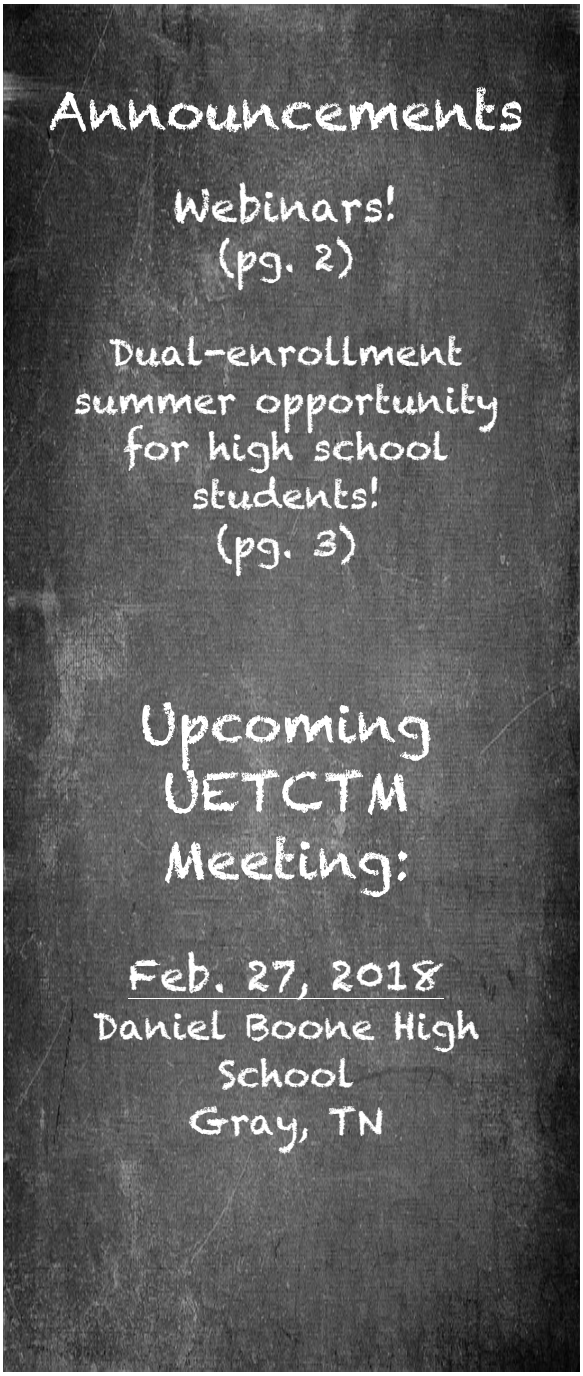
Upper East Tennessee Council of Teachers of Mathematics

NEWSLETTER VOLUME 18 ISSUE 5 MARCH 2018



INSIDE:

Webinars: High-impact learning without leaving home!

Rigor, Relevance and Relationships: Making Mathematics Come Alive with Project-Based Learning.

Author Talk: Jean S. Lee & Enrique Galindo

March 7, 2018 7:00 p.m.

For more information, click here.

Collective Call to Action: Excellence through Equity

Series: Equity and Social Justice in Mathematics Education

March 14, 2018 7:00 p.m.

For more information, click here.

Establish Mathematics Goals to Focus Learning and Use Evidence of Student Thinking

Sponsored by Texas Instruments

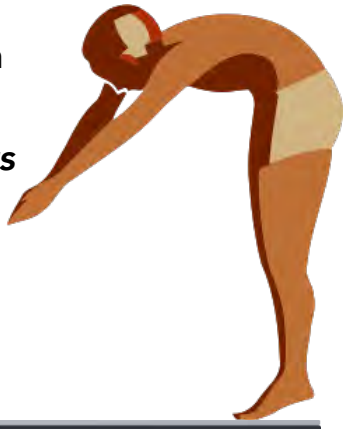
March 14, 2018 7:00 p.m.

For more information, click here.

Juniors and seniors can dive into summer opportunity!

High school students can dive into college early with convenient online summer courses at ETSU:

- ***Common requirements for several STEM majors***
- ***No scheduled meeting times***
- ***Exams proctored at locations convenient to students***



ONLINE:

Calculus II Linear Algebra

Differential Equations

DEPT. OF MATHEMATICS & STATISTICS

East Tennessee State University

June 4 – August 10, 2018

Thanks in part to a grant from the National Science Foundation administered by the ETSU Department of Mathematics and Statistics, the university's summer distance learning offerings will include Calculus II, Linear Algebra and Differential Equations. For high school students who have passed the AP Calculus exam, this is a great opportunity to get a jumpstart on college. Click here for more information about dual enrollment grants or scholarships. For more information about the program, contact Dr. Ariel Cintron-Arias at cintronarias@etsu.edu or 423-439-434.

President's Message: Are we breaking down barriers?

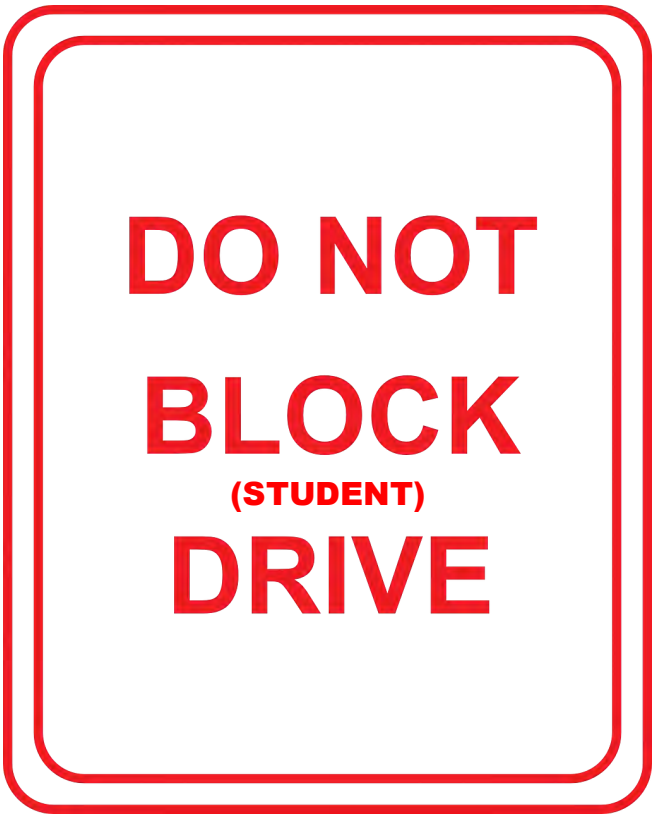
Getting where you're going requires good directions and good pathways. Yet according to principal reports, more than 70 percent of American math students are tracked into "ability" groupings. That's bad news *and* bad direction, because as NCTM President Matt Larson points out in his recent message, that kind of tracking will "sentence some students to dead-end mathematics course pathways that fail to prepare them for the workplace, for participation in our democratic society, or for the continuation of their education."

