunt to provide early math intervention before COVID. Leaders implemented Kickstart: Number Sense from Fall 2021 to Spring 2023, monitoring the development of critical math skills for first and second graders. By intervening early, Kickstart: Number Sense schools outperformed comparison schools of similar size across the state on third grade exams.

Example Critical Skill

I can +/- 10 from a given number within 120

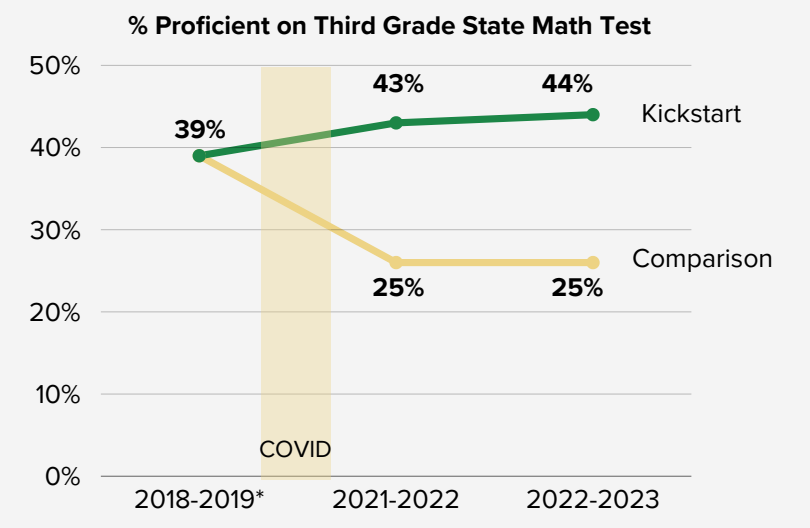
KEY FINDINGS

Grade 1 and Grade 2 Kickstart users showed significant growth over two school years, with more students meeting expectations for all critical math skills measured, closing gaps.



Kickstart Users outperform Comparison schools across multiple years.

Though starting at the same level of proficiency, Kickstart schools showed higher third-grade proficiency rates compared to Comparison schools in 2021-2022 and 2022-2023. Kickstart schools improved from before to after the pandemic, while Comparison schools experienced a reduction in proficient students.



Grades 1-2 Kickstart 2021-2022 vs. 2022-2023
1. Grade 1: $X2(1, N = 130) = 16.794$, $p < .001$, Phi coefficient effect size = .375.
2. Grade 2: $X2(1, N = 163) = 10.96$, $p < .001$, Phi coefficient effect size = .26.

Grade 3 Kickstart vs. Comparison Schools
1. 2018-2019: $X2(1) = 0.03$, $p = .86$
2. 2021-2022: $X2(1) = 18.88$, $p < .001$, Phi coefficient effect size = .15
3. 2022-2023: $X2(1) = 26.05$, $p < .001$, Phi coefficient effect size = .16

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Examining the longitudinal impact of Kickstart: Number Sense on school-level third-grade proficiency, Fall 2021-Spring 2023

Authors: Rachel L. Schechter, Ph.D., Laura Janakiefski, Ph.D., & Keisha Pendleton, M.S.

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Abstract

LXD Research conducted a study to evaluate the impact of the Zaner-Bloser Kickstart: Number Sense program, a math intervention designed to enhance foundational math skills among first and second-grade students in an Oregon school district over a three-year period from spring 2019 to Spring 2023. The program was implemented in two schools, engaging 130 first graders, 163 second graders, and 538 third graders. The student population included 15% Hispanic/Latino students, 8% English Language Learners, 15% students with diagnosed disabilities, and approximately 70% of students qualifying for Free/Reduced Price lunch. The district represents at least 19 different language backgrounds, reflecting a diverse and multicultural student body. The intervention comprised daily 20-minute group lessons focused on developing critical math skills, conducted by instructors without prior math teaching experience. The program's effectiveness was evaluated by comparing third-grade math proficiency rates between Kickstart students and their peers from comparison schools of similar size across the state, utilizing publicly available proficiency scores from the Oregon Statewide Assessments (OSAS) as the benchmark. Key findings demonstrated that Zaner-Bloser Kickstart: Number Sense students consistently outperformed their counterparts in comparison schools over multiple academic years. Specifically, in the 2021-2022 academic year, 43% of all Kickstart students achieved math proficiency, compared to 25% in comparison schools. In the 2022-2023 academic year, the proficiency rate for all Kickstart students was 44%, compared to 25% in comparison schools. Additionally, first graders' proficiency according to school-delivered assessments increased from 25% in 2021-2022 to 63% in 2022-2023, while second graders' proficiency rose from 36% to 62% over the same period. These results suggest that the Zaner-Bloser Kickstart: Number Sense program is highly effective in significantly improving early math outcomes, fostering a solid foundation in math for young learners, and potentially bridging educational gaps. The study's rigorous methodology and findings support Zaner-Bloser Kickstart: Number Sense as a comprehensive program that meets the criteria for ESSA Level 2.

Introduction

Number sense is a flexible, non-verbal understanding of numbers and their relationships. It is foundational for mathematical proficiency and is developed gradually through exploration, visualization, and contextualization of numbers. Strong number sense enables children to visualize, manipulate, and apply numbers comfortably–connecting them to real-world situations (Howden, 1989). Research suggests that early number sense predicts school success more than other measures of cognition, such as verbal, spatial, memory skills, or reading ability (Jordan et al., 2007).

