

Article

Teaching Strategies and Math Proficiency: A Study of K-3 Learners and Teachers

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Abstract: This study analyzed the mathematics competency of K-3 students and the extent to which teachers utilized various teaching methods. Data on student performance in Numbers and Operations, Operations and Algebraic Thinking, Measurement and Data, and Geometry revealed that many students performed below grade level, particularly in Measurement and Data and Geometry. The study also examined the extent of utilization of identified teaching methods, showing that traditional, explicit instructional strategies were more commonly used, while game-based and exploratory methods were less frequently applied. Correlation analysis indicated a significant positive relationship between the frequency of strategy utilization by teachers and the math skills performance of students. The findings suggest that consistent use of diverse and student-centered teaching strategies can improve student outcomes, particularly in early elementary mathematics education, highlighting the need for teachers to incorporate a broader range of effective teaching techniques.

Keywords: Early Elementary Mathematics, K-3 Math Competency, Student Performance, Teaching Strategies

Introduction

Mathematics competency in early education is a fundamental component of cognitive development, with strong connections to later academic success. Developing number sense and early math skills enhances children's cognitive abilities, including logical reasoning and problem-solving (Mera et al., 2022). Additionally, early math competencies predict long-term success not only in mathematics but also in other cognitive domains like language and executive function (Mulcahy et al., 2021). Cognitive precursors such as symbolic magnitude comparison and number line estimation are essential for



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building strong mathematical foundations in preschool and early elementary education (Rittle-Johnson et al., 2019).

Foundational math skills developed during early education serve as critical predictors of later academic success, especially in STEM fields (Shanley et al., 2019). Strong early competencies in areas like number operations, spatial reasoning, and pattern recognition significantly influence future achievements in mathematics and other subjects (Mujagić et al., 2023). The US Core Standards in Mathematics emphasize these foundational skills, ensuring alignment between curriculum goals and the necessary cognitive development pathways for young learners (Nguyen et al., 2023).

The US Core Standards in Mathematics focus on several key areas: Numbers and Operations, Operations and Algebraic Thinking, Measurement and Data, and Geometry. Early competencies in Numbers and Operations involve understanding counting, comparing numbers, and performing simple arithmetic (Jenßen et al., 2020). Operations and Algebraic Thinking help students solve basic problems and identify patterns, which are crucial in developing logical reasoning (Rittle-Johnson et al., 2019). In Measurement and Data, students learn to quantify objects and interpret basic data, while Geometry fosters an understanding of spatial relationships and properties of shapes (Nguyen et al., 2023).

Early elementary students face several challenges in mastering math skills, including developmental differences in cognitive and motor skills (Escolano-Pérez et al., 2020). Children with lower executive function or self-regulation often struggle with tasks that require sustained attention or problem-solving (Quis et al., 2021). The teaching methods employed by educators significantly influence students' ability to overcome these challenges. Effective teaching strategies that integrate hands-on learning and cognitive support have been shown to reduce skill gaps (Clements & Sarama, 2020).

Various teaching methods are employed to support math learning in early education, such as direct instruction, manipulatives, and cooperative learning. Studies have shown that manipulatives (e.g., blocks or counters) enhance children's understanding of abstract mathematical concepts by allowing them to visualize problems (Hawes et al., 2021). Cooperative learning encourages peer collaboration, fostering both social and cognitive growth (Johnston & Bull, 2021). Additionally, digital tools and apps are becoming increasingly popular, offering interactive ways to practice math skills (Mera et al., 2022).

Pedagogical approaches that align with children's developmental stages and cognitive capacities are critical in K-3 math education (Clements & Sarama, 2020). For example, constructivist approaches that emphasize student exploration and self-guided learning promote deeper understanding and retention (Rittle-Johnson et al., 2019). Educators should also scaffold learning experiences, gradually increasing task complexity as students' skills improve

(Jenßen et al., 2020). Importantly, addressing the emotional aspects of learning, such as math anxiety, can significantly enhance student outcomes (Jenßen et al., 2020).

