TeachME PROFESSIONAL DEVELOPMENT

CEUs for Teachers and Educators

Enriching Math Skills in the Lower Grades

Introduction

Instilling today's young learners with a commitment to, motivation for, and interest in incremental numeracy development is vital for their long-term success. Early mathematics is a subject that doesn't always get its due in preschool and kindergarten classrooms; and, unfortunately, that shortcoming may stay with students throughout the rest of their lives.

Prioritizing numeracy development early on has manifold benefits, not just for math development but for students' ability to think logically and recognize the way the world works around them. Enriched math skills can help a student learn other subjects better, as well—and, studies have shown, math skills generally correlate to markers of later success (such as high job aspirations and higher rates of high school graduation).

In this course, we will discuss the importance of basic numeracy, the current research currently that underlies numeracy's role in a classroom, and methods that teachers and parents can use to help a child grow in this vital skill.

Section 1: The Importance of Basic Numeracy Skills for Young Students

If we were to take a brief look at the average American preschool day, we might be surprised to see just how little mathematics is practiced, taught, or even thought about during that time. While this might not be surprising—there could be a part of us that thinks that preschool might be early for very young students to learn math skills—by contrast, preschools tend to spend much of their days helping students cement their gateway literacy skills. Numeracy is similarly extremely important, a true foundational skill for young students to learn, but it's not being introduced nearly as early as reading and writing skills (Pellissier, 2020).

(In fact, one study calculated that—compared to the hours a week a typical preschool tends to spend on storytime and basic reading and verbal comprehension skills—the average preschool spends approximately 58 seconds per day on math instruction.) (Pellissier, 2020)

Even those few moments set aside for math often aren't utilized to their fullest extent. Very young students, in the daily math minute they are allotted, often simply concentrate on reciting the numbers from one to ten, or other easy memorization tasks.

Little is done to broach the topic of larger mathematical concepts or logical flows that will help young students with later studies (Pellissier, 2020).

American parents and educators have largely grasped the importance of early literacy. It's time for mathematics to have a similar renaissance. As we'll discuss here, the research is showing that exposing our children to math early on in life is crucial for their later success in not only math but other topics as well. As one developmental psychologist mentioned, early math skills can often predict higher levels of aptitude and even achievement later in life. One study even noted that focusing on math early on in life tended to jumpstart later creativity and leadership skills (Pellissier, 2020).

All of this simply goes to say: It's time to put early math skills back in the spotlight. That starts, partially, with a realization that our current strategies for familiarizing young children with math concepts aren't quite doing the job.

Why Counting Drills Aren't the Same as Strong Numeracy Foundations

If a preschool environment does place some importance on teaching early math skills, it's done in a very simple way. Typically, a preschool math education consists of surrounding a child with numbers to increase familiarity, and to practice counting numbers in sequence (much like a child practices singing the letters of the alphabet). However, where early literacy education tends to use similar activities as jumping-off points for other early types of reading, speaking, and writing activities, that simple exposure to the existence of numbers tends to form the bulk of the preschool numeracy focus (Pellissier, 2020).

One Stanford expert on early education believes that this practice is far from sufficient to help young children form a solid foundation for later mathematics skills. Merely learning to count (by simple memorization) does teach children the numeric words and the correct ordering of numbers, but little else. Children who are able to rattle off the numbers from 1-10 (or even 1-100) demonstrate that they're good at memorizing lists. This skill does not necessarily show numeric awareness (Pellissier, 2020).

This exposure to numbers from an early age needs to be fortified with other activities. If the list of numbers that a child learns is not paired with meaning and relevance in those early years, a child will be behind in numeracy when the time comes to level-up those basic mathematics skills (Pellissier, 2020).

An Emerging Theory: Children Are Born with a Set of Early Math Skills

New studies are surfacing that are painting an interesting picture of the skills even month-old babies have when it comes to mathematics. One experiment out of the University of Arizona showed that six-month-old infants, while clearly not able to articulate an understanding of basic addition, expected the logical results of visual addition (for example, when two dolls were placed before them, one by one, and then two dolls were placed before them at the same time, the babies seemed to recognize that these were equivalent situations) (Pellissier, 2020).

Researchers believe that this instant and perhaps innate ability to recognize the number of a group of items before us may indeed be hard-wired. If so, it is suggestive that we are built with some degree of numeracy awareness. The current recognized term for this ability is 'subitizing,' or the ability to identify almost immediately the number of items before you (instead of looking at a group of five apples and needing to count from one to five each time) (Pellissier, 2020).

Researchers following young students as they increase this innate ability have been able to chart some level of expected progress by age. For example, preschoolers should be able to subitize a group of one to three items. By age seven, children should be able to instantly recognize the number of a group of up to seven items (Pellissier, 2020).

This might not seem like a critical or particularly impressive skill to an adult, but it's these types of foundational abilities that make math skills easier (or even possible) later in life. If children have the ability to naturally, instantly, and painlessly subitize larger numbers, they may find that other math skills come much easier to them as they grow (Pellissier, 2020).

While the first instances of this ability may be innate, it's our job as teachers to make sure that students strengthen and grow this skill. Merely reinforcing counting drills may not cut it, unfortunately - which means that we need to think outside the box when it comes to early math instruction (Pellissier, 2020).

The Importance of Introducing New Contexts for Numbers

One way to build upon the innate recognition or talent for numeracy that all children may already have is to help them learn more meaningful contexts for the numbers they may already be memorizing. This doesn't have to be complicated. For example, instead of simply counting to ten in a simple verbal exercise, it could help to take a number of fun, recognizable items - stuffed toys, for example - and set them before a child as you

count together. This will help students connect the phonological and verbal idea of the name of a number to the number of objects they see before them (Pellissier, 2020).

For early numeracy education, we can also capitalize on the natural abilities that young children have. For example, children around the ages of two or three are typically good at (and interested in) sorting activities, comparative activities, and recognition activities. If you give them a jumble of mixed-up toys, they will enjoy the task of sorting the toys from large to small, in different colors, and in different groupings (cars in one place, dinosaurs in another, and so on) (Pellissier, 2020).

As the children grow and understand the questions you ask them, you can ask a child to delve a little more into this natural sorting ability. You can ask them how many more dinosaurs they have when compared to cars. The child can work to count how many cars there are, and how many dinosaurs there are. You can request that the child work to sort the toys in different ways. All of these sorting activities will help your child connect numbers to real-world meanings, and thereby start to build a strong foundation for later math skills. This might seem basic, but this can help later when you begin to ask slightly more complicated numeric questions, such as adding the groups of toys together, or taking one car away from the child, and requesting an updated count (Pellissier, 2020).

