



Culturally Responsive Math Interventions

Marist College

PSYH 640 Academic & Behavioral Interventions
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About The Authors

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**The purpose of this handbook**

This handbook aims to provide resources for future and current school psychologists to advocate for their students who are culturally and linguistically diverse. School psychologists wear many hats when it comes to their everyday job. The goal of this handbook is to provide resources, interventions, and research that helps support learning for English language learners in mathematics. Culturally and linguistically diverse students tend to have limited access to resources and support in school. Our handbook aims to lend a helping hand to support students and teachers.



Cultural Responsiveness and Equity

Culturally responsive teaching is defined as incorporating the child's native language, cultural knowledge, as well as considerations surrounding self-concept, culture and achievement into the classroom (Escobedo et al., 1978). The literature centers around culturally responsive teaching and how to implement this pedagogy in the classroom. According to NYSED (2021) there is a growing amount of culturally diverse students in the schools, with 16% being Black or African American, 28% being Hispanic or Latino, and 10% being Asian or Native Hawaiian/Other Pacific Islander, compared to 41% of students being White. With more than half of the K-12 public school students in New York coming from a diverse background, it is important to consider the cultural implications for students. The research points to different ways that teachers can be culturally responsive and provides resources for them. Culturally responsive teaching involves including the student's culture into all areas of learning (Moore et al., 2021). There is also an aspect of culturally responsive teaching where the teachers should be aware of their own culture and how that may impact their students as well. However, when conducting research for culturally responsive math interventions, there seems to be limited literature on this topic.

There is a strong need for training programs to teach candidates about the importance of culturally responsive teaching. The research has shown that there is evidence that utilizing a Linguistically and Culturally Responsive Mathematical Teaching (LCRMT) training model will likely increase teacher's use of this pedagogy in the classroom (Song & Coopersmith, 2020). The field of cultural responsiveness is still new in education and is something that needs to be developed. Most of the research points to the adaptation of culturally responsive practice to interventions and curriculums instead of having actual interventions and curriculum dedicated to specific diverse students. The interventions talked about in this handbook focus on word problem solving and teaching students' skills to complete these problems. There is also an intervention that focuses on using the student's first language to improve their second language. However, these interventions seem to target adapting culturally responsive practices rather than making them culturally responsive in nature. This is still a developing field that needs research, although there are strides in the right direction.

While there is a need for culturally responsive math interventions, there is also a need for equity in math instruction. Similar to the research for math interventions, most of the research points to adapting culturally responsive strategies rather than having a specific curriculum to follow. The research points to three areas that are needed to close the racial equity gap: race-conscious teaching, awareness of racial dynamics in math classrooms, and humanizing math pedagogy (Ching & Roberts, 2021). Even if math curriculum is culturally responsive, it does not mean that it is necessarily equal. There should be instruction that is conscious of the different backgrounds of students in the classroom as well as extra support for these students.

References

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Website Resources

Website: Prodigy Games**Website link:**

<https://www.prodigygame.com/main-en/blog/15-helpful-math-websites-for-teachers-5-to-share-with-kids-downloadable-list/>

Mission: The goal for this website is to provide helpful math websites and resources for teachers to use for a successful classroom filled with learning.

Overview:

The specific page was written by Marcus Guido who provided and organized 15 websites that can be helpful for teachers and 5 websites that are helpful for kids. The main focus of *Marcus Guido* was math websites for teachers and he also provided 5 to share downloadable lists. Each of the tips/tools mentioned came with descriptions and the main idea of what each resource can be used for. Some of the resources are free and others require payment yearly or monthly fees. The following is a list of the resource that were provided:

(A list of resource that were proved for teacher and students are attached to the next page)

