Enhancing Math Comprehension Skills at the Elementary School Level: An Empirical Approach

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Abstract

The aim for this research is to improve the mathematical abilities of young children through the internet-based program i-ready. The relevance of these comprehension skills for elementary school students is imperative. The abilities of these students to interpret these mathematical theories and acknowledge the systematic approaches affiliated with the processing of these essential ideologies are significantly improved with the use of mathematical coaching. These students can utilize these comprehensive skillsets to decipher shapes, patterns, and numbers, while offering them a means of processing this information and assisting them with their cognitive development. The process from which the data was collected is through an observational online assessment tool *i-ready*. This software tracks and records the student's mathematic benchmarks. These benchmarks are the i-ready software's mechanism for highlighting the importance of analyzing student data to increase comprehension levels. This formative assessment was used to measure these students' comprehension, and with the assistance of analytical data, there was a strong correlation between statistical analysis and increased comprehension levels. This statistical analysis was verified with the assistance of both quantitative and qualitative inputs. This research will display that with the use of the i-ready software, as a problem-solving technique, the student's mathematical deficiencies could significantly decrease

Keywords
Mathematical, internet-based, systematic, comprehensive, deficiencies

1. Introduction

Math skills have taught us how to decipher our environments and surrounding. For children, the abilities affiliated with developing he competence to calculate, reason and problem solve can be challenging. Mathematics assists children in understanding the relationship between patterns and shapes in both a visual and cognitive sense. Mathematics can assist in the conveyance of thoughts, concepts, knowledge. This information is delivered via the use of numbers, diagrams, and charts. The young minds appreciation of these analytical, scientific, and numerical principles has been expressed in ways such as children's music, literature, and art, thus providing another realm to the importance of mathematical cognition. There are several principles that surround mathematical computation in elementary school these include:

- The ability to count and understand basic numbers.
- The ability of knowing when and where to use basic mathematical formulas.
- The ability to perform basic mathematical calculations.
- The ability to understand basic mathematical shapes.

Building on these required elementary level skills is imperative as it construct the foundation for mathematical literacy (Nagahi et a. 2019). The development of this mathematical knowledge directly correlates with the fundamentals and principles of critical thinking, problem-solving, and logic. With the use of *i-ready* these children could gain the cognitive mathematical skillsets to:

- Understand and decipher basic mathematical language
- Understand and recognize and recreate basic mathematical patterns and shapes.
- Understand, develop, and recognize numbers.
- Understand basic mathematical computations.

It has been stated that for the classroom teacher, data analysis requires identifying students' strengths and weaknesses regarding learning objectives and taking this knowledge into the design of future instruction (Karee E. Dunn 2013). The correct use of data also gives teacher more control over what the instruction happening in their classroom. "Leaders who use data productively have a mindset of being in charge of their own destiny, always needing to know more and creating or locating the knowledge that will be useful to them along the way." (Lorna Earl 2002).

Since the beginning of time, numbers have been used to defined people. The phrase, "What do the numbers say?" has millions of times around the world. British physicist Lord Kelvin said, "When you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind." (Kelvin 1896). Although it is important to know the numbers, it is more important to know the story behind those numbers. It is even more important to know what numbers to look at. "Any one assessment should not be used in isolation to determine the achievement level of a learner" (Department of Education and Training, 2021). While it is true, no one assessment alone should be used to measure the achievement or comprehension level of a learner. The use of data in the classroom is not a new concept. Educators have used data since the start of school. It has been said time and time again that the key to increased student academic achievement and comprehension is data-driven instruction. "Data-driven decision making (D3M) is the systematic collection, analysis, and application of many forms of data from myriad sources to enhance student performance while addressing student learning needs (Julie 2006)." The data should tell you how to teach and more importantly, what to teach. Data analysis is the process of collecting, modeling, analyzing data to extract insights that support decision-making (Holcomb, 2004). The concept of data analysis in education is a way for educators to know their students on deeper level. Effective data analysis in education means making real time decisions and changes. It means constantly questioning and altering current methods and strategies. Research has shown that using data in instructional decisions can lead to improved student performance (Jeffrey C. 2007). The objective of this study is to analyze and decipher if the online assessment tool *i-ready* is successful in decreasing the mathematical deficiencies in elementary level students.