The (Literal) Building Blocks of Your Student's Numeracy Capabilities

No-one likes dealing with blocks scattered all over the floor, but building blocks and other toys provide an easy 'in' for children to get excited about mathematical concepts from an early age. As it turns out, different measurements, amounts, and variabilities in distinct physical concepts (size, number, color, and so on) delight children. When something is very large, that fascinates them. The idea of being able to discover bigger and smaller things, the size relationship between toys, the thrill of counting ever higher - these are all alluring activities for young children, and it's important to capitalize upon that excitement (Pellissier, 2020).

Measurement and associated activities may be an easy way for young children to get interested in math; according to some experts, it may even be a better choice for introductory math activities than counting drills. Various measured constructs such as length, depth, and weight are concepts that we use without any thought in every day of our adult lives. Measuring activities can help develop these instinctive and useful skills. Concentrating on measurement skills can also help a child build logic and reasoning skills; and, because measuring helps connect abstract numbers with concrete visual or

tangible items, measuring can serve as a backdrop or foundation for later geometric study (Pellissier, 2020).

A Study in Shapes: Your Young Student's Visual Mathematical Foundations

When children play with blocks, they're doing far more than just building little houses or towns or vehicles to play with. They're boosting their spatial awareness. This type of play is hugely valuable: In fact, the more complex structures that children build with blocks when young, the higher correlation with math success in high school (Pellissier, 2020).

Blocks, building or otherwise, can help preschoolers visualize what a circle, a square, and a rectangle are. This type of connection is called visual literacy. Visual literacy and spatial awareness support both numeracy and literacy goals. However, very young students don't tend to learn these skills from early literacy efforts, which are generally more focused on communication, comprehension, and phonological awareness (Pellissier, 2020).

With visual literacy and spatial awareness, words that discuss space and depth and length and mass (such as 'behind', 'backward', 'edge', 'shallow') take on a concrete and practical meaning. This, in turn, can help confer a real-world reason for children to think of later math lessons as practical, useful skills instead of abstract ones - a key motivator to help children be far more excited about the prospect of practicing math (Pellissier, 2020).

A Child's Appreciation for Patterns Can Assist with Later Math Goals

From the very earliest days of children's development, they are able to recognize patterns—first in black and white, then in color, then with more detail, and so on. This evolving pattern recognition helps children understand the value of repeated patterns. This is far more than just a tenet of abstract art appreciation. The understanding of the relationship between what came before and what comes next allows children to extrapolate and manipulate quantities and patterns and, later, numbers in logical ways. This makes later understanding of multiplication and division much more natural and intuitive (Pellissier, 2020).

Why Is Math Important?

One could argue that math is far from a foundational subject. After all, students who might be planning on going into art or music might not need to know their algebra and geometry.

Setting aside the clear mathematical basis for elements of musical theory and quintessential art strategies for a moment, mathematics is important because it does provide a language of its own. Mathematics is the language of logic, according to one professor of child development. If you open a high-level logic textbook, you'll recognize the patterns and orders in which syllogisms and proofs take shape: They look like equations (Pellissier, 2020).

On a very basic level, critical skills are being taught, including teaching children to expect the next step in patterns, instilling them with an appreciation for different shapes, providing an intuitive understanding of how measurement and direction work, and helping set children up for success when it comes to setting up equations and manipulating logic—on the surface, they might be learning their multiplication tables, but on a much deeper and more instinctive level, they're learning how to think logically (Pellissier, 2020).

The benefit of intuitive logical systems cannot be overstated. An innate understanding of logic contributes to comprehension, rational thought, productive creativity, and the ways in which students (young and old) can add positive aims to society (Pellissier, 2020).

It isn't overselling it to state that the beginnings of those ends, the seeds that grow into necessary logical comprehension, often begin with very early numeracy skills.

Unfortunately, many preschool, PreK, and early grade parents and educators are not listening to this (Pellissier, 2020).

Math has a tendency to be difficult. In many cases, neither students nor teachers want to spend much time on it. In the early grades, mathematics (or any real, meaningful study of it) is pushed off until later years. The USA in particular ranks extremely poorly in mathematics competencies. Schools, teachers, and parents alike can take practical action to turn this trend around—or at least increase individual students' understanding of the logical systems that mathematics represents (Pellissier, 2020).

Section 1: Summary

While many of us are already keenly aware of the role that early literacy plays in a child's development, early numeracy is not generally at the same level as far as its significance. However, numeracy tends to be a good predictor of later student competency and success; and the skills that underlie numeracy can help children learn logic and spatial awareness, which can assist both with other subjects and with helping a child become a productive member of society.

However, many preschools and kindergartens aren't allotted the same time and attention to numeracy that they are with literacy, and many children are paying the price as a result.

In the next section, we'll discuss what the latest research says regarding how children can best learn these concepts.

Section 2: The Latest Research Regarding How Children Best Learn Mathematical Concepts

Just as research is constantly informing how best to help young students grasp early literacy, updated research may suggest more effective best practices for teaching math effectively—without suffering. These practices are based on recent findings of how the brain neurologically incorporates numerical concepts, as well as a growing understanding of the basis underlying math anxiety.

In this section, we'll look at what experts say about how children can learn math effectively, how math familiarity can help students succeed in other subjects, and what science suggests may be the best strategies for helping struggling students embrace mathematics.

The Research: How Children Learn Mathematical Concepts Most Effectively

More so than with any subject, people who encounter mathematical struggles - from young children to adults - display a startling lack of a growth mindset.

Individuals with a growth mindset encounter a problem or a struggle and don't see a wall; they see a door that they need to figure out how to open. They see a challenge, one that they enjoy (or at least see a way to accomplish) the prospect of surmounting (Lynch, 2019).

Persons who have a fixed mindset display less optimism and flexibility. When people with fixed mindsets find that they're in a problematic or difficult situation, their first response is often to shrug and assume that they just aren't cut out to deal with that particular problem. In English, we even have accepted terminology for this situation when math happens to be the struggle: A person will declare themselves "not a math person", and those around will nod sagely. If a person is simply not a math person, this is because the brain, somehow, is less primed to grasp mathematical concepts. These

individuals should therefore concentrate on writing or dancing or psychology instead. They are just not math people (Lynch, 2019).

This is not how learning works. Or rather, it's not how it should work. While those who have a growth mindset and realize that they struggle with math might openly acknowledge that they have an aversion to math problems, it doesn't end there. Rather than simply closing the door to any potentiality of math progress on their part, they accept that learning math will require work and perseverance. (Lynch, 2019).

Unfortunately, this isn't the prevailing train of popular thought when it comes to early mathematics success. As a society, we lump people into two categories: The math people, and people who are (very decidedly) not math people. We also tend to lay these labels on people very early, and based on strikingly unscientific criteria. If a young child shows interest in math, he or she is a math person. Any child who does not show any interest in math—which would be the majority, as math is not generally taught in a very interesting or attractive way—is not a math person (Lynch, 2019).

These labels don't mean anything. Sorting people into groups based on an early interest to learn about math more (or not) has nothing to do with their innate (or nonexistent) ability to learn math well (Lynch, 2019).