Website Name	Strengths
Prodigy Math Games	<ul style="list-style-type: none"> • Aligned with curricula for grades 1-8 • Differentiation • Accommodates diverse learning styles by using questions with words, images and graphs, and numbers • https://www.prodigygame.com
TES	<ul style="list-style-type: none"> • Templates for worksheets and report templates • Blog posts with tips • Lesson ideas and niche topics • https://www.tes.com/en-us/teaching-resources
TeacherVision	<ul style="list-style-type: none"> • Connects math with other subjects • Ex. downloading an activity for grades 3-5 that applies to long division and the Great Wall of China • https://www.teachervision.com/resources/worksheets/3rd-grade/mathematics
TeacherTube	<ul style="list-style-type: none"> • Education only version of YouTube • https://www.teachertube.com/
Math TV	<ul style="list-style-type: none"> • Has videos to supplement lessons • https://mathtv.com/
National Library of Virtual Manipulation	<ul style="list-style-type: none"> • Contains manipulation tasks targeted to students from Pre-K-12 • http://nlvm.usu.edu/en/nav/vlibrary.html
SuperKids	<ul style="list-style-type: none"> • Creates custom math worksheets and answer sheet • https://www.superkids.com/aweb/tools/math/index.shtml
Math Goodies	<ul style="list-style-type: none"> • Has interactive lessons • Engages diverse learners by featuring free puzzles, articles, and word problems • Can create custom worksheets • https://www.mathgoodies.com/
Math-Aids	<ul style="list-style-type: none"> • Create custom worksheets • Good for upper levels of math • Can generate word games and problems • https://www.math-aids.com/
Khan Academy	<ul style="list-style-type: none"> • Supplementals to in class instruction • Topics rooted in algebra, geometry, statistics, and other

	<ul style="list-style-type: none"> topics • https://www.khanacademy.org/
Wolfram MathWorld	<ul style="list-style-type: none"> • Suited for high school math • Resource entries for students and educators • https://mathworld.wolfram.com/
Online Chart Tool	<ul style="list-style-type: none"> • Create charts • Input data, adjust labels and modify design to create • Can upload CSV file • https://www.chartle.com/
Daily Starter	<ul style="list-style-type: none"> • Can be used as entry tickets or as a part of the lesson • Pre-K -8 • https://www.scholastic.com/sitemap.htm
Get the Math	<ul style="list-style-type: none"> • Teaches students how to apply math to the real world • Middle and High school students • https://www.thirteen.org/get-the-math/
NRICH	<ul style="list-style-type: none"> • Math games, articles, and problems • Students can submit a question and a mathematician will help • https://nrich.maths.org/
WolframAlpha Math	<ul style="list-style-type: none"> • Acts as an online scientific calculator that shows each step when solving an equation • https://www.wolframalpha.com/examples/mathematics/
AAA Math	<ul style="list-style-type: none"> • Online math practice resource • Immediate feedback to students • Word and graph-based questions • http://www.aaamath.com/
Math is Fun	<ul style="list-style-type: none"> • Games and puzzles • Uses kid-friendly phrasing with conscience sentences and cartoon characters • https://www.mathsisfun.com/
Math Open Reference	<ul style="list-style-type: none"> • Examples and explanations for younger students • Interactive math measurements • Graphing and scientific calculators • https://www.mathopenref.com/tocs/anglestoc.html

References

Guido, M. (2021). *15 helpful math websites for*

Teachers & 5 to share with kids [+downloadable list]. Prodigy Education. Retrieved from:

<https://www.prodigygame.com/main-en/blog/15-helpful-math-websites-for-teachers-5-to-share-with-kids-downloadable-list/>

Website: i-Ready

Curriculum Associates®

Website Link:

<https://www.curriculumassociates.com/programs/i-ready-learning/personalized-instruction/mathematics>

Mission: Providing children of all ages (K-12) with personalized math and reading instruction inside the classroom that promotes individualized paths for success.

Overview: This website provides the school district with i-Ready software to purchase based on the K-12 Common Core State Standards (CCSS) in mathematics and reading for learning and practices in a digital environment. The software is used for administrators, teachers, and students. The cost of a year's worth of i-Ready Diagnostic and i-Ready teaching licenses starts at \$30 per student, per topic. A minimum of 150 licenses (150 students) must be purchased by schools in order to use the program. Schools may be eligible for a discount if they acquire district-wide or multi-year licenses. Professional development training courses on how to utilize the program are available in an online, hybrid, and on-site method, with the starting price between \$2,500 and \$3,500 for each school.

This software is broken down into four tools: i-Ready Diagnostic, which offers an adaptive diagnostic for kindergarten through twelfth grade in mathematics and reading; i-Ready Online Instruction, which targets online instruction based on diagnostic for kindergarten through eighth grade students; iPad apps, which are games that support online instruction (the iTunes

store has a free download available for this app); and i-Ready Standards Mastery, which contains mini-assessments based on state standards.