3. Methods

The sample included 50 third grade students aged between 8 and 10. More than half of the participants we female (52%), and all the participants lived in the elementary school located at one of the southern United States. Participants were randomly assigned to two different groups and received instruction from instruction from the same teacher. The primary source of data was the i-Ready math diagnostic assessment. The i-Ready math diagnostic assessment measures students' current academic level and comprehension of math skills. The secondary source of data were formative assessments.

The i-Ready Math Diagnostic is a type of computer adaptive test that matches the difficulty of test questions to the ability of each student. As students answer questions correctly, the test gets more difficult. As students answer questions incorrectly, the test gets easier. In both scenarios, the test adapts to find the precise ability of each student in the quickest, most efficient way possible (Curriculum Associates, LLC, 2019). Each student's diagnostic assessment was uniquely created for them. Each student's assessment provided a challenge and consisted of material that the teacher had yet to teach as well as material that the student previous learned. The i-Ready Math Diagnostic scores were not based on the number of totals correctly answered questions, but the student's proficiency level (THE Journal, 2021).

A variation of formative assessments was used. Bell ringers, short answer questions, multiple choice question, and exit tickets are a few. Formative assessments provide real time data. This data can be used to make knowledgeable decisions in relation to instruction as well as small group work. The general of a formative assessment is to collect detailed information that can be used to improve instruction and student while it's happening (Great Schools Partnership 2014).

4. Data Collection

At the beginning of the school year, students were assigned the initial i-Ready math diagnostic assessment. This diagnostic was to be completed within the first thirty days of the school year. All students were given thirty minutes each day to work on the initial assessment. It should be noted, that for some students, the assessment was completed in one day, while for others the assessment was completed in up to five days. Students were not able to use a calculator, but they were given paper and pencil to complete computations by hand.

After the initial i-Ready math diagnostic assessment was completed, students were placed. The students had an overall placement within one of four categories. The categories were; one or above grade level, one grade level below, two grade levels behind, three or more grade levels below. Over half of the students had an overall placement of two or more grade levels behind. Figure 1. shows the results of the initial i-Ready diagnostic assessment. i-Ready is an internet-based program for the subjects of mathematics and reading that assists your student's teacher with the tools to analyze, personalize, and monitor the student's academic progress throughout the school year. Zero students were on or above grade level, thirteen students were one grade level behind, nineteen students were two or more grade levels behind, and eighteen students were three or more grade levels behind.

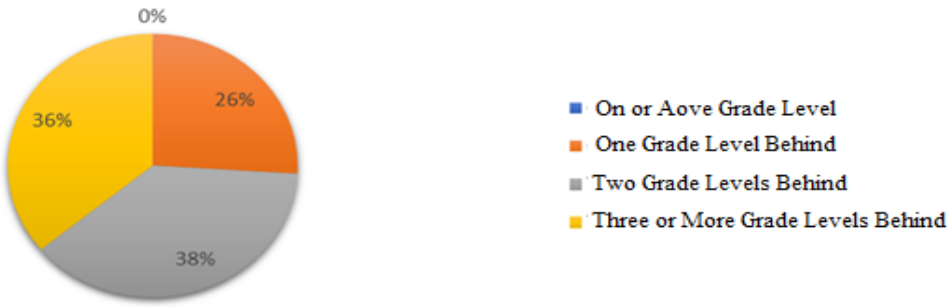

Figure 1. Beginning of the Year i-Ready Overall Placement Results

Students were also placed in each of four domains. The domains included Numbers and Operations (OA), Algebra and Algebraic Thinking (ALG), Measurement and Data (MD), and Geometry (GEO). Figure 2. shows the results of the initial domain placements. An average of 57% of the students were two or more grade levels in 'Number and Operations', 'Algebra and Algebraic Thinking', and 'Measurement and Data'. For the 'Geometry' domain, 72% of students were two or more grade levels behind.