Children are born with some level of numeracy awareness. All of us are, with few rare examples otherwise. One researcher noted that "numeracy is actually an innate skill, inherent in humans from birth and enhanced through formal education" (OECD, 2016).

If we take it as given that humans are all - to use our own phrase - 'math people,' if we start from that as our first principle, then we find that it's our responsibility to help people who don't think they have the ability to learn math. It's our responsibility to point out and nurture the innate numeracy skills or awareness that every person has (Lynch, 2019).

Whether we as adults believe that we are 'math people' or not, each of us operates with subconscious mastery of numeracy in our lives; we sense the number of small groups without having to count, we can do basic types of mental math, we can populate missing segments of patterns (think: songs, design, absent elements of recurring storylines) with some type of intuition, and we, in arguments and by solving problems, demonstrate the type of logical thought that underlies later types of math education like calculus and algebra (Lynch, 2019).

Each of us might not use complex mathematical skills regularly, but we do use more general math skills or underlying principles without thought. We can build on that. We can also concentrate on the benefits that nurturing those initial abilities has in our lives and on our brains (Lynch, 2019).

What Does Research Say About The Benefits of (Further) Math Learning?

Studies into the benefit of math learning have started to show that math is integral for the holistic, comprehensive use of the entire human brain. Learning math, in fact, stimulates many different parts of the brain - making it an excellent way to assist people as they work to learn other subjects, as it assists the brain with building overall habits related to higher or more logical thought (Lynch, 2019).

One study out of Tohuku University analyzed the various brain scans of children who were completing two different types of activities. One set of children was playing video games. The other set of children was working on a simple set of arithmetic problems. The brain scans showed that the students who were playing video games exhibited stimulation in the parts of the brain that interpret vision and movement stimuli. The students who were completing simple math problems had activity in many more parts of their brain, including the right and left areas of the brain's frontal lobe (Lynch, 2019).

In other words, performing basic mathematics operations seems like it has more of a comprehensive, all-over brain exercise effect than we previously thought. Doing math problems wakes up the entire brain and primes it for further learning. One of the researchers involved in the above study went as far as to say that the experiments "went on to show that addition and subtraction actually did more for growing brains than listening to music or listening to text read aloud"(Lynch, 2019).

Another study coming out of Stanford University analyzed the brain scans of students who were identified as 'at-risk' when it came to mathematics study. They sought to identify patterns in children who regularly studied with math, and strategized academic interventions to help children build the actual, physical electric connections in their brains that might be more present in students who were more 'math people.' Initiatives arising from this study are still in their beginning phases, but the hope is that schools across America will be able to use the data to design activities and curriculum that foster a more organic understanding of and appreciation for early numeracy development (Lynch, 2019).

Ultimately, there has been a prevailing (and incorrect) notion in education and popular psychology that the methodical, math-oriented parts of our brains are somehow

separate from the more creative, literary sections. This is not the case. Learning math has been shown to stimulate the entire brain. Every human is born with and actively utilizes some form of numeracy awareness, and there is (or should be) no such thing as a self-declared 'math person' (or the opposite) (Lynch, 2019).

Establishing accessible and effective programs to nurture early math awareness should be a first priority for modern educational establishments.

What Does Research Say About the Facilitation of Children's Math-Oriented Development and Learning Progress?

In modernity, we at least understand that developing mathematical skills is required for our overall academic progress; this is why math is a more required and central subject than, say, a niche science or foreign language study. We also understand that teaching math in the early years is more important than teaching math in the later years; we know that younger children have more plastic brains than older ones. We can see this simply from the fact that math study is a required subject for the very young, whereas more niche mathematical study becomes elective by the time high school or college rolls around (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).

What we don't necessarily have academically nailed down is the best way to foster an appreciation and excitement for the deep study of mathematical subjects. In the early years, mathematics is mostly about memorization - with the application of more logical or critical-thinking mathematics studies only appearing later on in a student's schooling. Modern scholars are probing the effects of this current setup, and positing that, perhaps, focusing on math comprehension and logical structures when a student is still very young (much as we do with reading comprehension) might reduce the possibility of math fading as a subject of interest by the time a student reaches middle or high school (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).

One recent study looked at the influential components or aspects of how children play in early years - such as when they are in preschool or kindergarten. They also looked at the way that early math teaching practices were communicated to students and the effects of the home environment on early numeracy development (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).

One of these studies sought to determine how children become fluent in the language of mathematics. To do this, they examined the mathematical conversations that happened when a student was in kindergarten. According to the researchers,

communication and conversation serve as a crucial link between internal thinking and external interaction. If children have the opportunity to provide communication and conversation, in those early years, based on their own internal thinking, that serves to help them nourish and grow their own mathematical-verbal toolkits. That serves to help them flesh out and ramify their own numeracy awareness (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).

Unfortunately, too often - particularly in those crucial early years - mathematics education is seen as a one-way street (very different from the way that early literacy and reading comprehension is approached). Teachers teach students mathematical concepts, students, strictly receptive, practice those concepts. Children rarely have the opportunity to present their own creative ideas for how numbers work, or to pose or contribute arguments surrounding the shapes they see all around them (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).

The influence of every aspect of early education on literacy and numeracy cannot be overstated. A student's early environment and its impact on numeracy development, in particular, is often extremely understated. For example, we take it for granted that very young children hear and incorporate vocabulary based on their caretakers' proximal conversations. We take it for granted that the signage, books, and discussions that surround a child from a young age all serve as starting points for phonetic awareness and reading comprehension (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).

However, one study found that the environment a young child is in certainly has huge impacts on that child's logical and numeracy development. For example, students often learn such subconscious and critical skills as spatial problem-solving from observing their caretakers move around their environments, talk about their schedules, or manage multiple children during preschool activities (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).

These newer studies posit the idea that - just as young children learn more vocabulary, the more they are surrounded with conversations - their numeracy toolkits will develop depending on the quality and quantity of the mathematical conversations with which they are surrounded and in which they are involved (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).

From this we can glean at least one action point for parents and teachers of very young math students: We need to talk about numbers, we need to ask them about what they're learning, and we need to allow them to formulate creative, imaginative theories

about early math subjects. We already do this for other subjects. We need to allow math the same courtesy for the best results (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).

We also need to turn our attention to the way young children make use of their playtime. Another recent study observed the different types of play that toddlers turned to when presented with a wide variety of toys and games. The researchers wanted to know how these early play skills might relate to a young child's innate understanding of the logic behind early mathematics (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).

The researchers found several interesting things from their study.