The i-Ready software system provides students with training (lessons) in math and reading, performance diagnostics (assessment), and progress reports (where they stand academically). Students take the i-Ready Diagnostic (an assessment) and then receive tailored online activities based on their skills, while their schools and districts get personalized data on their academic performance and improvement throughout the year. The data report located on the i-Ready dashboard shows which children are performing below grade level, missing classes, or failing tests. In addition, teachers get comprehensive reports on each student's diagnostic performance. This can help create a more effective learning environment, as students can be placed in groups based on their diagnostic grade level for a more individualized education. In lessons, students can virtually interact with manipulatives, which enhances learning, instead of simply reading from a textbook or learning through a lecture. During the lesson, if the student is not understanding or completing the activities correctly, an explanation is given to them. If a student performs well on a lesson, they advance to the next lesson; this is based on scores of quizzes that are given at the end of each lesson. If the student does not do well on the quiz, they will not advance to the next “level” and will be given further instruction. i-Ready is a new way of teaching and assessment to help promote positive learning and outcomes for all students. Contact information is found at the bottom of the webpage for more assistance.

References

Curriculum Associates. (2022). *I-Ready math: Achieving growth for all students*.

Retrieved from <https://www.curriculumassociates.com/programs/i-ready-learning/personalized-instruction/mathematics>

Website: Intervention Hero

Website Link: <https://www.interventionhero.com/academic>

Mission: The goal of this website is to provide strategies and research based resources for professional school staff members to help aid and promote student success academically and behaviorally.

Overview: The website is broken down into nine tables that can be found at the top of the webpage. The tabs consist of a home tab, MTSS tab, Academic Interventions tab, Behavior Accommodations tab, Solution Map tab, 504 tab, Mentorship tab, a More tab, and a Volunteer tab. This website provides research based interventions, academic research based sites, practice worksheets, progress monitoring probes, speech/ language interventions, fine motor interventions, preschool interventions, and interventions for English as a Second Language (ESL) students. The website also provides other resources that fall under tier 1, 2, and 3 interventions. In regards to academic research based interventions, each of the interventions are linked to common core standards for English Language Arts (ELA) and mathematics from kindergarten through high school. This website is free to access and almost all of the additional resources provided on this webpage are free as well. For more information and questions, the webpage does provide contact information at the bottom of the webpage.

References

Reith , S. (2015). *Intervention hero*. Retrieved from: <https://www.interventionhero.com/>

Website: Colorin Colorado

Website Link: <https://www.colorincolorado.org/>



Mission: This website has multiple resources, research based information, activities, advice, and intervention strategies that can be used by educators and families of English Language Learners Pre-k through 12th grade to support their learning of various topics and formats in school.

Overview: This website has a multitude of resources that are broken down into six categories at the top of the page. The tabs include ELL Basics, which includes information for educators new to teaching ELLs, a glossary with terms, resources that can be used by grade and state, ELL policy and research information, and information to help serve and support immigrant students. School Support includes information on School Enrollment, Program Planning, College Readiness, and Assessment. Teaching ELLs includes information on Distance learning, strategies and best practices, language and vocabulary instruction, literacy instruction, content instruction, and Common core. The For Families tab has resources for parents to help their children read and do homework at home, and ways to connect schools and families to each other to help students' success in school. The Books & Authors tab provides literature for professionals, young adults, and children to read. The Videos tab has links of classroom videos that demonstrate effective instruction for English Language Learners. There are also links specifically to provide resources for administrators, teachers, paraprofessionals, librarians, and parents and families. There is also

an additional resource library tab that includes more tips, guides, tool kits, and resources. The website is free, but they welcome donations so that they can provide more free resources for the public.

References

WETA Public Broadcasting. (2019). *Colorín colorado*. Colorín Colorado. Retrieved from <https://www.colorincolorado.org/>

Website: Citizen Math

Link: <https://www.citizenmath.com/>

Mission: Citizen Math emphasizes the importance of societal influences in mathematics. Their curriculum and resources intend to address issues respectfully; they want to prepare students to be active, considerate participants in society. They believe that they can achieve this objective through lessons that evoke creative problem-solving and enthusiasm. In their mission statement, Citizen Math states “You can’t bore people into action.” They wish to communicate that many societal issues do not have a “right” or “wrong” solution. Their lesson plans often encourage students to analyze problems from several different perspectives. Overall, they believe that math classes should consider real-world problems.