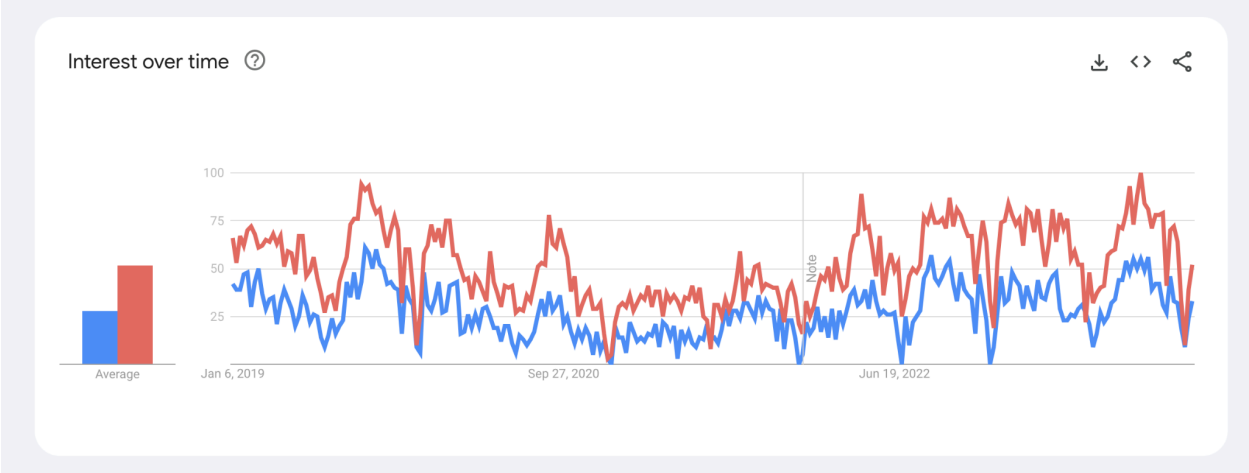
Weakness in number sense manifests as difficulties in counting procedures, fact retrieval, and computation. Students with gaps in number sense may struggle to grasp more advanced mathematical concepts, leading to difficulties in problem-solving, critical thinking, and overall mathematical proficiency (Geary et al., 2000; Jordan et al., 2003a, 2003b).

Studies indicate that math intervention is underutilized in most public schools (Schwartz, 2023). Based on data from Google Trends, which provides an unfiltered sample of actual Google web search requests, in comparison to reading intervention, math intervention is searched less frequently (see Figure 1; Google Trends, 2024). Searching for an intervention for number sense is practically nonexistent. Only 7 states require math intervention, compared to now 40 states requiring alignment to the science of reading (Schwartz, 2023). This is striking, given that the majority of students in the U.S. do not meet minimum levels of math proficiency (Hollins et al., 2022). There has been an increased focus on math since an analysis of post-pandemic recovery has identified uneven math recovery (Miller et al., 2024). Some researchers are calling for a greater focus on using evidence about how children best learn math to determine instructional methods and decisions about math education (Codding et al., 2023). Greater expansion of math intervention that aligns with recommended evidence-based practices can help teachers adjust their mathematics intervention programs according to the needs of their students to help increase the number of students on grade level (Fuchs et al., 2021).

In this study, the instructors implementing Kickstart: Number Sense did not have any formal math education training, they taught music, art, Spanish, and physical education.

Figure 1. Reading intervention Google searches outpace math intervention searches

Red = Reading Intervention
Blue = Math Intervention



Kickstart: Number Sense, authored by Jen Hunt, is a math intervention program for students struggling with grade-level math skills. It provides a targeted approach to bridging gaps in understanding and quickly advancing mathematical proficiency. In particular, Kickstart: Number Sense is a Tier 2 program meant to target gaps in specific number sense, an essential skill for becoming proficient in math (The Meadows Center, 2017). Kickstart: Number Sense supplements the core math curriculum by targeting the specific numerical skills foundational to children's future mathematical development and allowing them to access the core curriculum successfully.

Zaner-Bloser hired Learning Experience Design (LXD) Research to evaluate the impact of Kickstart: Number Sense on student outcomes over time. To achieve this, LXD Research has evaluated and compared Grade 3 state's math proficiency rate from public schools that used Kickstart: Number Sense in Crook County, Oregon, to similar schools in the state that did not use Kickstart: Number Sense. An additional investigation of year-over-year mastery on specific math skills for Grades 1 and 2 at one of the Kickstart: Number Sense schools provided evidence for the program's impact on student achievement leading up to third grade.

Method

Teacher Interviews

To learn more about the implementation of Kickstart: Number Sense, three educators with varied roles (instructional coach, physical education teacher, and behavioral therapist) were interviewed at one of the schools that implemented the intervention. The instructional math coach at one of the elementary schools recommended two additional instructors to interview who would provide

multiple points of view and work with different students: one behavior specialist and the other the physical education teacher. Through these discussions, insights gained about the implementation and program descriptions inform the interpretation of the student score comparisons reported below. Themes from the interviews are also included in the results section.