Hierarchical tracking shortchanges students in the lower tiers by focusing primarily on memorization and procedures without sufficient attention to understanding. This leads those students to fall further behind, and those hierarchies to become self-fulfilling prophecies, as the "opportunity gap" leads to "achievement gap." This is why Larson calls tracking and its corrosive effects "*educide*."

Today, even teachers are being tracked, consigning the most underserved students to the least experienced teachers.

Access to rigorous curriculum and high-quality instruction continues to be equally important, Larson asserts. "As mathematics educators we must simultaneously address the barriers too many students face to high-quality mathematics instruction as well as how students experience mathematics in the classroom."

For the complete message, click here.



The Struggle Is Real(ly) Good for You

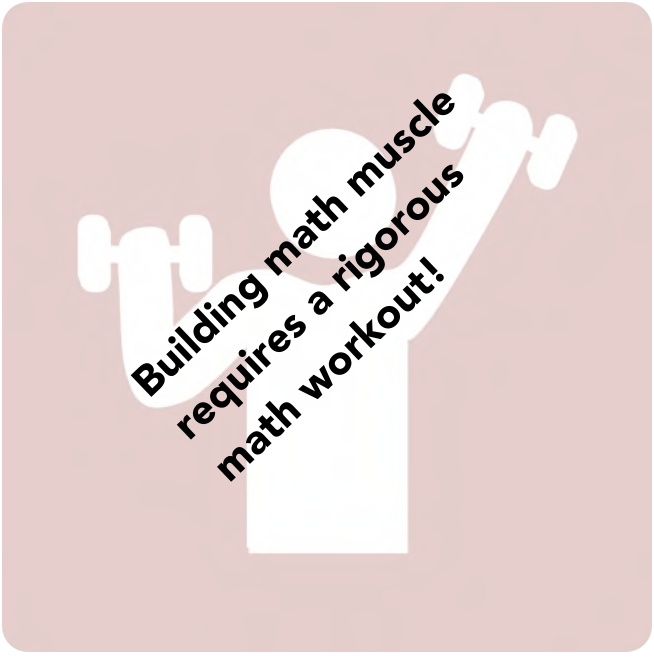
By
Amy Ivey

Imagine you are trying to get fit and prepare for an upcoming fitness challenge. You decide to invest in a personal trainer, and since it's a hefty investment, you want to shop around and find the trainer who will best prepare you for this challenge. That is only reasonable, right?

The first trainer you try gives you a decent workout. You learn to use a few new machines to target some new muscle groups, but in the end when the workouts are over you didn't really "feel the burn." The workouts are comfortable for you.

The next trainer you audition has a different approach. Each workout with this trainer has some similar aspects to the previous session, but something about it is always a little different whether it be more repetitions, more sets, or more weight. Your muscles shake as you try to finish the workouts. You can feel the lactic acid in every muscle. The day after each workout, you find at least one muscle group a bit sore. Nothing about these workouts is comfortable.

Which trainer do you hire to be your regular trainer? While it might be tempting to go with the most comfortable routine, that routine would not be the most effective to move you in the direction of your goal. You may, in fact, build some muscle and increase your endurance, yet working within your comfort zone or current capabilities will not advance you the way a rigorous, challenging fitness routine will. If you truly want the best results, those most aligned to your goals, you would hire the trainer that challenges you.



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The Struggle is Real(ly) Good for You

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Our job as educators is to help every student advance his or her capabilities not only in regard to the content standards of our discipline but also in critical thinking and problem solving strategies that they will use for the rest of their lives. Particularly in the discipline of math, when we give the students enough information to solve a problem easily or without a struggle, they may solve the problem correctly. They may even do this with speed and repeated accuracy. However, these results do not ensure that the students fully understand the concepts behind the calculations. Our job is to provide students with enough rigorous content so that they will grow to their full potential.

Does this mean we should pose nearly impossible problems to our students or leave them to figure out the strategies completely on their own? Certainly not. As with almost anything, balance is the key to success. I once had a teacher who answered any student's question with the response, "You are smart; you can figure this out on your own." While her intent

"Should we pose nearly impossible problems to our students or leave them to figure out strategies completely on their own? Certainly not."

may have been respectable, the practice was flawed. She did not question us to assess our current level of understanding or to lead us to discovering useful information. We weren't given enough information to even get us started. This was a higher level mathematics class, not one required to graduate. Those who took this class did so because we truly wanted to learn as much math as possible. Many in the class have gone on to careers that require a thorough understanding of mathematic principles. Yes, we were considered "smart" students. Still, we nearly drowned in this class.

Continued on pg. 7

The Struggle is Real(ly) Good for You

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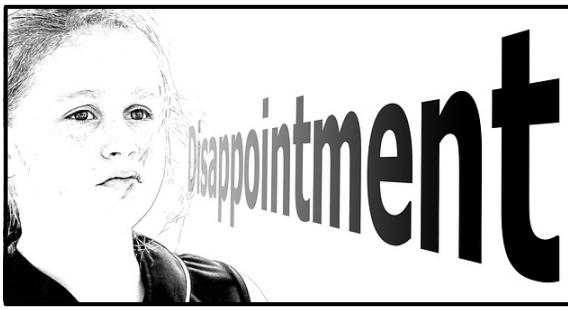
Our saving grace was that the majority of the students in this particular math class also had a second math class that semester. The rosters for these two classes were nearly identical. Almost every day, the teacher of the second math class would invest time at the end of her class explaining the concepts we were lacking from the first class. I gleaned just enough information and dug in just enough to make the only grade that was acceptable to me. I left that class with an A, but it was not because I understood the concepts. This struggle was too difficult. Mind you, I have not been in high school for over 20 years, but this experience has been seared in my mind. To say it made a lasting impression on me is an understatement.