Despite the extensive focus on mathematics competency in early education, there is a significant research gap in understanding how effectively teachers are using various instructional methods to meet the US Core Standards in Mathematics. Most studies primarily focus on student outcomes in specific math skills but rarely examine the direct correlation between teaching methods and student performance across all key areas, such as Numbers and Operations, Algebraic Thinking, Measurement, and Geometry. Additionally, while digital tools and manipulatives are increasingly used in classrooms, there is insufficient evidence on their long-term impact on student achievement, especially in diverse and low-performing schools. Addressing these gaps will help inform better teaching strategies and resource allocation for early mathematics education.

Methodology

This study employed a quantitative research approach, utilizing a descriptive correlational design (Wisdom & Creswell, 2013) to explore the naturally occurring relationships between the variables. The primary focus was on understanding the extent of utilization of identified teaching methods by K-3 Math teachers and their impact on enhancing students' mathematical skills. The participants comprised K-3 Math teachers, who were surveyed using a questionnaire designed to assess the frequency and effectiveness of their use of teaching methods aligned with the Common Core State Math Standards. The data collection instrument used a 4-point Likert scale to evaluate the teachers' use of these strategies, ranging from "Always used" (3.26-4.00) to "Less used" (1.00-1.75), allowing for a systematic measurement of the degree to which these methods were employed in the classroom. Additionally, correlation analysis was conducted to assess the relationships between teachers' demographic profiles, their attitudes toward identified Math methods, and the effectiveness of teaching strategies such as the Gradual Release Model in managing student math skills. The results were numerically measured and analyzed using appropriate statistical tools to provide insight into the effectiveness of these teaching strategies and their impact on students' critical thinking and reasoning skills.

Grade level	Above/On grade Level	One Grade Level Below	2 or more Grade Levels Below
Kindergarten	362-454	100-361	1-99
First Grade	402-506	347-401	100-346
Second Grade	428-516	387-427	100-386
Third Grade	449-526	413-448	100-412

For students to succeed in higher education and in their future employment, they must be able to develop solid mathematics skills early in their academic careers. Since students need to acquire the fundamental knowledge and abilities to excel in more complex mathematical subjects, the US education system has created a set of core requirements for mathematics instruction for grades K–12. This section of the study focuses specifically on the mathematics skills performance of K-3 students based on the US Core Standards: iReady Assessment for K-2 and Star360 Assessment for Third graders. The iReady Assessment consists of diagnostic and personalized instruction. The diagnostic assessment, an adaptive test, modifies its questions in response to the students' responses. It is intended to pinpoint the student's reading and math strengths and shortcomings. The test gives teachers information on how well each learner performed in particular reading and math categories. Each student has a tailored learning plan that is developed using the data. The Star360 Assessment is likewise an assessment for Grade three learners given within two weeks of enrolment and again during winter and spring. To guide the readers on the performance of the learners in the iReady Assessment for K-2 and the STAR 360 FOR Grade 3, the scores ranges and the corresponding categories are herein presented based on the US Core Standards:

Results and Discussion

Table 1. Number and Operations

Grade Level	Above/ On-Grade Level		One Grade Level Below		2 or More Grade Levels Below		Total	
	f	%	f	%	f	%	f	%
Kindergarten	10	11%	81	89%	-	-	91	100%
First Grader	24	26%	57	63%	10	11%	91	100%
Second Grader	15	16%	47	49%	34	35%	96	100%
Third Grader	53	54%	19	19%	27	27%	99	100%

Table 1 presents the performance of students across different grade levels in the area of Number and Operations. In Kindergarten, the vast majority of students (89%) are performing one grade level below, with only 11% at or above grade level. In First Grade, the percentage of students performing on grade level increases to 26%, though a significant majority (63%) remain one grade level behind, and 11% are two or more grade levels below. In Second Grade, only 16% of students are at or above grade level, while 49% are one grade level behind, and a notable 35% are two or more grade levels below. The most significant improvement is observed in Third Grade, where 54% of students are performing at or above grade level, 19% are one grade level behind, and 27% are two or more grade levels behind. This data suggests that as

students' progress through the grades, there is a gradual improvement in their math competency, though a significant portion of students, particularly in the early grades, struggle to meet grade-level expectations in Number and Operations.