Implementation Description

A school district in Oregon consisting of five elementary schools purchased and rolled out Kickstart: Number Sense (Kickstart) over two years at its two main K-5 buildings, SY 2021-2022 and SY 2022-2023. The district noticed a decline in math scores on the third-grade state exam before the pandemic. One school decided to pilot Kickstart with one group per grade in 2020-2021 (Pilot in Table 1 for the implementation description). Almost immediately, the staff began noticing improvements in student performance. Kickstart was purchased for expansion in the pilot school and formally started in a second school in Fall 2021 as a multi-instructor intervention in School A and as a math intervention pull-out in School B.

In School A Kickstart was available in the first- and second-grade classrooms for the 2021-2022 school year. In addition, the district expanded the program throughout the year by leveraging four teachers from across the building with open time slots. They pulled groups to help provide Kickstart to more students who needed it from any grade (Year 1 in Table 1). These were specialists in the building implementing Kickstart without formal math education training, who taught music, art, Spanish, and physical education. As a result, more students across varying levels could be served.

Table 1. Implementation of Kickstart and its alignment with data collection with School A

Implementation Year	**Student Grade**			
	K	**1st**	**2nd**	**3rd**
2020-2021 (Pilot)	Kickstart Pilot implementation with one group per grade			
2021-2022 (Year 1)	4 teachers/ grade	4 teachers/ grade	4 teachers/ grade	Targeted
2022-2023 (Year 2)		Last year's K	Last year's 1st	Last year's 2nd

Shaded blocks represent the years and grades represented in this study's data collection

This expanded implementation model was used initially and throughout the 2022-2023 school year (Year 2 in Table 1). This year, each pull-out teacher was assigned to a dedicated classroom. Classroom teachers partnered more explicitly with the pull-out teachers and included pieces of Kickstart to supplement the core regularly. This study focuses on nearly 300 first and

second-grade students from the two “expanded” years who had Kickstart as a supplement and/or as a pull-out intervention as needed.

Because the program is highly scripted and simple to facilitate, instructors using Kickstart successfully implemented the program, even without specific training in math instruction. However, it is important to note that intentional planning and previewing of the lessons are necessary to maximize learning session time and minimize disruptions and distractions.

“Easy, accessible, usable.”
“Teachers especially love the songs and 10 Park.”
- Math Instructional Coach

Intervention Program Description

Kickstart: Number Sense is a Tier 2 math intervention program meant to fill gaps in specific number sense holes and is designed to help students who enter school unprepared for the grade-level core curriculum. As an intervention, it is to be used to supplement the core curriculum and was written to be a 20-minute small group lesson, which fits flexibly into schedules.

Kickstart: Number Sense addresses skills that fall into four categories (Aunio & Räsänen, 2016):

- Symbolic and non-symbolic number sense (basic magnitude comparison)
- Understanding mathematical relations
- Counting skills
- Basic skills in arithmetic

The skills that Kickstart: Number Sense addresses help lay the foundation for strong number sense to prepare students to access the third-grade core curriculum. The Kickstart: Number Sense intervention provides students with more explicit and systematic instruction in these areas based on developmentally sequenced activities.

Kickstart: Number Sense can be implemented in both push-in and pull-out formats and is flexible in that instructors can repeat stages according to student needs. This flexibility extends to the ability to move students through varying levels as needed. For example, a second-grade student struggling with number sense can be served in an intervention group that includes first graders at the same level. Built-in assessments are effective at not only placing students in the appropriate stage, but also useful as a diagnostic assessment to provide a benchmark score for all students from which to tailor math instruction.

Additionally, the ready-to-use kits minimize preparation time, and the provided assessments help place students in the program while monitoring their progress. The progress monitoring forms

and assessments help instructors pinpoint strengths and weaknesses. The program is divided into three stages. Stage A, Stage B, and Stage C provide the intervention needed to access the core math curriculum for kindergarten, grade 1, and grade 2, respectively. There are two ways to place students in Kickstart. Teachers can refer to a chart and place students based on demonstrated knowledge and struggles or administer the included placement assessment.

Kickstart: Number Sense is designed to be quick and easy to implement. The program is designed with students in mind, emphasizing interactive components, use of manipulatives and highly engaging partner talk opportunities. The games are designed to be exciting for the students and provide them with extra practice and independence. In addition, the program is intended to help students feel a stronger sense of math identity, greater confidence in math abilities, and a greater willingness to answer questions and participate in the math community.

Core Curriculum Description

The school district in this study implemented the Engage New York (Engage NY) math curriculum as the core math curriculum. The Engage NY math curriculum consists of major, additional, and supporting clusters (Table 2). These clusters are broken down by grade level and build on each other to support foundational skill development in mathematics. At a high level, students in grades K-2 are expected to master addition and subtraction concepts, skills, and problem solving in addition to mastering place value. By the end of second grade, students should be able to produce single-digit sums from memory and be able to calculate single-digit sums and differences within 100.

Table 2. Engage NY Content Clusters across Grades 1-2

Grade 1	Grades 1 & 2	Grade 2
Understand and apply properties of operations and the relationship between addition and subtraction Work with addition and subtraction equations Extending the counting sequence Measure lengths indirectly and by iterating length units Tell and write time	Represent and solve problems involving addition and subtraction Add and subtract within 20 Understand place value Use place value understanding and properties of operations to add and subtract Represent and interpret data Reason with shapes and their attributes	Work with equal groups of objects to gain foundations for multiplication Measure and estimate lengths in standard units Relate addition and subtraction to length Work with time and money

Based on feedback from the instructors interviewed for this study, the EngageNY curriculum assumes that students are able to subitize and count. Although EngageNY includes concepts such as number talks and partners to ten, instructors reported that students were still struggling with number identification and number writing. Data suggests that teachers are more likely to indicate that EngageNY provided students with opportunities to explain and justify their work. Teachers also indicate that EngageNY addresses three instructional goals that are also central to Kickstart: Number Sense: conceptual understanding, procedural skills, and application to real-life contexts (Kaufman et al., 2017).