Conversely, I had another teacher that year that created struggle for me, but her approach was vastly different and had a drastically different result. This class, 11th grade English, was one in which I was not considered a natural. The curriculum had a strong emphasis on writing as this was the year in high school in which we took a state writing assessment. I was very uncomfortable in this class as the assignments all seemed like mountains I had to climb. The difference was that this teacher provided us with a metaphorical toolbox of writing strategies. She held us to very high standards, yet she gave us the tools to meet these standards. She showed us many different strategies to organize our writing and insisted we follow the five-step writing process. At the time, that process seemed like added steps, the purpose of which was surely nothing more than torture. However, learning to outline,



"I left the class with an A, but it was not because I understood the concepts. This struggle was too difficult."

Continued on pg. 8

The Struggle is Real(ly) Good for You

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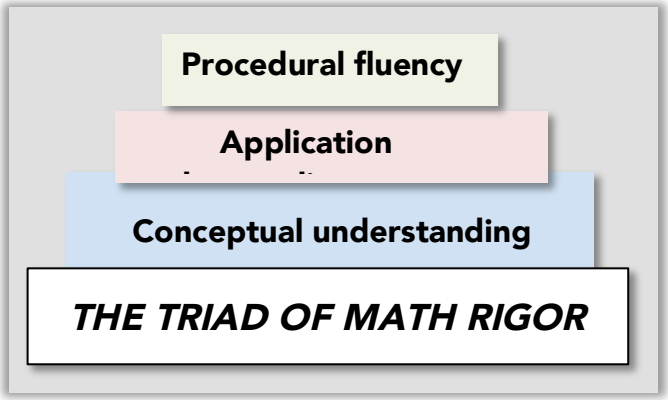
use graphic organizers, and thoroughly plan our writing before we began to draft was the structure I needed to make sense of the large assignments. It allowed me to chunk my thoughts into manageable parts that would come together to make the whole of my essays. These were like building blocks, which she helped us cement together throughout the year to build a solid understanding of the writing process. At the end of my 11th grade year, the most difficult year of my high school career, I was stunned to be awarded the 11th grade writing award. It was very validating, and it is still my most treasured academic award. Even before this award, I knew that I wanted to go to college. I did not ever dream though that I would go on to pursue two graduate degrees. The background in writing that I gained struggling through my junior year of high school paid great dividends for years to come. These skills were even more valuable than any award could ever be.

Hopefully by now, you subscribe to my notion that a productive struggle is not only healthy but essential to helping students achieve the greatest growth possible. I assert that this must be a balanced approach. Rigor is the three-legged stool upon which this balance may be perched. Rigor as it relates to mathematics can be expressed as a triad consisting of conceptual understanding, application, and procedural fluency. I would argue that these could be visualized as a pyramid. Conceptual understanding must be the base of this pyramid. Students may be able to regurgitate formulas or follow algorithms, but without the conceptual understanding behind these, at some point these young mathematicians will meet a road block. Building this conceptual base will serve as the essential foundation for application and eventually fluency.



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The Struggle is Real(ly) Good for You

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Your question now may be, "How do I provide a struggle while building that conceptual understanding? Isn't this where explicit teaching comes in? How do I allow my kids to struggle with basic concepts?" The answer is to think of oneself as more of a tour guide than an instructor. Why do people take tours? They are curious. Rarely in life do opportunities and experiences just place themselves in our paths. People seek out experiences they wish to undergo. We should utilize the natural curiosity in our students to "hook" them and guide them to mathematical experiences in which they will be active participants. People are willing to put forth effort if they feel the payoff is worth it. Students may not understand the value of rich math experiences. Still, when they struggle to accomplish conceptual understanding of math concepts, the intrinsic reward will sneak up on them. Along the journey, we must provide our students with essential tools and guide them to use these to explore and investigate problems for themselves. Questioning is far more valuable than stated facts and supplied algorithms. When we question and guide rather than act as experts, we allow students to be in charge of their own learning. Not only will they develop a deeper sense of understanding, but they will also build confidence and pride that doesn't come without the sense of challenge. ■

"We should utilize the natural curiosity in our students to 'hook' them and guide them to mathematical experiences in which they will be active participants."

Audience Accountability

By
April Mullikin

You have spent time working your students up to presentations, and now you face the task of keeping them engaged while their peers are up front. You want them to be attentive and respectful, but unless you give them a compelling reason to pay attention they are going to just sit and let their minds wander. So how can you keep students engaged and on task during presentations?

WHAT IS IT?

I recently discovered an online program that has drastically changed the dynamics of presentation day in my classroom. It does require students to have access to technology at their seats, so you would need laptops or tablet devices. Considering our society's current state of technological functioning, I am hoping many of you will fall into this category.

GoFormative (https://goformative.com/) is a digital tool that allows you to see your students' responses in real time, respond to them privately, and challenge them to give detailed responses to any given prompt/question. Ideally, you would use individual devices, but you could modify the procedure for pairs or use it with small groups if that is your only option. Used during classroom presentations, this tool creates an environment in which everyone has a task to complete throughout the process.

HOW TO USE IT

Create a teacher account on the website, and set up classes in whichever manner you choose – by block is my preferred method. There is very little time required up front, because students join each class when they log in. Next, have students create an account at GoFormative.com using their email address and then enter

Continued on pg. 11

Audience Accountability

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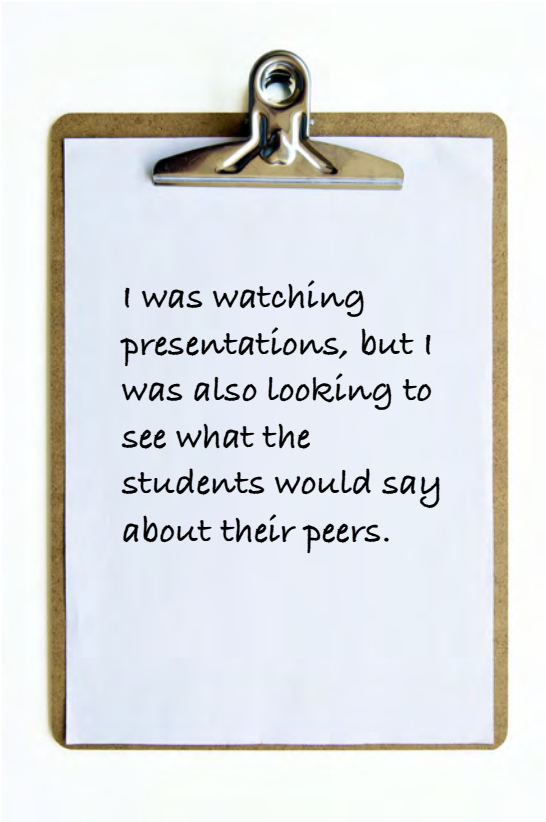
the class code that you provide. Once your digital classes are ready, develop the question for which you would like a response and assign it to each class. When students log in, they are given a list of all assignments available to their class. They will click on the one that correlates to presentations – however you name it. A window will open for the student that gives the writing prompt/question and they will type responses in the box provided. On the teacher screen, you can see student responses each in a small window and get real time updates as they type. If someone is trying to give vague answers, you can send messages to each of them individually to facilitate a deeper reflection.