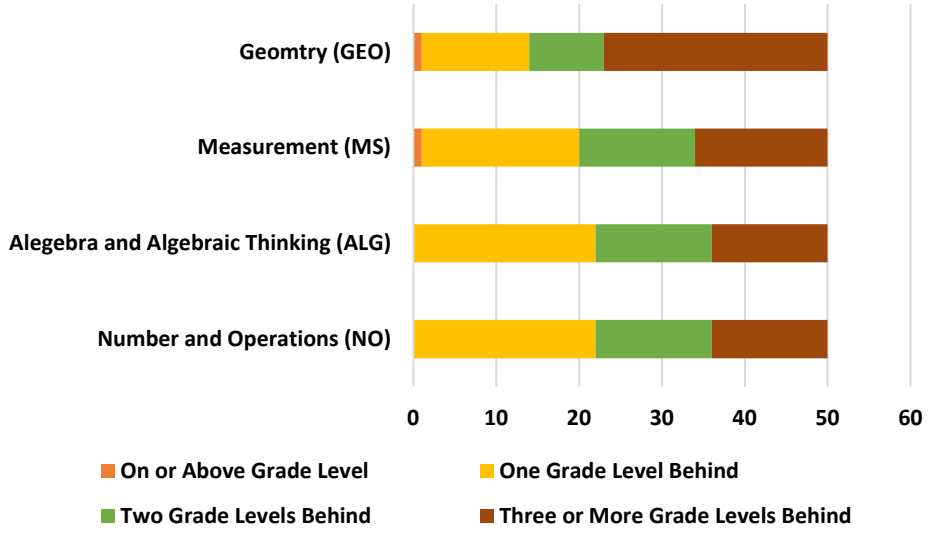

Figure 2. Beginning of Year i-Ready Domain Placements

5. Results and Discussion

After the first i-Ready diagnostic assessments were given, the data was then analyzed. A plan was put in place to monitor and increase student achievement and comprehension levels. The goal was to increase the number of students

who are one grade level or on grade level by 10% mid-year and i-Ready diagnostic assessment was to be given at each point.

The teacher was to cover standards that fell within the 'Number and Operation' and 'Algebra and Algebraic Thinking' domains. Standards are learning goals for what students should and be able to do at a certain grade level. (Common Core 2020). Domains are larger groups of related standards (How to read the grade level standards 2022) These standards were to be covered up until around the mid-year diagnostic assessment.

Once the teacher began teaching the standards, she would give daily formative assessments. "The usefulness of student data is generally proportional to the frequency of with which it's collected." (Venables, n.d.). These assessments were low-staked and gave the teacher the opportunity collect data in real time. For example, if the formative assessment asked the student to subtract the numbers 252 and 149, and the student's answer was 117, she would be able to pinpoint the mistake and clear up the misunderstand on the spot. Not only did she know that the student made a miscalculation, but she also knew why and how. The teacher repeated this with every student. From there, she was able make astute decisions regarding whole class instruction.

After months of collecting and analyzing data to improve comprehension and student achievement, the mid-year i-Ready diagnostic was given. There was a two-week window to blocked off for the assessment. Like the initial i-Ready assessment, students were given thirty minutes each day to work on the assessment until it was completed. Students were not able to use a calculator, but pencil and paper were provided for any calculations.

Figure 3. and Figure 4. display the results for the mid-year i-Ready diagnostic assessment. There was a significant improvement in overall placement results. There was a target of a 10% increase in students placing in one grade level below or better. There was an increase of 34%. They were just as big when evaluation the domain placement results. In 'Geometry', only 54% students were two or more grades below grade level. In Measurement and Data, 8% more of students were only one grade level below or better. For Algebra and Algebraic Thinking', 64% of all students are one grade level below or better. The Number and Operations domain is where students seemed to place the best. 68% of all students were one grade level below or better.