- They found that the same skills that allow children to be mentally active while engaging in both solitary and parallel play structures *and* a child's ability to both initiate and remain engaged in playing with others exhibited a positive correlation with a child's mathematical strengths. The more interactive the type of play activity, the stronger the correlation to early mathematical competency. The researchers thus deduced that there was some link - and perhaps an influential structure between - social, general play skills and early mathematical learning. The study has not yet revealed whether they are causally linked (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).
- Another study sought to further understand the link between the play habits of toddlers and their burgeoning logical skills. The study investigated the innate challenges of early communication, as toddlers sought to correspond with one another through play activities. The idea of a playful application of logic (e.g., a playful application of the language of mathematics) grew to a theory that the early formation of interaction proficiency and social skill fluency has a large impact on later mathematical studies. Why? Children's play is messy, contextual, and methodological. It's full of influencing variables. Children who demonstrate the confidence for and the subconscious skill regarding initiating gameplay correspondence express understanding of the way that social logic works. They demonstrate an understanding of the simple tasks and methods that underlie common childhood games. They quickly learn and exhibit mastery over simple patterns; they become proficient at both receiving and expressing simple instructions to one another. The idea of receiving, interpreting, and executing tasks is a key part of early gameplay with others - and it's also a central part of

many (even higher-level) mathematical operations (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).

- The researchers noted that involvement and engagement in gameplay tended to seep outward and influence the engagement and involvement that young children exhibited with their everyday environments. This almost always correlated with increased numeracy development. Our world is based on intrinsic numerical constructs. A difference between different children - perhaps even those destined, later on, to claim identities as 'math people' or not - is the level to which children notice and digest our world's framework of numbers. To this end, researchers posited that young children's home environments and the level to which basic numeracy is incorporated there would present a strong factor into their later mathematical competency. To the extent that socio-cultural backgrounds and demographic influences play a part in the numeracy of a young child's home environment, other studies have demonstrated a link between social status and perceived proficiency in school settings (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).
- A separate study building off this idea decided to challenge the assumption that a home environment influences a child's ability to progress in math. To do so, the researchers involved compared young student's ability to focus on numbers or numerical symbols. They also assessed each young student's home environment. This study found that home environment was less important than preschool interaction and focus on true early math comprehension. However, the literacy and numeracy of a young child's environment at all times - both at school and at home - certainly cannot hurt while acting in support of the activities that occur at school (Björklund, van den Heuvel-Panhuizen, & Kullberg, 2020).

The Research: How Math Education Affects Overall Academic Achievement

Recent research into the nature of math achievement has asked other questions surrounding competency and its correlations. For example: Can math achievement in the very young be a predictive marker for math success later in life? Similarly, can math achievement in the very young spread from math to success in other subjects or even other competencies, such as social or storytelling skills?

The basis for understanding these connections requires an understanding that math is more than symbols and numbers; it represents a logical language and a framework for understanding problem-solving structures. When we think about it this way, it becomes

clear that understanding math may lead to an increased facility with understanding the way the world works - which might lead to an increased understanding both of other academic subjects as well as the best ways to go about daily life (Renaissance, 2018).

To probe this question, one researcher delved into the math scores and later educational careers of thousands of students across the nation. The numbers he saw as an output of this study yielded interesting results (Renaissance, 2018).

- A student's levels of math achievement were alone able to explain a 30-60% variance in the chance that that child was ready for college. This researcher did not propose that math competency was the only factor that influenced a child's readiness for college, but did claim that it seemed to be one of the more important factors (Renaissance, 2018).

- As a result of this strong correlation, this researcher claimed that he could look at students' levels of math achievement when they were in pre-K, and have a relatively good chance of correctly predicting their eventual enrollment at a two to a four-year college (and even later matriculation in higher degree programs). While this theory might sound outlandish, out of the sample size he studied he was able to present many accurate predictions - leading the researcher to sum up his findings: "school math achievement is a good predictor of whether students in P–12 education stay on track toward two-year or four-year college education" (Renaissance, 2018).

This conclusion has not been replicated by any other study, and the specific link between pre-K math studies and graduate work seems tenuous at best. But it is clear that the link between student success and math achievement is present—and, likely a very strong one (Renaissance, 2018).

This left researchers with another question: If math is critical for successful student outcomes, what are the math milestones required to help children succeed?

Let's look at a brief overview of the mathematics content that researchers are concluding is most essential for students of various ages in K-12 programs. We'll focus mostly on the early and elementary grades in this short section, but mentioning the eventual areas of focus to be prioritized in later grades can give a good perspective for early grade teachers (Renaissance, 2018).

- **Elementary school math:** The essential types of math knowledge for elementary-aged students seem to be whole-number division and the concept of fractions.

One study reached this conclusion by looking at the math scores of thousands of children across the United States and the United Kingdom. The goal was to identify the math subjects that best correlated with or even predicted long-term learning outcomes. These two key concepts - fractions and division - strongly correlated with overall student achievement. In fact, the study also found that familiarity and mastery of division and fraction concepts were more strongly correlated to later math achievement than family income. Family income levels are very indicative of student achievement levels—so, if this finding is accurate, it could represent an interesting way to prioritize leveling of the school's academic playing field. This also, the study noted, does not mean that students should not also prioritize learning other mathematical operations, such as subtraction and addition. The study also found that there was not a correlation between fraction and division mastery and other non-math skills such as reading comprehension (Renaissance, 2018).

- **Middle school math:** The researchers wondered that if the relationship between elementary school math and later high school math achievement levels were so pronounced, what would middle school math predict - or exhibit a strong correlation with? One study into this very question found that if a student failed a math course in sixth grade, there was only a 13% chance that they later graduated on time. (There was a 6% chance of graduating late and an 81% chance of failure to graduate at all.) From this, it becomes clear that, at the very least, there is some link between math comprehension or math-related success and the motivation or likeliness of making towards a high school diploma. The study also found that success or failure in that hypothetical sixth-grade math class was more strongly linked to high school graduation than a student's race or their verbal competency (Renaissance, 2018).

- **High school math:** We can trace the ongoing predictive power of math competency through high school. In high school, as it turns out, students' math performance could end up affecting their professional and career goals - as well as the rest of their lives. Researchers found that there was a relationship between the achievement of high schoolers in fields of mathematical study. Those ninth-graders who attained a score of 75% or higher in math courses tended to have higher career goals. Their lower-scoring counterparts started out with lower career aspirations and also tended to see those aspirations decline as they went through high school. The high-achieving student population also experienced a decline in their aspirations, but because they started at a higher point, they

> ended with career goals that were far higher than their peers who didn't do so well with high school math. The authors of this study suggested that math achievement in early high school could be seen as a critical filter for student career goals - and low math achievement tended to steer students away from hoping for careers in health, social sciences, or commerce fields (Renaissance, 2018).

The researchers noted that the predictive domino effect of math achievement did not appear to dissipate as time went on, following students even through college graduation and secondary degrees (Renaissance, 2018).

It doesn't appear to be exaggerating much to say that prioritizing early numeracy seems to set students up well for life - and failing to follow through on that early math development can hinder a child's (easier) path to success (Renaissance, 2018).