WHAT ABOUT THE PRESENTATION

The question that I posed to my students was as follows:

Please provide feedback for each presenter. Type their name and give a praise and suggestion for improvement. It could be about the content of their project or about the presentation itself.

While presentations were taking place, I kept a clipboard on hand to make notations about presenters and the audience. I was watching for the basic presentation expectations, but I was also looking to see what the students would say about their peers. In addition to the score for each student's presentation, they also received a score for the feedback they provided about their peers – the audience accountability portion.



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Audience Accountability

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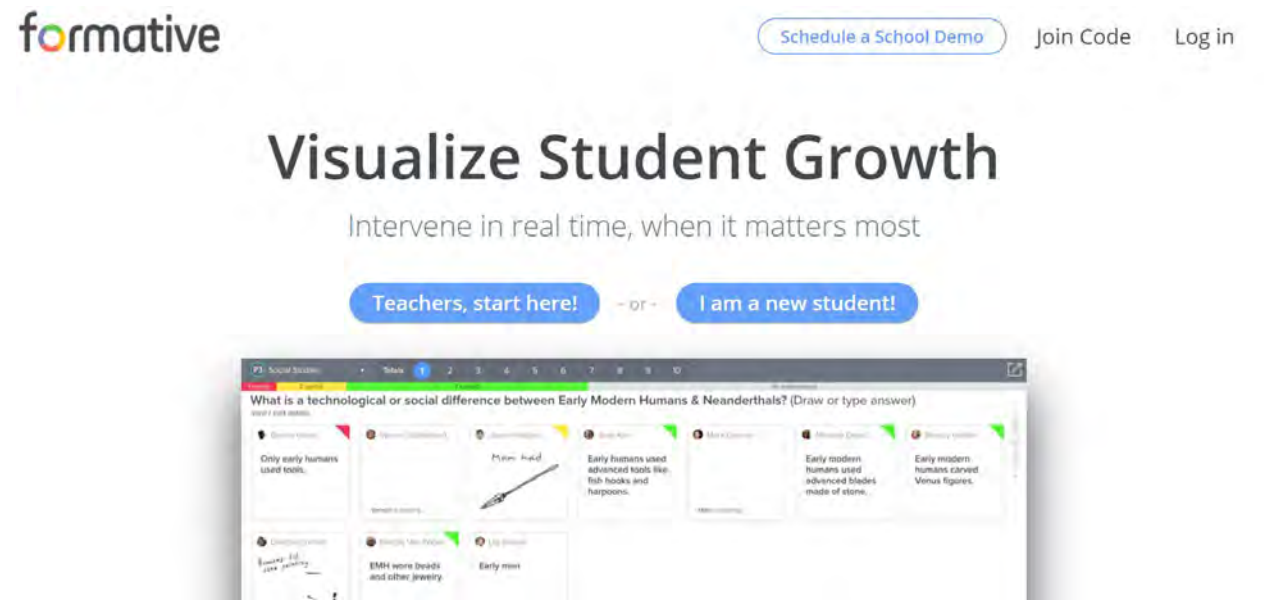
REFLECTION

In evaluating how the process went, I believe it accomplished the goal of keeping the audience engaged. To utilize the full possibilities for reflection, I plan to add another level to the process next time I use GoFormative. I think I will add an element somewhere along the process where the students will give themselves feedback after their presentation is over. I will also find a way to export the audience feedback into another program and provide that to each presenter as part of the reflection process. ■



The Importance of Using Math Manipulatives in the Classroom

By
Jennifer King

What is a manipulative? Manipulatives are physical objects that are tangible. As an early childhood educator, I have learned from Jean Piaget's investigations that children are active learners and benefit from hands-on experiences. Children go through three levels of building their knowledge: Concrete, pictorial, and abstract. When children go through the concrete level, they are able to form the understanding that manipulatives will help them to build knowledge of math. Their progress from pictorial to abstract levels helps to show how manipulatives are beneficial.

By using manipulatives, children are able to explore and really dig into mathematical concepts. They are able to take on different concepts and strategies in math. Manipulatives can help to introduce new standards, math practices, and tasks, but they can also help to show the practice of learned skills or review of content.

Some of the most essential and beneficial manipulatives to have in the classroom are counters, dice, rekenreks, pattern blocks, decks of cards, ten frames, place value mats, place value cubes, rods, and flats. These manipulatives allow children to develop concrete models. Teachers can also use inexpensive manipulatives such as food. Children love to use candy or cereal. Using food can allow teachers to make connections to children that may not have an interest in math. Having a variety of manipulatives for math content allows children to find their own success in math and to make connections.

Children love to use candy or cereal as manipulatives.

Continued on pg. 14

The Importance of Using Math Manipulatives in the Classroom

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Using different kinds of manipulatives helps to expand and build their understanding in math. Manipulatives are great to use across all grade levels, but in the early childhood years children really benefit from having a hands-on experience. These hands-on experiences allow children to retain math concepts and strategies. Children are able to refer back to their own experiences, and this helps them to make connections in future grades.

As a teacher you are able to question children and see how they are thinking and reasoning. You are also able to see if they understand mathematical concepts or if they are struggling. When you see children struggling when using manipulatives it is always great to model and/or allow children to work in pairs. You want children to develop a growth mindset that is positive and allows them to reach their full potential in the mathematical content that is covered. Children can be the real teachers with manipulatives. They can teach adults a new way of thinking. As teachers we are then able to see that manipulatives are truly an asset to the classroom. We just help to guide children to have memorable experiences in math. ■

"Children can be the real teachers with manipulatives. They can teach adults a new way of thinking."