Assessment Descriptions

School-Delivered "Critical Minimum Skills" Assessment

Because the standardized state-level assessment of mathematics starts in Grade 3 in Oregon, student skill growth in Grades 1 and 2 was monitored through school-delivered assessments. The study school leaders identified "critical minimum skills" for each grade level that a child should show proficiency with by the end of the school year, based on educator-identified gaps in understanding that were pervasive across grade levels (Table 3).

These skills are assessed to help students get on grade level for future grades and concepts covered later in order to build a strong foundational understanding. This set of skills links closely to key areas of good number sense, which include counting, number knowledge, and arithmetic operations (Jordan et al., 2010). These critical minimum skills lay the foundation for future mathematical understanding and problem-solving. The ability to fluently add and subtract within 20, solve one-step word problems, and use efficient strategies for numbers up to 1000 support a strong grasp of basic operations. Number sense and numeracy are built upon understanding the structure of three-digit numbers, comparing numbers, and recognizing the amount of tens and ones in a two-digit number (Empson, 2011).

Table 3. Critical Minimum Skills Assessment Coverage for Grades 1-2

Grade	Critical Skill
First	I can count to 120
	I can add and subtract within 20 using varying strategies
	I can determine an unknown number in an +/- equation
	I can +/- 10 from a given number within 120
	I can compare two 2-digit numbers using >,<,=
	I can add two numbers within 100 using an understanding of 10's & 1's
	I can identify the amount of 10's and 1's in a two-digit number
Second	Fluently +/- within 20 using mental math. Know from memory sums of two 1-digit numbers
	Use +/- within 100 to solve one-step word problems
	Understand that the three digits of a number represent 100's, 10's, and 1's
	Compare two up to 3-digit numbers
	Add & subtract within 1000 using efficient strategies
	Subtract within 1000
	Mentally add or subtract 10 or 100 to a given number

State Assessment

The Oregon Statewide Assessments (OSAS) are conducted every year with grades 3 through 8 and 11 as summative tests in English language arts and mathematics. The math portion of the assessment measures a student's depth of knowledge in applying concepts and procedures, analyzing and solving problems using math, and communicating or critiquing mathematical reasoning (OSAS Math Blueprint). Each student gets an overall score that falls into one of four levels (1-4). A Level 3 is "at the standard" and demonstrates an adequate understanding of the content and skills, and a Level 4 is "above the standard" and demonstrates a thorough understanding of the content and skills. A Level 2 indicates partial understanding of the content and skills, and a Level 1 demonstrates minimal understanding of the content and skills. The Grade 3 Mathematics assessment covers assessment targets including understanding and solving problems using the four operations, number estimation, using place values, applying mathematics to the real world, and communicating reasoning based on numerical information presented in drawings and diagrams (see Table 4 below for the full set of concepts covered by the test).

Table 4. Oregon State Mathematics Assessment Coverage for Grade 3

Blueprint Table Mathematics Grades 3–5						
Claim/Score Reporting Category	Content Category[1]	Stimuli		Items		Total Items by Claim
		CAT	PT	CAT[2]	PT[3]	
1. Concepts and Procedures	Priority Cluster	0	0	7	0	10
	Supporting Cluster	0		3		
2. Problem Solving 4. Modeling and Data Analysis[4]	Problem Solving	0	1	3	2-4	5-7
	Modeling and Data Analysis	0				
3. Communicating Reasoning	Communicating Reasoning	0		4	0-2	4-6

Target Sampling Mathematics Grade 3						
Claim	Content Category	Assessment Targets	DOK[1,2]	Items		Total Items
				CAT	PT	
1. Concepts and Procedures	Priority Cluster	B. Understand properties of multiplication and the relationship between multiplication and division.	1	3	0	10
		C. Multiply and divide within 100.	1			
		I. Geometric measurement: understand concepts of area and relate area to multiplication and to addition.	1, 2			
		G. Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.	1, 2			
		D. Solve problems involving the four operations, and identify and explain patterns in arithmetic.	2	3		
		F. Develop understanding of fractions as numbers.	1, 2			
		A. Represent and solve problems involving multiplication and division.	1, 2	1		
	Supporting Cluster	E. Use place value understanding and properties of operations to perform multi-digit arithmetic.	1	2		
		J. Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.	1			
		K. Reason with shapes and their attributes.	1, 2			
		H. Represent and interpret data.	2, 3	1		