Unfortunately, it also seems that we as a society aren't doing too well to hit even the most universal benchmarks of mathematical competency for our young people. If we look at the rates of students that achieve competency according to state standards of math proficiency, the data quickly tells a bleak story. Only "40% of fourth-grade students, 33% of eighth-grade students, and 25% of twelfth-grade students scored proficient or above on the 2015 NAEP math assessment" (Renaissance, 2018).

Of course - if we remember to look at this situation with a growth mindset, instead of a fixed one - just because a student is trailing in math one year doesn't mean that that student is doomed to a life of lower achievement. If students struggle with math (or if they're a self-professed 'not a math person'), they can still move toward an echelon associated with higher success, one incremental math skill at a time. The same study also offered hope to struggling students: One researcher analyzed students in grades three through eight who initially struggled with math before joining a research-based remedial math program. Some 42% of the students were able to master math concepts and achieve college readiness (Renaissance, 2018).

The Research: Approaches to Early Childhood Math Education

The latest research can also give us an idea of the most strategic and effective methods to pursue success for children in early math education.

Research-based teaching strategies to help children want to learn more about math actually incorporate simple recommendations. Children are practical people. If we take steps to make math useful, understandable, and beautiful, they'll naturally be interested

in learning more. Let's discuss those three aims and how one might incorporate them in the modern classroom.

Making Math Understandable

When researchers and educators polled a large number of early-grade students, they found something surprising: Apparently, young students often feel like math is out to trick them (Barkat, 2017).

Think about it: Learning the language of math, getting to a point where the different symbols that make up most math equations and problems, is very literally like learning a new language - but one with puzzles and problems organically built into its structure. This makes learning symbolic math one of the most difficult tasks that a student will undertake. When students first start to grapple with symbolic math, they're building and strengthening many different pathways in their brains - distinct pathways that will have to fire in parallel instantaneously and subconsciously in order to make math easy. This does not happen overnight. While we are born with a natural inclination towards numeracy, learning how to communicate via symbolic math is a monumental task (Barkat, 2017).

Even though - as some might say - we're wired for math, it's tricky to take the innate awareness of numerical concepts that we have and marry that to a seemingly-abstract system of symbols and operations. Making that leap requires a great deal of help, and sometimes it's simply not presented in the most natural way (Barkat, 2017).

One way to take advantage of the brain's natural architecture is to approach the earliest of math education from a visual-spatial lens. Young children love to complete visual-spatial tasks. If you have an entire classroom of children who need to learn math, assigning them a series of visual-spatial math achievement tasks is a good way to go. The children will see these tasks as fun, and unconsciously practice math comprehension in a tangible, memorable way that they can build on later with more didactic work (Barkat, 2017).

To help choose activities that make math understandable, choose ones that emphasize the following math comprehension subjects:

- Games that help children develop an accessible version of a mental number line
- Games that have children mentally manipulate objects in space (e.g., asking children to rotate cubes to use an image on a specific side)

- Games that ask children to manipulate spatial relationships with each other
- Activities that capitalize on geometrical relationships

Simple games like hopscotch, blocks, activities like quilting or origami, or other similar undertakings can easily be given a math bent for classroom success (Barkat, 2017).

Those activities can help with the visual-spatial understanding of mathematics. How are we to help a child integrate the more symbolic side of math comprehension? Learning the logic and the language of math relies on phonological awareness and other brain functions that are developed through early literacy. Building the bridge between what a child has already learned about literacy and the visual-spatial mathematical awareness that a child is learning can be difficult. The sweet spot tends to lie in the prioritization of verbal math activities, particularly activities that also incorporate a child's sense of visual-spatial math (Barkat, 2017).

Examples of such activities include:

- Counting everything in sight, including familiar areas and objects like one's own body parts or types of objects in the surrounding classroom
- Counting the duration of seconds while performing stretches or physical tasks

Making Math Useful

As noted above, children are practical people. They enjoy the things in their life that feel useful and purposeful. In order to help children be excited about learning math, they need to know that it serves a practical purpose in their lives (Barkat, 2017).

As symbolic math can feel quite abstract, children can feel like it's not purposeful. As a teacher, one of your jobs is to change that. Activities that can make the use of mathematics very relevant to young children include:

- Tracking relevant and interesting data, such as the height of students in the classroom, as they change over time
- Making math competitive—assigning young children the task of keeping score, which necessarily includes adding, counting, and subtracting

Making Math Beautiful

Research is showing us that beauty has a singular effect on learning. It produces pleasure. It attracts. It provokes interest.

If perhaps, the average person were asked how beautiful symbolic math is, the response would likely be in the negative. Learning math requires effort. It can be difficult. It is not a process that is necessarily associated with beauty (Barkat, 2017).

Making math beautiful can help attract the innate design-consciousness of young children's brains. Using activities like origami, early drawing prompts, and the like to help children learn about the beauty of symmetry and specific shapes and angles; teaching children about dancing to help them learn about visual-spatial relationships between dance partners and body parts; even using beautifully-illustrated stories featuring mathematical concepts to associate a visual with the math topic in children's brains—these are all ways that we can work to make math more innately interesting and attractive (Barkat, 2017).

Ultimately, our way forward is simple: If we find ways to make math more beautiful, useful, and understandable at the very beginning, we'll have a much better chance at igniting that all-important inner motivation that will prime a young child for success from the early years (Barkat, 2017).

Section 2: Summary

Modern research is yielding interesting results about one of America's most-disliked subjects. As it turns out, our brains might be, to some extent, wired for math—which makes our job as teachers less about imparting brand-new information and more about nurturing the seeds of comprehension that might already be there.

However, we need to teach in ways that are effective for students, and in ways that prioritize math subjects that will have the most exponential learning effects for students. Rote memorization may not be the best method to achieve these ends.

To discuss further what might be better options, we'll turn to the third section.

Section 3: Practical Strategies for Building Math Skills

Now that we've discussed the importance of early numeracy as well as the current research underlying how children learn mathematical concepts, it's time to get practical. In a classroom setting, what are the best ways to help a student learn mathematics?

Let's start with a prescient question.

What are signs that a child is struggling with math?

In order to best help a child that is struggling, we need to be aware that that's the case. After all, we can only provide targeted interventions if we are aware that they're needed.

To that end, here is a list of several observable signs that we can use to tell whether a student is struggling with efficient and effective mathematics comprehension (Nisbet, 2019).

- **Expressing comments that are negative about math.** If they say things like 'I'm not good at this,' or 'I hate this,' then that's a pretty clear early sign that they are struggling. If they go out of their way to avoid math, that can also be telling.
- **Exhibiting signs of math anxiety.** Math anxiety is a very real affliction. If a child displays marked anxiety while being asked to demonstrate math skills, they are likely not confident in their math comprehension.
- **Demonstrating difficulty connecting math relationships.** Much of mathematics relies upon understanding basic numerical relationships—for example, the inverse relationship between addition and subtraction. If a child has difficulty making these connections, it's time to intervene.
- **Difficulty managing time well.** Time management is one of the practical ways that a person demonstrates knowledge of temporal mathematics. If a child doesn't quite show the ability to adhere to a schedule or read a clock with ease, that's worth remembering.
- **Confusion when extrapolating math to practical problems.** If a child completes problem sets easily but flails when met with a real-world issue (such as the number of days left until their birthday, or the change required when purchasing something), that could be a sign that they're very good at test-taking or rote

memorization—but not yet skilled at practical, real comprehension of mathematical subjects.