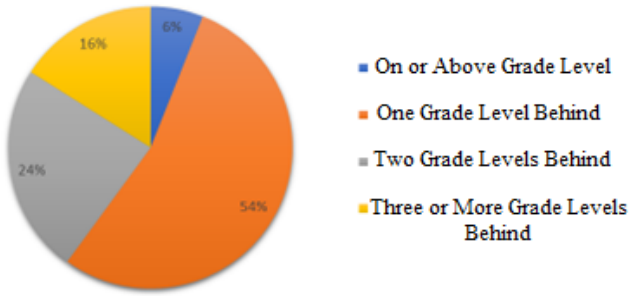

Figure 3. Mid-Year i-Ready Diagnostic Overall Placement Results

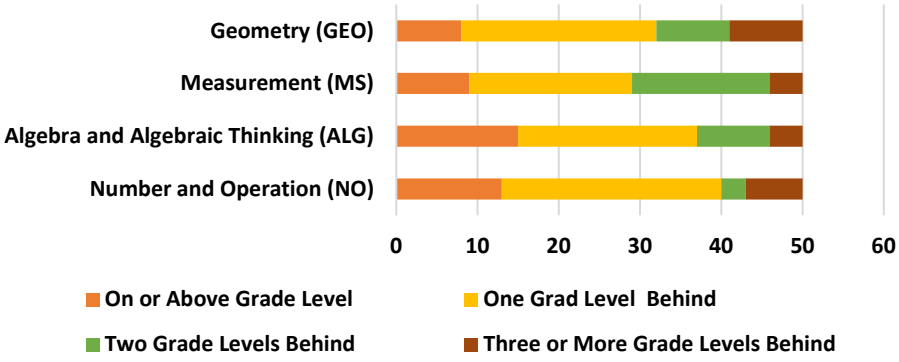

Figure 4. Mid-Year i-Ready Domain Placement Result

Once the Mid-Year i-Ready Diagnostic Results had been analyzed, the same steps were taken to continually promote and maintain student comprehension levels and growth. The first half the school year was majorly focused on the ALG (Algebra and Algebraic Thinking) and (NO) Number and Operations domains. The focus was same, while occasionally visiting the (GEO) Geometry and (MS) Measurement domains.

The teacher taught the standards as she had been doing for the first half of the school year. She continued to implement daily formative assessments. The data from daily formative assessments told her exactly what her students knew, and what she needed to know to continue to help them grow. Not only that, but her students began to realize where they were, and what they needed to do to reach their personal goals.

After a few more months of implementing formative assessments and collecting and analyzing data, the End of Year i-Ready diagnostic was given. There was a one-week window blocked off for this assessment. Unlike the first two i-Ready diagnostic tests that were given, students were given forty-five minutes to work daily. Students were not allowed to use calculators, but paper and blank paper were given for any calculations. They worked each day for the set time until the test was completed. Most students completed their test on day two.

Figure 5. displays the overall placement results for the End of Year i-Ready diagnostic test, while Figure 6. shows the placement by domain. The goal was to increase the number of students placing in the 'One Grade Level Behind' or better. There was almost a 50% decrease in the number of students placing two or more grade levels behind. This is in comparison to the Beginning of year i-Ready diagnostic test results. 72% of students were 'One Grade Level Behind' or better. That is almost triple the 26% from the Beginning of year i-Ready diagnostic test, and 12% increase from the Mid-Year i-Ready diagnostic test. Over half of the students placed 'One Grade Level Behind' or better in all domains.