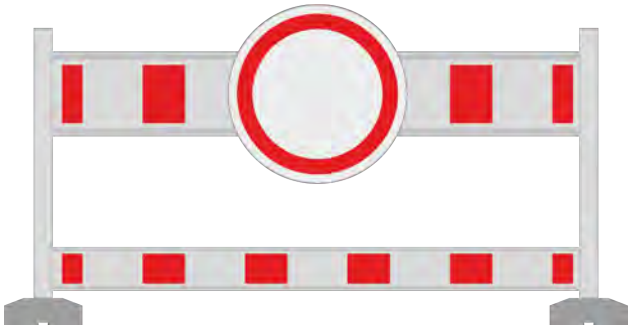
To See What They See

By
Carletta Fields

A group of kindergarten students begin the year bright eyed and full of energy. They are picking up on letters and how to use them to create words. The excitement of learning to read is incredible and drives the teacher to push them further. They are brilliant! Then there is math. Students are just not getting it as quickly as reading. Most can count to 10 and some further, but they struggle to find the pattern. They get stuck at the same places over and over. They have difficulty applying it. They cry, they scream, they refuse, and the teacher begins to think, "My students cannot do math!" Sound familiar? All teachers have asked themselves the same question. "How can I find where my students are struggling and help them to understand?" If only we could see what they see.

Theresa M. Hopkins, a postdoctoral fellow in mathematics education at the University of Tennessee, and Jo Ann Cady, an associate professor of mathematics education at the University of Tennessee, decided to do just that. How? They knew that for teachers to be able to teach basic mathematic skills necessary for success, they had to fully understand what it was that they were expecting their students to understand. That's how they came up with the idea of ORPDA.

ORPDA is a new number system that Theresa and Jo Ann created that allows educators to see what students see. Let's begin with place value. We all know that numbers go from 0-9, but their values change depending upon where they are located within a number. For example, the "9" in the number 9 simply equals 9, but the "9" in the number 91 equals 90. We



"Kindergarteners get stuck at the same places over and over. They have difficulty applying it….and the teacher begins to think, 'My students cannot do math!'"

Continued on pg. 16

To See What They See

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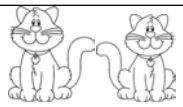
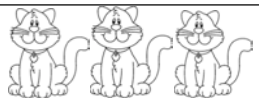
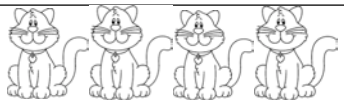
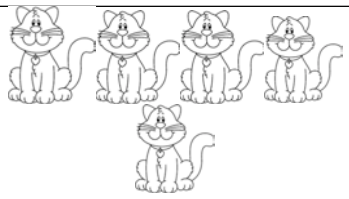
begin by teaching children rote counting and recognizing numbers. We quickly move into equating these number symbols and names with quantities and proceed to push further, asking students to combine these symbols and quantities to create new symbols and quantities. This comes so naturally to us that we often ask, "Why don't they get it?"

Say you are presented with the symbol *^@ and asked to tell its value. You can't because you do not know what these symbols represent. So, before you can answer the question, you must first be taught the symbols and what they represent. Take a look at the chart below:

*	Star	
@	At	
#	Pound	
^	Caret	
		

Continued on pg. 17

To See What They See

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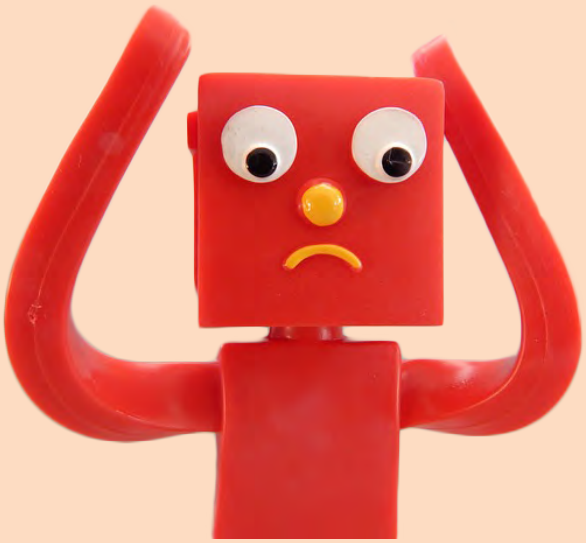
You can begin to see the pattern when given the symbol, its name, and what it represents, but the last boxes are blank. The ORPDA system has only one symbol remaining, which is ~ . Given what we know about our number system, what do you think the symbol for the last quantity is?



"Now before you give up, take a moment to think about how students are feeling just learning the basic numbers, symbols and quantities."

We know that after we reach 9 in our number system, we begin putting numbers together to create higher numbers beginning with 10. So, if the * is comparable to our 1 and ~ is the only symbol left, then ~ must be comparable to our 0. This means that the last symbol is *~ and we no longer have a system built upon base 10 but base 5, or *~ , also known as Flub.

Now before you give up, take a moment to think about how students are feeling just learning the basic numbers, symbols, and quantities. This is where we begin to see what they see, but it doesn't stop there. Take a look at the chart on the next page, and you will see the patterns begin to emerge.

Continued on pg. 18

To See What They See

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At skoobrat Chart

star *	at @	pound #	caret ^	flub *~
doozle **	Sholt *@	pouflube *#	carflube *^	atty @~
atty-star @*	atty-at @@	atty-pound @#	atty-caret #^	poundy #~
poundy-star #*	poundy-at #@	poundy-pound ##	poundy-caret #^	carety ^~
carety-star ^*	carety-at ^@	carety-pound ^#	carety-caret ^^	star skoobrat *~~
skoobrat star *~*	skoobrat at *~@	skoobrat pound *~#	skoobrat caret *~^	skoobrat flub **~
skoobrat doozle ***	skoobrat sholt **@	skoobrat pouflube **#	skoobrat carflube **^	skoobrat atty *@~
skoobrat atty-star *@*	skoobrat atty-at *@@	skoobrat atty-pound *@#	skoobrat atty-caret *@^	skoobrat poundy *#~
skoobrat poundy-star *#*	skoobrat poundy-at *#@	skoobrat poundy-pound *##	skoobrat poundy-caret *#^	skoobrat carety *^~
skoobrat carety-star *^*	skoobrat carety-at *^@	skoobrat carety-pound *^#	skoobrat carety-caret *^^	at skoobrat @~~