- **Exhibiting a lack of progress towards mathematics milestones.** When children fail to meet the same milestones in early mathematics that their peers exhibit, a teacher should take note and intervene to provide support for those children so they don't fall behind.

This last begs the question: What are practical mathematics milestones? What is the standard progress to which children (and their early-grade teachers) should aspire (Nisbet, 2019)?

Fortunately, we do have some idea of the early math goals that we need to work toward. Examining the state standards and the topics that make their way onto grade-by-grade standardized examinations can give us an idea as to the progression that is expected of a young student.

For a more general sense of ideal progression, we'll look at the types of math skills that young learners should prioritize in those early grade years, as well as practical and fun instructional techniques that educators can use to teach them.

What types of math skills are expected of young learners?

For a more comprehensive listing of the skills that young learners should prioritize, it's a good idea to consult state-by-state standards of early math goals. However, common expected skills for young students might include:

- Being able to perform basic calculations—addition, subtraction, counting, multiplication, and division—with whole numbers
- Being able to estimate the result of those basic calculations mentally (thus showing a familiarity with the idea of practical manipulation of numbers, instead of simply an awareness of the methodology)
- Being able to recognize patterns, complete them or fill in missing parts of those patterns, and extrapolate those patterns (demonstrating an awareness of the underlying relationships between parts of those patterns)
- An awareness of basic decimals, fractions, rates, ratios, and percentages, and an ability to manipulate those entities with some level of success

- A familiarity with measurements—volume, distance, height, etc.—as well as a practical understanding of using that data (e.g., in recipes, or in spatial activities such as dancing or origami)
- A basic understanding of statistical information and an ability to interpret simple graphed or visually-presented data.

As we touched on above, teaching these concepts can be much easier and more effective if we take steps toward making these concepts beautiful, useful, and understandable. In the next section, we'll discuss practical ways to do that in your classroom.

Helpful Strategies for Teaching Children Math

It's easy to feel that being able to teach mathematics is a learned skill itself - or even a core competency that only some of the population naturally has. This is not the case. While it may be easier for some persons to grasp mathematical concepts, anyone can teach children how to learn these concepts well - as long as we follow specific, strategic, and time-tested strategies for passing on critical information in an effective way.

Math is a crucial skill for children because, as we discussed above, it can help them better learn other subjects. It's also a subject that's very commonly emphasized in standardized testing: Your students' math skills are often considered representative of their overall learning and achievement status.

As this is the case, many teachers seek to give their students a boost by teaching to the test. This strategy often manifests itself in test prep materials, drilling worksheets, unwieldy sessions with flashcards, and other rote learning practices. While these strategies can be helpful to a certain extent, working on actually helping children internalize mathematical concepts will have a more long-ranging reward than simple memorization.

There are teachers who have found ways to maximize their students' test scores and provide sound, fun instruction at the same time.

There has also been a lot of study into what makes a competent, effective, and compassionate numeracy educator. The following are attributes or characteristics of numeracy teachers who have the skills and qualifications to do well for their students:

- Good numeracy teachers create active, collaborative learning environments.

- Good numeracy teachers model different numeracy strategies for their students as they figure out different ways to communicate and solve problems.
- Good numeracy teachers motivate and nurture students through perceived difficulties learning or struggling with math.
- Good numeracy teachers help their students accept responsibility for their own numeracy journeys—but provide empathetic support as the student does so.
- Good numeracy teachers use classroom design and management to help children learn math subjects.
- Good numeracy teachers utilize hands-on experiences, class discussions, and various types of content to help children learn in several varied ways (Kentucky DoE, 2020).

Many of these skills, common to good numeracy teachers, can be learned or improved upon if needed.

As it turns out, being a good numeracy teacher often comes down to being creative about your teaching tactics and being willing to vary your instruction from time to time. Here, we provide a list of strategies - some outside-of-the-box, others more foundational - that can help you and your students have a more effective and engaging experience as you work toward mathematics mastery.

1. **Make sure that your students are aware that you have high expectations for each of them** - regardless of their specific learning proclivities. Instead of allowing them to think that merely memorizing the multiplication table is their goal, work with them to soar higher. If any of your students assert that 'they are not good at math," challenge that. If you have students in your class who are of demographics often unfairly associated with poor math skills, make sure to acknowledge them when they succeed. It's very easy to think that one is bad at math - which necessarily builds a wall against further progress. Instead, help your students build a growth mindset regarding mathematics. Focus on helping them attain inspiration and motivation for the subject. One way you can do this is by having constantly high expectations of them, no matter what (Adams, 2020).
2. **If you don't like math, find a way to forget that.** A strong dislike for mathematical concepts, instruction, and homework sets is far from just a childhood concept. Adults also experience math anxiety. If you teach from that place of negativity, your students will be able to pick up on it. You need to make sure that you don't

pass on any of your potentially negative or nerve-wracking experiences concerning math to your students. Aside from being careful about your own demeanor and language when you're initially presenting a mathematical concept in class, you can also adopt a more positive attitude when you're helping students one-on-one. For example, if a student is struggling over a mathematical concept or a homework question, it can be tempting to empathize with them or console them in a way that suggests that you get it - math is just tough. This doesn't help a student build a growth mindset. Instead, focus on being positive and confident that your students can solve their problems, and help them with practical strategies that can help them overcome their issues (Adams, 2020)..

3. **Be proactive regarding your teaching strategies.** Look forward to the types of problems and concepts that students will have to be familiar with in order to end their upcoming tests, and find more relaxed or subtle ways to introduce crucial or complex topics. This will help your students familiarize themselves more naturally with mathematical concepts that could be completely overwhelming if only focussed-on in the last month of the year (Adams, 2020).

4. **Use testing and assessment strategically throughout the year.** Generally, your students will only sit through a standardized exam once or twice a year. This is not enough feedback for you to fully understand how your students are doing. Even testing schedules based largely on more substantive midterm and finals structures don't give you enough time to really assess whether a student needs more help. One good strategy is to plan out your year's necessary or strategic exams to fit the criteria required by your school, and also to have a type of testing that is more seamless with your instruction style. (This will also help reduce the anxiety that your students have around testing because they'll be familiar with your assessment style) (Adams, 2020).