Target Sampling Mathematics Grade 3					
Claim	Content Category	Assessment Targets	DOK[1,2]	Items	Total Items
				CAT	PT	
2. Problem Solving 4. Modeling and Data Analysis	Problem Solving (drawn across content domains)	A. Apply mathematics to solve well-posed problems arising in everyday life, society, and the workplace.	2, 3	0-1	1–2	5-7
		B. Select and use appropriate tools strategically. C. Interpret results in the context of a situation. D. Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas).	1, 2, 3	0-1	
	Modeling and Data Analysis (drawn across content domains)	A. Apply mathematics to solve problems arising in everyday life, society, and the workplace. D. Interpret results in the context of a situation.	2, 3	0-1	1–3	
		B. Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem. E. Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon.	2, 3, 4	0-1		
		C. State logical assumptions being used. F. Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas).	1, 2, 3	0-1		
		G. Identify, analyze, and synthesize relevant external resources to pose or solve problems.	3, 4	0		
3. Communicating Reasoning	Communicating Reasoning (drawn across content domains)	A. Test propositions or conjectures with specific examples. D. Use the technique of breaking an argument into cases.	2, 3	1-2	0-2	4-6
		B. Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. E. Distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in the argument—explain what it is.	2, 3, 4	1-2		
		C. State logical assumptions being used. F. Base arguments on concrete referents such as objects, drawings, diagrams, and actions.	2, 3	1		

Sample Description

This study included students in Grades 1-3, with data on the school-delivered Critical Minimum Skills Assessment for Grades 1 and 2 across the 2021-2022 school years and data from the state-level assessment (OSAS) for Grade 3 from the 2018-2019 to the 2022-2023 school year. All students who used the Kickstart: Number Sense program were from a school district in Oregon that serves over 3,000 students across 3 elementary schools, one middle school, and two high schools. According to the 2022-2023 Crook County School District Report Card, the school district that implemented Kickstart: Number Sense serves 15% Hispanic/Latino students, 8% English Language Learners, 15% students with diagnosed disabilities, and around 70% students who qualify for Free/Reduced Price lunch; at least 19 different language backgrounds are represented in the school district student body. Because individual demographic information about the participating students was not available for the current study, a breakdown of representative demographic information from the participating schools was sourced from US News and is reported below in Table 5. Demographic information is included for the two treatment schools who used Kickstart alongside information about the comparison schools, as well as the statewide breakdown of demographic information.

Table 5. Demographic Breakdown across Participating Schools in Oregon

	Minority Student Enrollment	Gender (F)	Free/ Reduced Price Eligibility	Proficiency on State Assessment	Student to Teacher Ratio
Treatment School A	14%	49%	70%	43%	16:1
Treatment School B	32%	49%	66%	38%	15:1
Comparison Schools	34%	48%	62%	37%	17:1
All Oregon Schools	41%	47%	49%	51%	22:1

Grades 1 & 2

Although there were students across grades who used Kickstart: Number Sense at each of the two main K-5 elementary schools, LXD Research partnered with one of the schools to collect detailed skill-level performance data to understand the program's impact. In that school, first and second graders used the program in small groups across the 2021-2022 and 2022-2023 school years. To best align with the third-grade scores presented later in this paper, the data collected from 130 first and 163 second graders were examined.

Grade 3

There were 3,177 third grade students' scores from 14 schools evaluated in this study. Of those, 538 were from the two schools that used Kickstart: Number Sense from 2018 to 2023 across grades K-3 (as described in Table 1). Data are available from the 2018-2019 school year as well as the 2021-2022 and 2022-2023 school years. However, due to the COVID-19 pandemic, data were not collected during the 2019-2020 and 2020-2021 school years.

Comparison schools were selected that were similar in size and in starting year (2018-2019) scores as the two Kickstart: Number Sense schools. The comparison schools included 12 schools with a total of 2,639 third graders. The comparison schools were from districts throughout Oregon.

For the 2018-2019 comparison, 197 Kickstart: Number Sense third graders were compared to 1,062 Comparison school third graders. For the 2021-2022 comparison, 141 Kickstart: Number Sense third graders were compared to 754 Comparison school third graders. For the 2022-2023 comparison, 200 Kickstart: Number Sense third graders were compared to 823 Comparison school third graders. Participation rates were slightly lower post-pandemic for reasons unknown by the time of this study publication.

Analysis Plan

Grades 1 & 2

Data for every first and second grade student in one of the Kickstart: Number Sense schools was gathered and analyzed from 2021-2022 to 2022-2023. For each year, students were determined to have met all of the critical minimum skills or not according to the school-delivered Critical Minimum Skills assessment for each grade level. Cohorts of students by grade level were examined. While many students met only some of the skills, the goal of the Kickstart: Number Sense intervention was for each student to meet all of the critical minimum skills. The number of students in each grade meeting proficiency in all 7 grade-level skills on the Critical Minimum Skills assessment (see Table 2 for the breakdown of grade-level skills) were compared with pre-post tests across the two years to determine the amount of growth[1]. Chi-squared tests were used because the outcome variable was count data, and Phi coefficients are included as measures of effect size, with 0 meaning no association and 1 meaning perfect association between variables. For interpretation, a value of Phi coefficient = 0.1 is considered to be a small effect, 0.3 a medium effect, and 0.5 a large effect (Cohen, 1988).

[1] When all seven skills were not evaluated, students were assessed based on the skills that were included in the evaluation (at least 5).

Grade 3

For Grade 3, Kickstart: Number Sense was compared against Comparison schools at each of three time points: 2018-2019 (baseline), 2021-2022, and 2022-2023. The number of students meeting proficiency standards was compared across Kickstart: Number Sense users and Comparison schools at each time point. Chi-squared tests were used because the outcome variable was count data, and Phi coefficients are included as measures of effect size, with 0 meaning no association and 1 meaning perfect association between variables, with the same interpretation of effect size as listed above. Note that 2019-2020 and 2020-2021 data were not collected due to the COVID-19 pandemic.