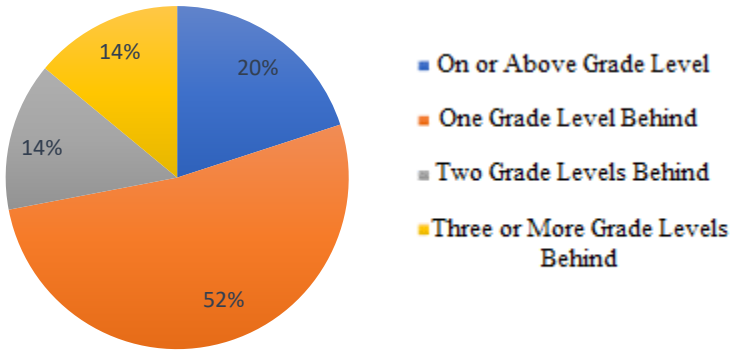

Figure 5. End of Year i-Ready Diagnostic Overall Placement Results

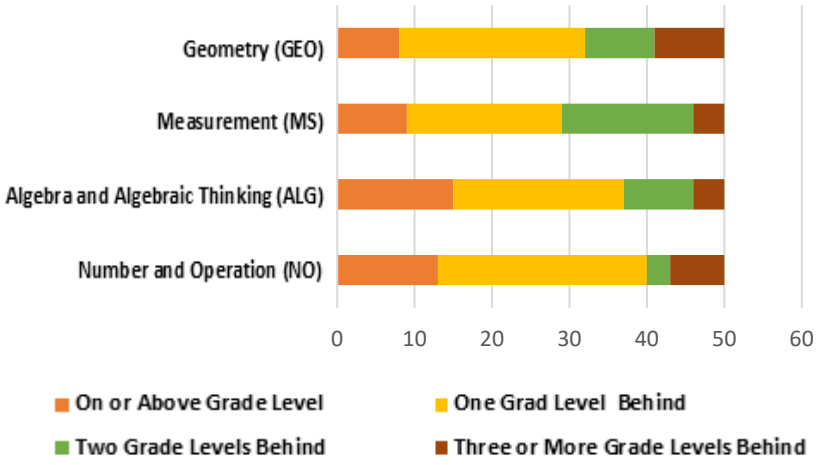

Figure 6. End of Year i-Ready Domain Placement Results

5.3 Proposed Improvements

This study should be replicated with different groupings of students to further validate the use of data analysis to increase student and comprehension levels at the elementary level. Further research could investigate daily or weekly changes in growth amongst students.

In this study, data analysis was shown to have an undeniable impact on the increase of student achievement and elementary math comprehension levels. The data analysis gave the teacher an opportunity to see who her students where academically and meet them where they were.

5.4 Validation

Educational leaders take on duties such as overseeing team members, providing leadership, identify areas of growth and improvement, and inspecting processes (Hossain et al. 2020). Powerful educator's layout curriculum and manage tasks all through the faculty 12 months. These initiatives are created specifically for students' needs and are detailed and controlled in step with insanely strict guidelines. The pressure to conform to federal legislative requirements and district and state mandates have created a stressful situation for teachers (Jacobson 2016). One individual teacher will typically have a diverse group of students with a wide variety of skills and abilities. They must use differentiation techniques to guarantee a lesson or project is adapted to each student. They must communicate effectively with not only the students, but parents, administration, and colleagues. Educational leaders are the backbone of these students' educational successfulness, and with the use of utilities such as the i-ready system, the students' futures are endless.

6. Conclusion

It is important to express that the *i-ready* software should only be utilized as a supplemental educational program to assist teachers and encourage students, and this tool is not a resource for grading students. The mathematical skillsets of the elementary level students are analyzed, observed, and corrected as deemed necessary by the educator. The use of data analytics to decipher the deficiencies affiliated with our youth's cognitive mathematics skills is the driving force behind their growth and improvement. This information is not only privy to individuals who work in the technical fields it is available as a resource for all whom have an interest. The same methodology and technologies utilized to improve technical processes, can assist in improving a student comprehension levels, and promote student academic growth. Data analytics is a tool that can and should be utilized in the classroom for cognitive growth, our students' futures and the fate of mathematical cognition relies on this process. Mathematics and is principles are monumental in our elementary aged children's futures, and with programs such as *i-ready*, their cognitive mathematical skills can flourish.

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Biographies

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Unique L. Kilgore is an Engineering Management graduate student at Arkansas State University. She spent the past two years as a math and science teacher in the Forrest City School District. She holds a B.S. where she focused on Industrial Technology, Management, and Applied Engineering from the University of Arkansas at Pine Bluff. Unique currently serves as an Assistant Energy Engineer for an energy consultant company in Arkansas. She hopes to her continue studies and combine her love for STEM and education.

Brian Merrill is a graduate student in the Management Department of the College of Engineering and Computer Science at Arkansas State and currently pursuing the Master's in Engineering Management. He is an Electro-Mechanical Engineer at a Pharmaceutical Manufacturing Facility located in North Las Vegas, Nevada. Holds a B.S., in Electrical Engineering from Nevada State College, with minors in Mechanical Engineering, and Biomedical Engineering and a certificate in Engineering Management from the universities engineering department.