Table 2. Operations and Algebraic Thinking

Grade Level	Above/ On-Grade Level		One Grade Level Below		2 or More Grade Levels Below		Total	
	f	%	f	%	f	%	F	%
Kindergarten	21	23%	70	77%	-		91	100%
First Grader	41	45%	47	52%	3	3%	91	100%
Second Grader					19			
	17	17%	60	61%	19	%	96	97%
Third Grader					18			
	60	61%	21	21%	18	%	99	100%

Table 2 provides a breakdown of student performance in Operations and Algebraic Thinking across grade levels. In Kindergarten, 23% of students are performing at or above grade level, while the majority, 77%, are one grade level below. By First Grade, there is a noticeable improvement, with 45% of students performing at or above grade level, 52% one grade level behind, and 3% two or more grade levels below. In Second Grade, only 17% of students are at or above grade level, 61% are one grade level behind, and 19% are significantly behind by two or more grade levels. The largest increase is seen in Third Grade, where 61% of students are performing at or above grade level, 21% are one grade level below, and 18% are two or more grade levels below. These results suggest that while students show gradual improvement in Operations and Algebraic Thinking as they progress through the grades, there are still a significant number of students in early grades who lag behind in this area of math.

Table 3. Measurement and Data

Grade Level	Above/ On-Grade Level		One Grade Level Below		2 or More Grade Levels Below		Total	
	f	%	f	%	f	%	f	%
Kindergarten								100
	9	10%	82	90%	0	0%	91	%
First Grader								100
	13	14%	60	66%	18	20%	91	%
Second Grader								100
	8	8%	40	42%	48	50%	96	%
Third Grader								100
	44	45%	40	40%	15	15%	99	%

Table 3 shows student performance in Measurement and Data across various grade levels. In Kindergarten, only 10% of students are

performing at or above grade level, while a significant 90% are one grade level behind. None of the Kindergarten students are performing two or more grade levels below. In First Grade, 14% of students are at or above grade level, 66% are one grade level behind, and 20% are two or more grade levels below. Second Grade exhibits the greatest challenge, with only 8% of students at or above grade level, 42% one grade level behind, and a significant 50% two or more grade levels behind. By Third Grade, there is a marked improvement, with 45% of students performing at or above grade level, 40% one grade level behind, and 15% two or more grade levels below. This data indicates that Measurement and Data are particularly challenging for students, especially in the earlier grades, though improvement is seen as students' progress, particularly by Third Grade.

Table 4. Geometry

Grade Level	Above/ On-Grade Level		One Grade Level Below		2 or More Grade Levels Below		Total	
	f	%	f	%	f	%	f	%
Kindergarten	12	13%	79	87%	0	0%	91	100%
First Grader	18	20%	61	67%	12	13%	91	100%
Second Grader	13	13%	37	39%	46	48%	96	100%
Third Grader	51	52%	20	20%	28	28%	99	100%

Table 4 presents the performance of students across grade levels in Geometry. In Kindergarten, 13% of students are performing at or above grade level, while a significant 87% are one grade level behind, and none are two or more grade levels behind. By First Grade, 20% of students are at or above grade level, 67% are one grade level behind, and 13% are two or more grade levels below. In Second Grade, only 13% of students are performing at or above grade level, 39% are one grade level behind, and a concerning 48% are two or more grade levels behind, highlighting significant struggles in this area. In contrast, Third Grade shows substantial improvement, with 52% of students performing at or above grade level, 20% one grade level behind, and 28% two or more grade levels below. This data suggests that while Geometry poses challenges for students, especially in Second Grade, there is a marked improvement in Third Grade, with over half of the students performing on or above grade level.

Table 5 provides data on the extent of utilization of various teaching methods by the teacher respondents in teaching mathematics. Overall, the total mean score of 2.52 suggests that the teaching methods are generally "Used" by the respondents.