Study Results

Teacher Feedback about Kickstart: Number Sense

Teacher feedback about Kickstart: Number Sense has been overwhelmingly positive. Because the program is designed to be implemented by any instructor, with or without specific training in math instruction, teachers find the implementation to be smooth. Several teachers indicated that they felt fully comfortable with the program within a couple of weeks of implementation. Teachers confirm that they experienced solid results with Kickstart: Number Sense. In one example, by the end of first grade, all students who began the year in Stage A, had progressed out of Stage A and most students had progressed out of Stage B.

"The beauty of Kickstart: Number Sense is that anyone can do it."

"Teachers find it to be easy and self-explanatory."

"It was great that we could manipulate the Ten Park game to match any classroom theme to make it even more relevant, some teachers may even use TenPark as a number talk or include songs from Kickstart: Number Sense into whole group instruction"
- Instructional Instructional Coach

Teachers have also discussed the importance of familiarizing oneself with the materials prior to conducting an intervention group, so that there are no distractions to the students, transitions are smooth, and time can be maximized.

"At first I was struggling a little bit with it because there were so many little transitions with all the manipulatives and just learning how to use it." When asked how long it took to get comfortable with the program, he replied, "a few weeks."
- Physical Education Teacher

Students' Learning Experience

Student experience with Kickstart: Number Sense has been positive. Teachers report that students using Kickstart: Number Sense enjoy the engagement aspects of the program. The students especially enjoy the songs, games, and physical activities. Teachers also report that students are engaging in partner talk regularly and having math conversations with classmates where they can share their thinking and justify their reasoning.

> *"They love the games. The Dragon Treasure game, the Sun Energy game, they love those games with the spinners. They can now play those games and partners, and I don't have to help them whatsoever. I can just literally monitor. They can do those games completely by themselves. They love those games."*
>
> - Behavioral Therapist

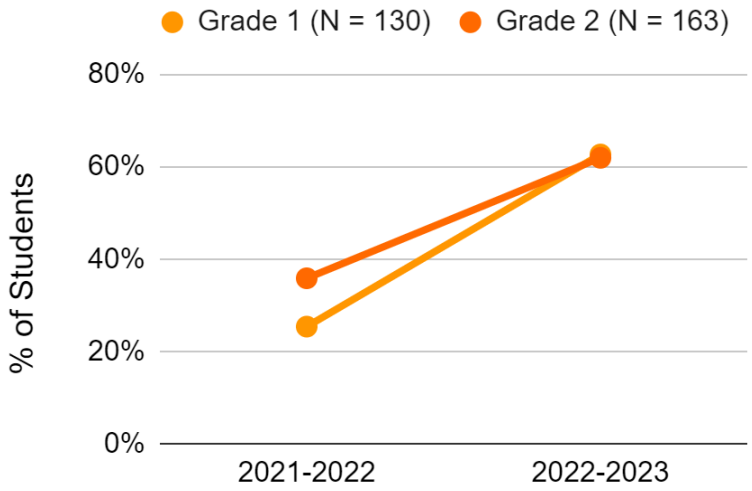
Meeting Expectations for Critical Minimum Skills

Grades 1 & 2

Kickstart: Number Sense users showed significant growth across the 2021-2022 to 2022-2023 school years, in both Grade 1 and Grade 2. Grade 1 Kickstart: Number Sense users showed significant growth from the 2021-2022 to 2022-2023 school year, with more students meeting expectations for all skills measured by the Critical Minimum Skills assessment, $\chi^2(1, N = 130) = 16.794$, $p < .001$, with a medium to large effect size of Phi coefficient = .375. Only 25% of Grade 1 students met all of the skills in 2021-2022, but by 2022-2023, 63% met expectations for all the assessed skills.

Grade 2 Kickstart: Number Sense users also showed significant growth from the 2021-2022 to 2022-2023 school year, with more students meeting expectations for all skills, $\chi^2(1, N = 163) = 10.96$, $p < .001$, with a small to medium effect size Phi coefficient = .26. Only 36% of Grade 2 students met expectations for all skills in 2021-2022, but by 2022-2023, 62% reached the threshold.