Continued on pg. 19

To See What They See

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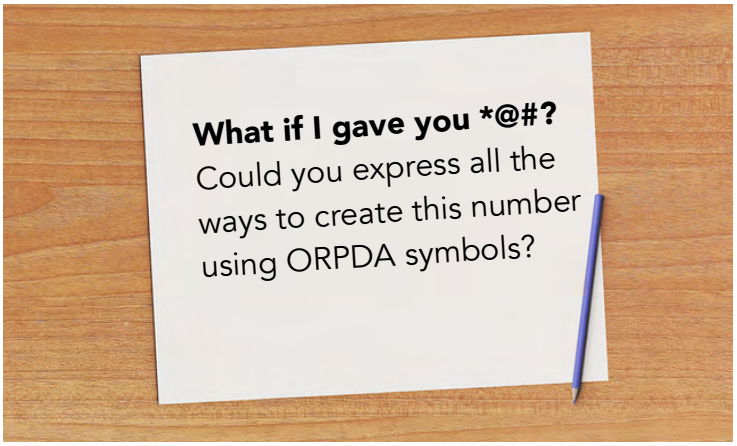
Could you take what you know and fill in the chart? Well, if *~ is like 10 then we know the next pattern would be 11 so doozle must be **. The pattern continues, but notice what happens when you reach star skoobrat. You have run out of two-digit patterns and must now move to three-digit. What will it look like? If **carety-caret is comparable to our 99, then star skoobrat must be *~~**. Also take note of how **the names doozle, sholt, pouflube, and carflube seem to be random and do not repeat like the others do. This is comparable to our teen numbers 11-19** and helps us to see why students struggle with the teen numbers. Take note of how flub become flube just as ten becomes teen. Star skoobrat is comparable to our 100. So, just like our hundreds, skoobrat is at the end of the first one but then jumps to the front when we move to skoobrat star. This is all beginning to make sense now, but only because we have our number system to base it upon. Think again about how the students are feeling without having any prior knowledge or example to compare to.

Once you feel confident that you have figured out the pattern, try applying this knowledge. Create addition problems using these symbols. What issues do you run into? If given a quantity of items and an ORPDA symbol, could you circle the correct amount? What if I gave you *@#? Could you express all the ways to create this number using ORPDA symbols?



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To See What They See

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What we begin to find is that we recognize the symbol and know that it equals an amount, but we must have access to some type of cheat sheet to reference such as the at skoobrat chart. We also find that when adding, we are tempted to put the amount of each symbol instead of the groups and extras. BAM!! Place value issues begin to arise.

This simple idea of creating a new number system has allowed teachers to finally see what our students see. We can now fully understand why they struggle, where they struggle, and how to help them succeed. We can now go from, "My students can't do math" to "My students can't do math, YET"!! ■

"We can now fully understand why they struggle, where they struggle, and how to help them succeed. We can now go from, 'My students can't do math' to 'My students can't do math, YET!!'"

Ditching the Desk

By
Heather Henley

For years, I have taught in a classroom that does not have a teacher's desk. My colleagues have often questioned my reasoning for not having one. They just did not get it. My theory behind ditching the teacher's desk lies in the fact that our classrooms are a learning space. I am the facilitator of learning in the classroom. I want to model to the students how to interact with one another, and utilize the space to foster a learning community. As I began implementing more cooperative learning and guided groups I realized there was a major component missing. How do you work cooperatively in a classroom filled with bulky furniture?

Teachers around the country are transforming schools to create coffee shop classrooms. This new approach encourages teachers to transition from a traditional seating chart to flexible seating which includes inviting seating options.. Moving from desk dwellers to classroom community learners, students are being exposed to enriched environments that encourage independence, choice, and cooperative learning.

Research by Erin Klein from *Learning and the Brain* suggests teachers should not strictly look to content, curriculum, and application. In a sensory-rich environment teachers promote choices, collaboration, and reflective thinking. By implementing brain-compatible elements such as lighting, seating, and learning space, students will grow as learners and leaders in the classroom community.

The first step to ditching the desks is to declutter. Teachers must eliminate items that take up valuable work and learning space. Understanding the need among students for collaboration, problem-solving, and reflection, teachers can focus on the need for areas that promote each of these elements.

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Ditching the Desk

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With this step, establishing flexible seating rules is a must. These rules will vary by teacher. Finding what creates the best learning environment for the students is the ultimate goal.

The third step is to incorporate lighting and music in the classroom. This will allow students to feel invited and comfortable in the classroom. Incorporating lamps and fluorescent light filters alleviates eye strain and stress. Opening blinds and turning on a lamp or two will allow students to feel at ease in the learning space. Throughout the day, play various types of music to stimulate student learning and keep that brain engaged.

As we enter a new era of teaching, embrace the changes it brings. It is time for our classrooms to transform to student-centered learning spaces. Get out there and ditch some desks. ■

Create an inviting atmosphere with:

- Flexible seating
- Lighting: Lamps or natural light
- Music

Morning Meeting Meets Math

By
Michelle Poole

Every teacher knows and understands the importance of starting off on the right foot. For that matter, every parent and every human (who hasn't found the magical do-over button) knows and understands the importance of starting the day off in such a way that we can have the best day possible. No one wakes up and says "I think today I will show up late, struggle to do what is asked of me, have a bad attitude, and make my day the worst day it can be." If you know of someone who actually does this, please don't let that behavior become contagious.

As teachers, we don't have the opportunity to see that our students "get up on the right side of the bed," but we do control how we start our day and our students' days. As a primary grade teacher, I believe that the first time I gather my students together each morning should be meaningful and help to set a tone for the rest of our day. This "Morning Meeting" as it is called in our class, is a valuable time to explore, discuss, and question. I have also found that this time is an essential part of my overall math instruction. Just as many primary teachers are required to do, I spend all morning on ELA instruction. I have to fill those peak morning hours with read-alouds, guided reading, phonics instruction, individualized learning stations, and so forth. Now that the morning hours are packed, lunchtime has come and gone, and recess has occurred, it is now time to get my kids excited and re-energized for math. That's right, math comes at that time of the day when each and every one of us would like to take a nap.

"At a time of day when each and every one of us would like to take a nap, it's time to get my kids excited and re-energized for math."

Continued on pg. 24.

Morning Meeting Meets Math

(continued)

So, what do we do? Well, I have found that there is no point in fighting a losing battle. Math is an afternoon class, and that is that. But what if I could just take a few minutes in that peak time of alertness and energy to get my kids thinking like mathematicians? Just a drop in the bucket to get their minds thinking about numbers, shapes, graphs, patterns, etc. Maybe I could use my morning message to include a math task? Or perhaps I could do more than just find out what day of the week it is on the calendar. The truth is that our young students learn at times when they don't even know how hard they are working. We take something that is very routine for our kids like calendar or morning message and throw in a math twist.

Begin your day with a class discussion on the "Daily Number." You can vary the number, or you could use the number of days you have been in school. Use that number and ask your students to explore deeper. You might choose to vary the exploration depending on the number or the time of year and your students' readiness. You don't have to spend an exorbitant amount of time in order to make a difference. You might even choose to let them work with a partner or in a group and do only one of the tasks. Allow students time to share, to model, and to justify their work.