5. **Make sure to modify your teaching structure based on what we learn.** Often, we're so focused on proctoring good exams and making sure that we give good feedback to our students that we forget that our teaching styles and even the modes in which we give exams themselves are flexible. If you learn that a majority of your students didn't understand a concept the first time around or are struggling in a specific way, taking the time to modify the way you present subjects or going through a specific problem set can help an entire classroom of children work toward success. Always make sure that you ascertain how much

your students have understood and how much of the subject matter they have retained before working toward growth in that subject (Adams, 2020).

6. **Draw the lines between mathematics subjects and other subjects that your students might be learning.** Your students are practical people. One of the reasons they may not like math, particularly as it moves to more niche subjects like basic algebra or geometry, is that they can struggle to connect it to practical uses in their everyday life. While geometry and algebra may be focuses for later grades, you can set younger children up now to believe that math is fundamentally practical. Discuss the financial transactions that are simulated in books; find ways to discuss the shapes presented in famous pieces of art. Ask your students what they want to do when they grow up, and find creative ways to show them that astronauts, race-car drivers, and famous actresses all need to know math fundamentals (even if it's a stretch)! This will help your students understand why it's important that they know their multiplication tables or other mathematical concepts that could, otherwise, seem irrelevant at best (Adams, 2020).

7. **Offer your students the opportunity to choose their own learning tasks.** Sometimes, all children need to feel is a little creativity or freedom with their own educational experiences. When it comes to more traditionally stressful subjects like mathematics, simply allowing your students to make choices that impact their own experience will work as a buy-in, making them feel like they have more control and ownership over the way they learn these subjects. Work to give your children two options for how they work to master a subject - or, to reduce work on your behalf, perhaps allow them to choose the order in which they tackle assignments or the manner in which they complete assignments. For example, a student could choose to complete a timed math challenge, quiz a friend on math topics, or give a small (minute-long) presentation on a math topic - all using a math assignment sheet that you give them. This also helps adapt one subject or assignment to multiple learning modalities without your having to cater multiple lesson plans to your student body (Adams, 2020).

8. **Encourage your students to talk about math.** Without giving your students unintended space to air their grievances about mathematics, make it clear that your classroom is a space for communicating positively about mathematics and in language that incorporates mathematical concepts. Encourage your students to have conversations about the ways that they approached specific problems, or

have them describe the ways in which they conquered their math struggles. This will give you helpful information regarding what your students are thinking. It will also naturally help them incorporate math topics, instead of parroting things back at you without retention. This type of natural conversation around math will also help you discern which children understand mathematics concepts, and which students are simply memorizing the answers to common sums or question prompts (Adams, 2020).

9. **Play math games in your classroom.** It sounds like a trite strategy, but simply showing your students that math can be practical as well as fun can go a very long way toward helping them embrace the subject. You need to help your students want to engage in the mathematical process. One way to invite participation without suffering is to start with math games. Math games can help meld a sense of mathematical fluency with your student's sense of competition and strategic thinking. These types of games (we'll provide a list in a later section!) can also promote class bonding over mathematical concepts in a non-stressful, positive manner (Adams, 2020).

10. **Try to garner as many opportunities for hands-on learning as is possible.** As previously mentioned, children are inherently practical. Math can seem extremely abstract. Any strategy that you can use to make these concepts more concrete will help your students be more interested in learning. Use toys or blocks to help students visualize basic sums or other ways to manipulate groups of units; give them rulers and pieces of fruit or cereal boxes to give them a real idea of what they're measuring when they find values for height, width, area, and circumference. If you give your students examples of why knowing this information might help them in a dream career or even at home, that will also appeal to your students' practical side - for example, a cereal box with increased height and depth will probably have more cereal in it; help them see why this is the case (Adams, 2020).

11. **Target deep understanding, not rote answers to easy equations.** While there is certainly a time and a place for memorizing procedures (carry the one!) for fundamental pieces of arithmetic or being able to recall a basic formula if you and your students target learning about math in this way you'll both get overwhelmed very quickly. If this is your approach to math, you'll find that there's simply too much information involved! To combat this common approach, consider spending far more time on activities that foster understanding. Allow your students to

explore mathematical concepts; go through the reasons that different math procedures are completed in specific ways (e.g., the order of operations). Help your students understand the various strategic ways that they can solve problems, and from those strategies allow your students to realize what the common procedure or formula would be. This is a much stronger way for your students to make mental connections that support mathematical literacy, rather than giving them the formulae to memorize from the start (Adams, 2020).

12. **Consider using ultra-meaningful, real-life prompts when your students are learning math.** We've all heard about the number of apples various farmers have before a subset of those apples are eaten by wayward farm animals. This might be cute, but it (likely) doesn't speak to the majority of children's lives - and therefore may not land in an effective way. If you're teaching your students about the concept of area, talk about their dream homes (how large would they be?) or the size of your classroom and the layout of your school as practically as you can. This will help your kids directly understand the meaning behind your lessons. Another great idea? Pretend that you're redecorating your classroom. How much wallpaper do you need? If you used a specific shape of tile, how many would you need? Peppering the conversation with both mathematical and other, more popularly 'fun' questions will keep your students interested and excited (Adams, 2020).

13. **Allow your children to struggle.** It may seem counter-intuitive, but experience with that feeling of frustration (and the subsequent empowerment of breaking through that frustration) is all-important when helping students build their own growth mindsets. When you give your students a problem to solve, let them figure out at least one way to solve it (if not multiple ways). It's not your job - at least not initially - as a teacher to provide the correct answer; your job is to invite the child into the learning process. Asking your students follow-up questions to guide them to the correct process as they struggle is one such effective strategy; carefully exposing them to helpful resources is another. If you see yourself less as an instructor and more as a guide when it comes to grappling with mathematical subjects, it might help: After all, remember that your students don't need to be told or to memorize that 2+2=4, rather they need to incorporate the basic concept of addition into their mind on an intuitive, subconscious level. You don't do that; they do. It's your job to help them master this ability (Adams, 2020).

14. **Provide rewards and inject excitement into the learning process.** If your students have never before experienced success while learning math - or if all they have experienced consists of mind-numbing problem sets and flashcards - it's time to help them see that the world of mathematics can be an exciting one. If the subject matter itself doesn't spark joy for your students, you can build just-adjacent systems that do so, instead. Introduce a certificate, sticker, or point system around meeting mathematics milestones; recognize achievements that your students make - no matter how objectively small - in a purposefully celebratory way. This won't take much effort on your part, but it will mean the world to a student who may need a little incentive to study their math texts (Adams, 2020).