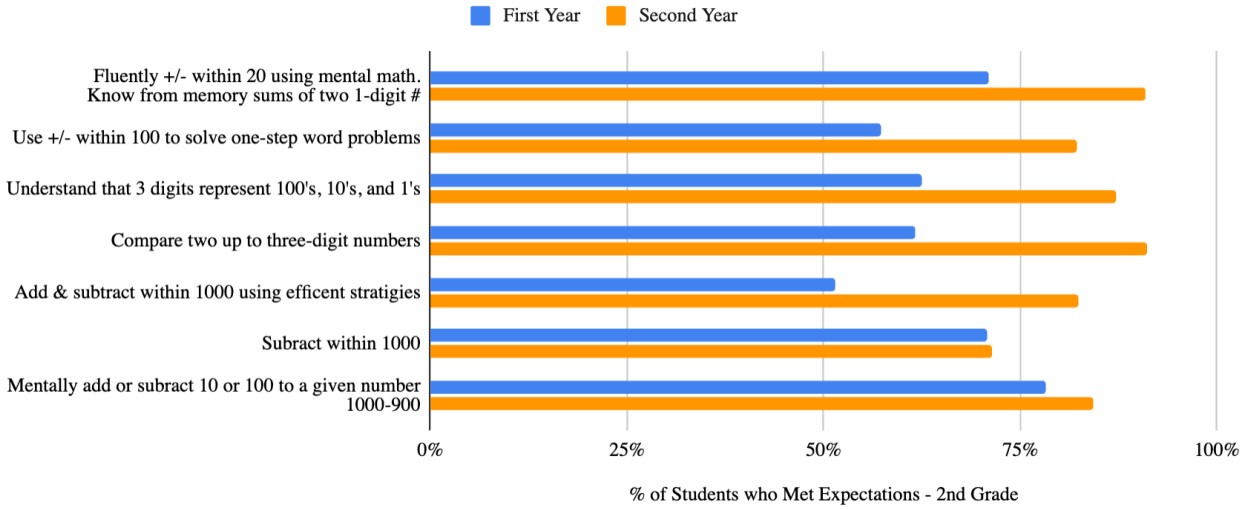
Figure 2. Increase in the proportion of students who met all critical minimum skills



Starting the year with the expanded implementation of Kickstart: Number Sense also led to stronger performance on key Grade 2 skills (Figure 3). Across all skills assessed, more students in Year 2 (2022-2023) met the Grade 2 Critical Minimum skills than in Year 1 (2021-2022). As a result of extending the implementation of Kickstart: Number Sense, the district saw large improvements in critical minimum skills, with most of these skills showing improvement by 20% or more in Year 2.

In terms of specific skill growth, the skill of adding and subtracting within 1000 using efficient strategies saw an increase of 30 percentage points, from 52% at the end of Year 1 (2021-2022) to 82% by Year 2 (2022-2023). The skill of comparing two to three-digit numbers increased by 29 percentage points from 62% at the end of Year 1 to 91% at the end of Year 2. The skill of using addition and subtraction within 100 to solve one-step word problems improved from 57% to 82%, an increase of 25 percentage points from Year 1 to Year 2. These particular skills and their improvement among students receiving math intervention result from good number sense and reflect the skill-building capabilities of the Kickstart: Number Sense intervention.

Figure 3. The cumulative impact of Kickstart: Number Sense across years

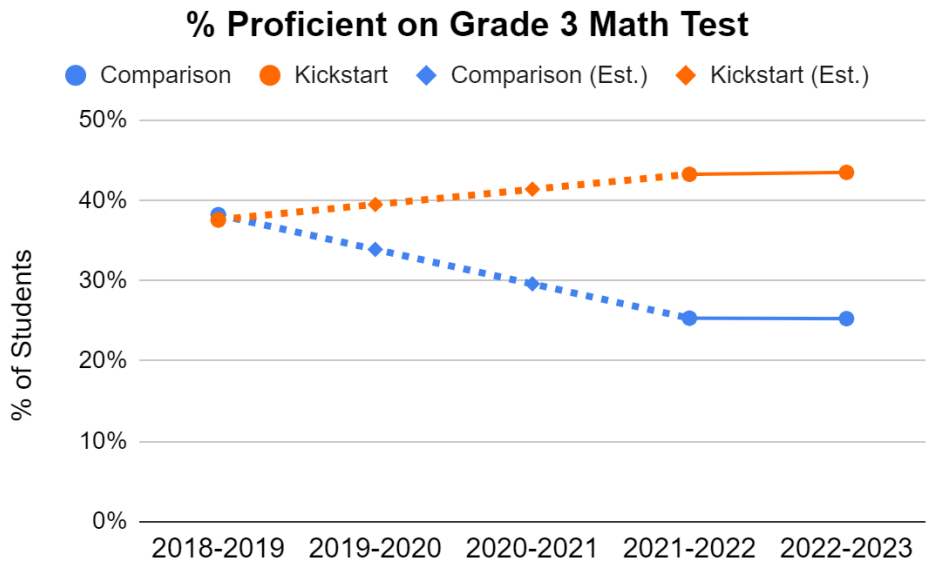


Grade 3

Grade 3 Kickstart: Number Sense users showed no difference in starting year (2018-2019) scores compared to the Grade 3 Comparison schools, $\chi^2(1, N = 1259) = 0.0$, $p = .86$. Comparison schools had 38% of Grade 3 students meeting proficiency standards, as did the schools that used Kickstart: Number Sense. Grade 3 Kickstart: Number Sense users showed higher performance in 2021-2022 compared to Comparison schools, $\chi^2(1, N = 895) = 18.88$, $p < .001$, with a small to medium effect size of Phi coefficient = .15. Comparison schools only had 25% of Grade 3 students meeting proficiency standards in 2021-2022, whereas Kickstart: Number Sense schools had 43% of Grade 3 students meeting proficiency standards in 2021-2022.

Grade 3 Kickstart: Number Sense users showed higher performance in 2022-2023 compared to Comparison schools, $\chi^2(1, N = 1023) = 26.05$, $p < .001$, with a small to medium effect size of Phi coefficient = .16. Comparison schools only had 25% of Grade 3 students meeting proficiency standards in 2022-2023, whereas Kickstart: Number Sense schools had 44% of Grade 3 students meeting proficiency standards in 2022-2023.