During the Morning Meeting time you can find many ways to dabble in meaningful math in order to catch your students in the prime learning time. So, before you dig deep into the ELA instruction block bring math to the class in one or more of these great ways:

Daily Number Exploration

- Write it.
- Draw it.
- Add ___.
- Subtract ___.
- Find it on a number line.
- Build it.
- Write the number word.
- Locate it on the 100 chart.
- What is the number before it?
- What is the number after it?
- Is it an odd or even number?
- How many digits does it have?

Continued on pg. 25.

Morning Meeting Meets Math

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You can also find math in something as simple as having students attend to daily duties such as checking and reporting attendance, completing lunch order slips, and keeping track of the time.

You will never find a kid more excited to do math than the kid who thinks he or she is keeping you organized and on time. Our younger students are eager to please us even if it means they have to do some math. ■

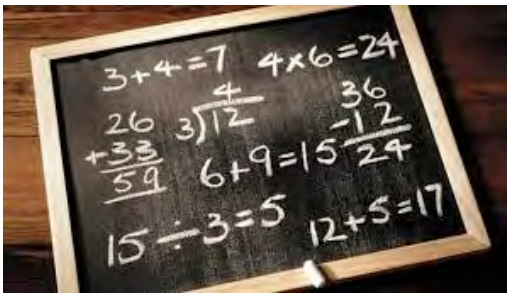
Construct a graph
Keep track of the day of school using various formats
-rote counting
-place value
-build the number in expanded form and post it
-count down days to events
Use your calendar for:
-skip counting
-recognizing and extending patterns

ANTM

By
Margaret Trent

For many the acronym ANTM stands for America's Next Top Model, a reality-based TV program, hosted by Tyra Banks, where would-be models compete for the title of America's Next Top Model. The role of being a model is to create advertisements in which the model is wearing or displaying clothing and/or products for corporations (modeling). These advertisements are used to influence society's ideas of what the top trends are in the fashion world.

In the classroom we find that teachers often teach their students to solve math problems using arithmetic. Arithmetic is the study of numbers and includes the basic operations. When student are presented with complex formulas, they simply insert a value for a given variable, calculate their answers by using the operations they have been taught, and come to a final answer. This process has been in the class for as long as many teachers, parents, and students can remember. This process has created a learning environment where it does not matter why you put the numbers in to the formula and solve, students just do.



Consider the differences between basic arithmetic and mathematics. Mathematics can be defined as the branch of science dealing with the study of measurements and properties of quantities using numbers, quantities, shapes, symbols, structures and geometry. Arithmetic can be defined as the branch of mathematics dealing with the study of numbers, their

Continued on pg. 27.

ANTM

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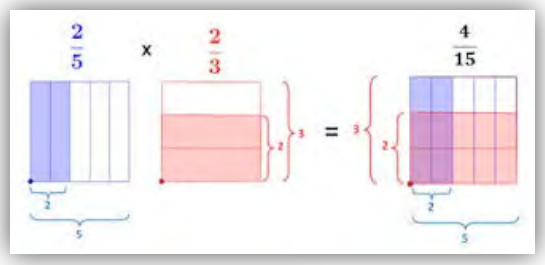
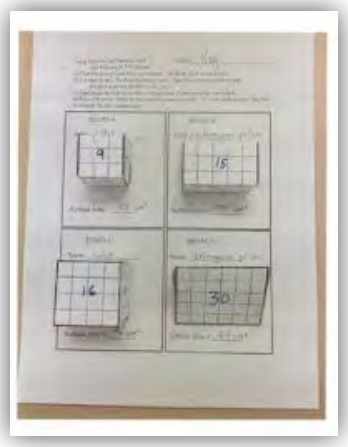
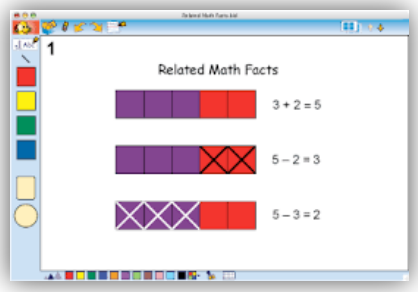
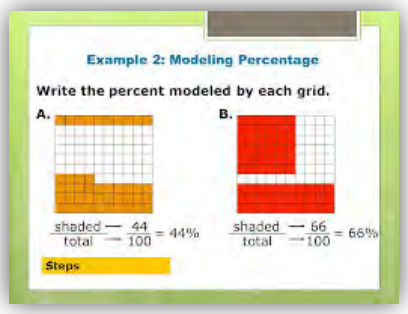
properties and operations including basic operations of division, multiplication, addition and subtraction. Essentially, mathematics is about theory and arithmetic using numbers for calculations. With mathematics, students are asked to provide proof for the theories involved in solving formulas. Which allows them to visualize why the arithmetic works.

One common method used in mathematics to prove the theories, or the "why" behind the arithmetic, is known as modeling. This method can be used in various grade levels in a multitude of ways. Students can draw images that represent the arithmetic that is taking place, use a manipulative to illustrate the methods, and formulate a connection between the process and the arithmetic. It allows students to explore the concepts being addressed in the curriculum.









Continued on pg. 28.

ANTM

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When students are able to grasp the ideas visually, it leads to a greater comprehension of the arithmetic taking place. Formulas are no longer plug and solve; they are now the models for how the problem is solved.

As with modeling in the fashion industry, modeling in mathematics is also used to influence the thinking of our students. The major difference between the two is that modeling in the fashion world is intended to create a bias toward a product, style, or mindset. In mathematics, modeling is used to prove theories as true. This creates an unbiased thought process. When the arithmetic can be proven, the learner has no room to second-guess the work they have done. So rather than focus only on the Arithmetic, Now Try Modeling. ■

"As with modeling in the fashion industry, modeling in mathematics is also used to influence the thinking of our students."

A High School Teacher's Perspective on Keisha's Paycheck Problem

By
Olivia Blair

As a high school algebra teacher, I often push my students to make sense of difficult word problems by creating algebraic equations. Word problems can be intimidating to most students, and it is not uncommon for students to read through a word problem and completely give up before they actually begin to calculate anything. Once students begin to understand how to create equations, I often ask them, "Well, why does this equation work?" It is important for students to understand that the process they took to formulate their answer is more valuable to them than the answer itself. However, one question I ask myself quite often is "what happens when the students do not understand the algebra?"