15. **Strategies that can Help Struggling Students With Math Skills.** For generations, math has been a famously difficult subject. Legions of students have struggled with it. As teachers, we have to be careful to empathize with students who confuse mathematical concepts without further validating math's label as intrinsically confusing. It's a delicate balance that we need to work to achieve. If you have students in your class who struggle with math, consider implementing these basic, strategic methods in your classroom:

16. **Extremely Explicit Instruction.** Much of the time, we work towards project-based and discovery-based learning objectives. For many subjects and for many students, these are very modern and very effective ways for young people to pick up new concepts in an intuitive way that gives them responsibility and ownership over their academics. For many, this is a great strategy. However, if your students are chronically struggling with really 'getting' a mathematical concept, this organic educational approach may not resonate well. In this case, it's a good idea to step back and revert to slow, reasoned, step-by-step instruction. Students who are struggling should still be exposed to the same type of experiential learning techniques that they may be used to, but providing them with a little more framework and stability might be the best course of action (Todd, 2018).

17. **Provide Context for All Mathematical Concepts.** Part of the reason why mathematics can be construed as confusing and frustrating is simple: Much of the time it's extremely abstract. Without a concrete rationalization for why it's useful - or, less pragmatically, without a way to 'see' it in their heads - many kids will struggle to grasp the more esoteric concepts within basic mathematical instruction. Students learn through many different modalities, after all; and

students who are naturally less text-based may not intuitively grasp the concept of multiplication or (later down the road) exponentials, geometric theorems, or algebraic variables when these topics are communicated verbally. Allowing your students who may struggle with math to experience activities that provide context for mathematical concepts can open the door to higher understanding in a way that works for them. Providing students with videos, hands-on activities, and pictures that represent mathematical concepts can go a long way. Another good method is to pair a struggling student with another who has been able to grasp the concept. Watching a peer go through the problem-solving process can help instill confidence in students. It can also help them understand the approach better when it's worked out before them by a friend than when it's simply depicted on a chalkboard. In either case, thinking outside of the box to give struggling students many different points of entry into a mathematical concept is a good way to see if a slight shift in educational strategy might work (Todd, 2018).

18. **Lean into Models and Creative, Non-Verbal Representations.** This point is similar to the last - but for a different rationale. If you think about the ways that a student's brain grabs on to literacy and numeracy concepts during early education, you'll find that the slow ramp-up to mastery for both literacy and numeracy often follows a very similar trajectory. If students are struggling with math, they might also be struggling with reading, vocabulary, or comprehension. If so, giving them more verbal presentations, text materials, or word problems isn't going to help. Rather, it'll compound the issue and make it more attractive for the student to just write math off entirely. If you believe that your student might be having issues with both literacy and numeracy, your first step needs to be to alert your student's parents and other teachers so the child's entire care team can help provide interventions to help the child get back on track. In order for your student to grasp mathematical concepts without relying too much on verbal proficiencies, finding more visual methods of communicating concepts is key. For example, bar modeling representations can help children interpret word problems into visual media (Todd, 2018).

19. **Take Time to Review Basic Concepts as Well as Incremental Ones.** This is a good strategy for your entire class, not just any children who may be having difficulty grasping tougher concepts. Set aside a small amount of time per day to review math activities focusing on concepts you've introduced in the past. For many students, this will be easy - which will help boost their confidence in mathematics as well as their speed in basic arithmetic. For others, it'll be a necessary review of

mathematical foundations. Math trivia games, quick flashcards, or even an exit question with a few quick problems on it would all do the trick—it's more important to be small and consistent than incredibly creative with this particular educational strategy (Todd, 2018).

20. **Lean into mnemonics.** There's a reason that mathematical mnemonics have been popular for decades: they work. Giving your students tools to help them be where they need to be never goes out of style. One such strategy could be a simple mnemonic to help them remember the concept . Other strategies you can give your students include actions like helping them verbalize when they need assistance, directing them to out-of-class resources, assigning them to peers their age who can assist them, and giving their parents resources to assist with math skills at home (Todd, 2018).

Above, we mentioned that parental support at home can be crucial for helping struggling students cement their math skills as they grow. However, parents may require nudges and resources from you in order to get started. Often, parents want to help their children, but don't know how to do so in a way that is effective or that works with your specific teaching strategy. As you put together your curricula and lesson plans, consider incorporating specific ways to help your students' parents with at-home support. The following list may provide ideas for you to use!

- Give your parents ideas for activities that can help your students relate mathematical concepts to their daily life. For example:
    - When your students' parents ask for assistance setting the table for dinner, they could simply talk about the number of bowls, forks, and spoons that they need. They could fold their napkins into different shapes and ask their child to identify them.
    - When going to the store, parents can enlist their children to help them pick out specific numbers of different types of groceries, ask for help navigating a recipe and selecting appropriate ingredients, or even helping count the change associated with small purchases at the store.
    - If parents are cooking at home with their children, the parents can ask for help measuring ingredients.
    - Parents can show their children a calendar, talk about the number of days in a week and in a month, and help their children put together a simple

countdown of days that remain before an event that the child is particularly excited about.

    - Parents can draw a map (to scale!) of their homes and help children determine which is the best emergency escape route (Bobowski, 2018).

- Parents should be encouraged to check in on their child's assignment lists on a daily basis. In order to help their children best, it's a good starting point to be aware of what they're studying and what they're doing on a daily basis.
- Schools can provide parents with a list of online games, phone apps, or types of computer software that the parents can encourage their child to use at home.
- Schools can help parents be aware of games that help teach math techniques at home, such as dice games, easy card games, or math brainteasers to discuss over dinner.
- Parents can ask their children to count aloud by ones, fives, twos, or tens. To aid with familiarity in counting and basic computing, parents can ask children to count objects around the house, or ask simple verbal math calculations (such as following the number of cars ahead of them in a drive-through line, or the number of minutes left in a TV program).
- Parents can help children build a basic awareness of spatial recognition, shapes, and foundations for geometry by pointing out examples of shapes and angles in the real world (for example, the right angles of books and pieces of paper, and the parallel lines of railroad tracks). Parents can use simple, readily-available items around their houses such as toothpicks and paper towel rolls to make simple shapes, and ask their children to help.
- Parents can help children understand the concepts of measurement by using comparative descriptors in regular conversation (e.g., shorter, taller, more, less, same, about, heavier, lighter) and asking their children to assess various volumes and sizes as well. Parents can also ask their children to tell them the time, measure items around the house with a kid-friendly ruler, and familiarize themselves with an easy timer or stopwatch to assist with or measure the duration of various household tasks.
- Parents can help introduce children to the basic concept of statistics and probability simply by asking questions regarding the number of blue candies they're likely to find in a rainbow pack; what type of weather conditions are likely

to be present in the upcoming week; and whether a favorite sports team is likely to win. Then, if the child shows interest, a parent can continue this real-time education by graphing or keeping track of wins and losses, weather events, occurrences of colored candies, or any other recurring events to help the child see that it's possible to map the probability of events over time (Bobowski, 2018).

Summary and Conclusion

Recent studies have shown us that early numeracy development is more important than we might have previously thought—and that much of modern numeracy teaching doesn't kick in, in an effective way, until years after it's too late to ensure mastery and success. With this in mind, teachers and parents alike can work to make sure that today's children have the resources they need to get excited about learning math.

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