Figure 4. Growth in State Assessment Proficiency for Kickstart: Number Sense Grade 3



Note: 2019-2020 and 2020-2021 data were not collected due to the COVID-19 pandemic. The dotted lines represent estimated scores using the trend line.

Discussion

As increasing attention is being placed on the need for math interventions that work, Kickstart: Number Sense shows a substantial, positive effect on addressing gaps in students' foundational mathematical thinking. In this study, the proportion of students meeting critical minimum early math skills identified by the school district improved dramatically year over year. These schools also showed evidence of the early intervention deepening students' understanding of numbers and advancing their proficiency in grade-level skills. Looking ahead to third-grade proficiency in Spring 2023, schools that used the Kickstart: Number Sense intervention showed almost double the number of students achieving proficiency than the comparison schools. By starting the program implementation during and through the pandemic, these schools prevented the loss and stagnant recovery that its comparison schools experienced.

Not only did the Kickstart: Number Sense program show clear evidence of supporting students' math learning, but teachers expressed highly positive feedback about the program. Teachers reported that they found implementation smooth, feeling fully comfortable with the program after only a few weeks. Teachers also reported seeing the effects of the intervention with their students, recognizing the improvements in students' confidence and curiosity produced by Kickstart: Number Sense. Further, students enjoyed Kickstart: Number Sense's engaging songs, games, and physical activities. The program also promoted students' engagement in partner talk,

with teachers also reporting that students had regular math conversations with classmates where they shared their thinking and justified their reasoning, building a stronger school-based math community.

Limitations

The data assessed here show significant improvements for schools using Kickstart: Number Sense. However, the study approach here draws from two datasets with a few missing pieces. Student proficiency data was only available from one of the two schools that used Kickstart: Number Sense for Grades 1 and 2. The data for Grades 1 and 2 could also only be compared for year-over-year gains but were not assessed against comparison schools that were not using Kickstart: Number Sense. The data for Grade 3 specified at the school level how many students met proficiency standards each year, not indicating which specific students did or did not use Kickstart: Number Sense, limiting what can be said at the student level about the program's impact. The available data did not include student-level demographic variables, so these variables could not be controlled for in the current analyses. The generalizability of these findings should be limited to schools with similar profiles (see Table 5), as the analyses conducted could not account for demographic data at the individual level. From a study design standpoint, this study is retrospective, meaning that the research team did not assign the treatment group or monitor the implementation.

The current study more closely resembles what district leaders would do naturally when determining how programs work. District leaders often compile different data sources and consider them together as evidence of how students are progressing in order to make decisions about the next steps. Despite these limitations, the combination of the mixed-method design and the program's large impact over multiple years gives it the ESSA level 2 recognition by LXD Research.

Conclusion and Next Steps

Kickstart: Number Sense shows a clear benefit as a math intervention tool in supporting students' critical skill development and being an easy-to-implement and enjoyable program for teachers and students. The next steps include closer looks at how teachers implement Kickstart: Number Sense, considerations for how greater implementation fidelity may support even greater learning benefits, and how Kickstart: Number Sense may influence other aspects of math performance, including students' beliefs about math.

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Appendix

Grade 1

Contingency Tables

Contingency Tables

	Proficient		
Year	0	1	Total
21-22	47	16	63
22-23	25	42	67
Total	72	58	130

Chi-Squared Tests

	Value	df	p
X^2	18.272	1	1.915×10^{-5}
X^2 continuity correction	16.794	1	4.167×10^{-5}
N	130		

Nominal

	Value
Phi-coefficient	0.375
Cramer's V	0.375

Grade 2

Contingency Tables

Contingency Tables

	Proficient		
Year	0	1	Total
21-22	59	33	92
22-23	27	44	71
Total	86	77	163

Chi-Squared Tests

	Value	df	p
X^2	10.955	1	9.337×10^{-4}
X^2 continuity correction	9.932	1	0.002
N	163		

Nominal

	Value
Phi-coefficient	0.259
Cramer's V	0.259

Grade 3 – 2018-2019

Contingency Tables

Contingency Tables

	Condition		
Proficient	Comparison	Kickstart	Total
0	656	123	779
1	406	74	480
Total	1062	197	1259

Chi-Squared Tests

	Value	df	p
X^2	0.031	1	0.860
X^2 continuity correction	0.009	1	0.923
N	1259		

Nominal

	Value
Phi-coefficient	−0.005
Cramer's V	0.005

Grade 3 – 2021-2022

Contingency Tables

Contingency Tables

	Condition		
Proficient	Comparison	Kickstart	Total
0	563	80	643
1	191	61	252
Total	754	141	895

Chi-Squared Tests

	Value	df	p
X^2	18.880	1	1.392×10^{-5}
X^2 continuity correction	18.004	1	2.204×10^{-5}
N	895		

Nominal

	Value
Phi-coefficient	0.145
Cramer's V	0.145

Grade 3 – 2022-2023

Contingency Tables

Contingency Tables

	Condition		
Proficient	Comparison	Kickstart	Total
0	615	113	728
1	208	87	295
Total	823	200	1023

Chi-Squared Tests

	Value	df	p
X^2	26.047	1	3.331×10^{-7}
X^2 continuity correction	25.167	1	5.258×10^{-7}
N	1023		

Nominal

	Value
Phi-coefficient	0.160
Cramer's V	0.160

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