While attending a workshop recently, I realized the power of visual representation. For students to gain conceptual understanding of a problem, they need to be able to express the process they took with new mathematical ideas. In this workshop, we were given a word problem that involved several fractions. A variety of approaches were used, but the teachers who used visual representations to formulate their answers helped me grasp a new outlook on mathematical models. The problem is shown on the next page, followed by my algebraic approach versus a visual representation. Both of these methods had the same result.

"It is not uncommon for students to read through a word problem and completely give up before they actually begin to calculate anything."

Continued on pg. 30.

A High School Teacher's Perspective on Keisha's Paycheck Problem

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Keisha's Paycheck Problem

Keisha receives her paycheck for the month. She spends 1/6 of it on food. She then spends 3/10 of what remains on her mortgage payment. She spends 3/7 of what is now left for her other bills, and 5/8 of what now remains for entertainment. This leaves her with $300. What was her original monthly take-home pay?

My first "go-to" was an algebraic equation, and I was able to gain a solution with my technique. However, while explaining my process to another teacher, I noticed how complicated it might sound to my students. As I was listening to other teachers explain their process, one technique in particular stuck out to me.

This teacher completely modeled her entire problem, using a rectangle. I was flabbergasted and completely amazed at how simple the problem could have been solved. You will see both techniques being used below and on the following page.

X = paycheck

$\frac{1}{6}\ x$ ⟶ *Food*

$\frac{3}{10}\ \left(\frac{5}{6}\ x\right)$ ⟶ *Mortgage*

$\frac{3}{7}\ \left(\frac{7}{12}x\right)$ ⟶ *Bills*

$\frac{5}{8}\ \left(\frac{4}{12}\ x\right)$ ⟶ *Entertainment*

$$\frac{1}{6}\ x + \frac{3}{10}\left(\frac{5}{6}\ x\right) + \frac{3}{7}\left(\frac{7}{12}x\right) + \frac{5}{8}\ \left(\frac{4}{12}x\right)$$

SIDE WORK

$\frac{6}{6} - \frac{1}{6} = \frac{5}{6}$

$\frac{1}{6} + \frac{1}{4} \rightarrow \frac{2}{12} + \frac{3}{12} = \frac{5}{12} \rightarrow \frac{12}{12} - \frac{5}{12} = \frac{7}{12}$

$\frac{1}{6} + \frac{1}{4} + \frac{1}{4} \rightarrow \frac{2}{12} + \frac{3}{12} + \frac{3}{12} = \frac{8}{12} \rightarrow \frac{12}{12} - \frac{8}{12} = \frac{4}{12}$

Continued on pg. 31.

A High School Teacher's Perspective on Keisha's Paycheck Problem

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$\frac{1}{6}x + \frac{1}{2}\left(\frac{1}{2}x\right) + \frac{1}{1} + \left(\frac{1}{4}x\right) + \frac{5}{2}\left(\frac{1}{12}x\right)$ ⟶ *Reduced*

$\frac{1}{6}x + \frac{1}{4}x + \frac{1}{4}x + \frac{5}{24}x$ ⟶ *Multiply*

$\frac{4}{24}x + \frac{6}{24}x + \frac{6}{24}x + \frac{5}{24}x = \frac{21}{24}x$ ⟶ *Create common denominator and add*

$\frac{3}{24}x = 300$ ⟶ *Solve for "x"*

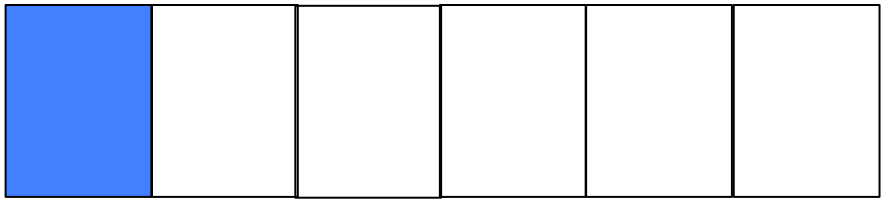
$3x = 300$

$x = 2400$

Rectangular Method

Step 1: Let the rectangle represent the whole check.

Step 2: $\frac{1}{6}x$



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A High School Teacher's Perspective on Keisha's Paycheck Problem

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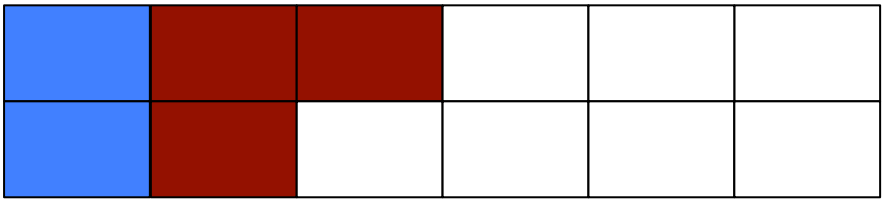
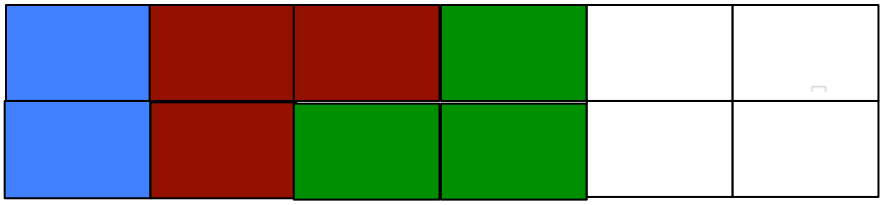
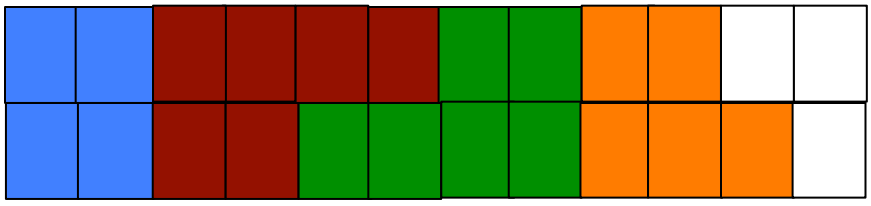
Step 3: $\frac{3}{10}$ **of what is left**



Step 4: $\frac{3}{7}$ **of what is left**



Step 5: $\frac{5}{8}$ **of what is left**



Step 6: Notice that there are 24 boxes. 21 out of the 24 boxes are shaded in with a color. There are 3 white boxes that represent the $300 that you have remaining. This means that each box is a $100 block. Therefore 24 boxes = $2400.

Both techniques calculated the correct answer, and both could be used to enhance student understanding. My hope is that through visual representations, I will be able to intrigue student interest, enhance conceptual understanding, and spark curiosity. ■

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