Table 5. Extent of Utilization of Identified Math Strategies by the Teacher Respondents

Teaching Methods	Mean	Standard Deviation	Verbal Description
Make it hands-on	3.56	0.5	Always Used
Use visual and images	3.94	0.24	Always Used
Find opportunities to differentiate learning	3.38	0.48	Always Used
Ask students to explain their ideas	3.50	0.5	Always Used
Incorporate storytelling to make connections to real-world scenarios	3.00	0.82	Used
Show and tell new concepts	3.31	0.75	Always Used
Knowing students regularly how they're doing	3.56	0.5	Always Used
Explicit instruction	3.56	0.5	Always Used
Conceptual understanding	3.19	0.6	Used
Puzzles	1.63	0.48	Less Used
Skip counting	3.19	0.6	Used
Time tables	2.25	1.29	Moderately Used
Card turnover math games	1.50	0.5	Less Used
Counting on strategy	3.13	0.64	Used
Near doubles strategy	2.38	0.74	Moderately Used
Compatible numbers strategy	1.75	0.44	Less Used
Partition strategy	1.94	0.86	Moderately Used
Estimating strategy	1.94	0.83	Moderately Used
2D shapes dominoes	1.44	0.5	Less Used
How to create mystic rose	1.13	1.13	Less Used
Calendar ideas and activities	1.75	0.44	Less Used
Free area task force	1.38	0.74	Less Used
Sorting data with Venn Diagram	2.06	0.7	Moderately Used
Total	2.52	0.45	Used

Some strategies are more frequently utilized than others. Methods like using visuals and images (mean = 3.94), making it hands-on (mean = 3.56), and explicit instruction (mean = 3.56) are consistently "Always Used" with low standard deviations, indicating regular implementation across classrooms. Other methods such as conceptual understanding (mean = 3.19) and skip counting (mean = 3.19) are also commonly "Used," but less frequently than the top methods. In contrast, certain strategies, such as puzzles (mean = 1.63), card turnover math games (mean = 1.50), and 2D shapes dominoes (mean = 1.44), are "Less Used," indicating they are rarely incorporated into math lessons. Additionally, some strategies like partition strategy (mean = 1.94) and estimating strategy (mean = 1.94) are only "Moderately Used," revealing that their application is more sporadic. This suggests that while some highly effective strategies are being consistently used, there is less reliance on others that could potentially enhance engagement and conceptual understanding. Overall, there seems to be a preference for traditional, explicit, and visual methods, with less frequent use of game-based or exploratory learning strategies. This data provides valuable insight into the teaching methods commonly employed in

early math education, but also highlights areas where teachers may benefit from exploring additional instructional strategies.

Table 6. Significant Relationship Between the Math Skills Performance of the K-3 Learners in Math and the Extent of Utilization of Identified Strategies in Math by the Teacher Respondents

Variable	Mean	Std.Dev	N	Comp Rho	p- value	Decisio n	Result
Math Skills	1.91	0.72	377				
Extent of Utilization	2.52	0.45	16	0.58	0.03	Reject	Significant

Table 6 presents the correlation analysis results between the math skills performance of K-3 learners and the extent of utilization of identified teaching strategies by the teacher respondents. The average math skills performance of the students is indicated by a mean score of 1.91 with a standard deviation of 0.72, while the extent of utilization of teaching strategies by teachers has a mean of 2.52 and a standard deviation of 0.45. The computed Rho value of 0.58 suggests a moderate positive correlation between the two variables. Additionally, the p-value of 0.03 is below the significance threshold of 0.05, leading to the rejection of the null hypothesis. This indicates a statistically significant relationship between the extent of utilization of teaching strategies by teachers and the math skills performance of K-3 students. Thus, the more frequently teachers utilize effective teaching methods, the higher the students' performance in math.

Conclusion

Based on the findings, it is evident that while there is improvement in math skills performance as students' progress through grade levels, a significant portion of K-3 learners still struggle with foundational mathematical concepts, particularly in areas like Measurement and Data, and Geometry. The performance levels for Numbers and Operations, and Operations and Algebraic Thinking, while slightly better, also reflect that many students are performing below grade level, especially in the earlier grades. The extent of utilization of teaching strategies by the teacher respondents, indicates that more traditional and explicit methods are frequently used, whereas game-based and exploratory learning strategies are less utilized. Importantly, the results show a significant positive relationship between the extent of teaching strategy utilization and student performance, suggesting that more consistent and effective use of teaching methods correlates with better student outcomes. Overall, these findings highlight the need for teachers to expand their use of diverse, student-centered strategies to enhance the math skills of K-3 learners more effectively.

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