Overview: Citizen Math provides supplemental mathematics lessons for students in grades 6 through 12 that enable them to explore engaging and culturally responsive topics. Students learn to think critically and collaborate with one another to solve the cultural and societal issues that

are currently impacting their lives. They develop self-efficacy and peer relationships, as well as increase their engagement with the class material. This curriculum is supported by an academic study in which over 25,000 students increased their classroom performance after experiencing two supplemental Citizen Math lessons; the increase was reflected in test scores and measures related to engagement and morale. Overall, teacher satisfaction was also positively impacted by these lessons.

On the Citizen Math website, educators will find resources to support their implementation of this supplementary curriculum. Educators are able to access some lessons for free; however, the majority of lessons require individuals or institutions to pay a membership fee on a monthly or yearly basis. Members may subscribe to a starter pack, which includes one lesson per major topic, or a full pack, which includes two lessons per major topic. They may also choose to purchase materials for a multi-grade cluster (Grades 6, 7, and 8; Grade 8, Alg. 1, and Alg. 2), or all grades (6, 7, 8, Alg 1, and Alg 2). Please refer to the table below for pricing options.

<i>Monthly</i>	Starter Pack	Full Pack
Multi-Grade Cluster	\$14.00	\$22.00
All Grades	\$20.00	\$32.00

<i>Yearly</i>	Starter Pack	Full Pack
Multi-Grade Cluster	\$140.00	\$220.00
All Grades	\$200.00	\$300.00

The Citizen Math website provides a link to the study performed and the subsequent results obtained to support their program. For clarification, the Citizen Math program was originally called “Mathalicious.” This study contained three conditions. The Full Treatment condition included a subscription to the Citizen Math curriculum, as well as access to webinars to support instruction. The License-Only Treatment condition only included a subscription to the program. The Control Condition did not include any components; teachers were encouraged to continue their typical instruction. Strong results were presented in certain categories targeted by the curriculum. Increased lesson-use by teachers was positively correlated to increased test scores for students exposed to Citizen Math. Additionally, students in the Full Treatment condition reported that mathematics has real-world applications more so than students that were randomly assigned to the other treatment conditions. Researchers believe that the belief that math has practical uses will encourage motivation and effort amongst students.

Citizen Math provides an explanation of the available tools and how to use them in their instruction. These tools include interactive video clips, graphs, and charts that catalyze discussion. To facilitate insightful discussion, each lesson includes a handout of core questions and data that is related to the topic. Student responses may be easily shared and collected electronically. Educators can also find a guide outlining the timing and structure in which they may introduce the supplemental lessons. The guide also includes the mathematical objectives

and real-world applications for each lesson, as well as exemplar student responses and teaching tips.

Cultural Responsiveness: The lessons provided by Citizen Math include culturally relevant and interesting topics, such as minimum wage, homelessness, the impact of Covid-19, and the cost of toys in a McDonald's happy meal. Increased interest in the instruction material improves student engagement and facilitates the comprehension of mathematical concepts. The goal of the implementation of Citizen Math is to create a society in which individuals are forward-thinking, curious, and motivated to make a positive difference in their communities.

References

Citizen Math. (n.d.). *Real world math problems*. Retrieved March 14, 2022, from

<https://www.citizenmath.com/>

Jackson, K. & Makarin, A. (2018). *Can online off-the-shelf lessons improve student outcomes? Evidence from a field experiment*. American Economic Journal: Economic Policy. 10(3), 226-254.

Website: Equitable Math

Link: <https://equitablemath.org/>

Mission: Radical Math’s main mission is to provide resources that support Black, LatinX, and Multilingual students thrive in the classroom. The resources are for students in grades 6-8. *A Pathway to Equitable Math Instruction* states that this website supports an integrated approach to math that focuses on Black, LatinX, and Multilingual students. The mission is to address any barriers that there might be to math equity as well as provide grade-level instruction that aligns to grade based standards. *A Pathway to Equitable Math Instruction* provides educators with resources to plan their curriculum as well as ongoing opportunities to engage in self-reflection as they begin to develop an anti-racist math practice.

Overview: *A Pathway to Equitable Math Instruction* is a blueprint for providing students and educators with the necessary resources to become culturally responsive in the classroom. On the homepage of the website, there are the *5 Strides on the Path to Math Equity*, which are: dismantling racism in mathematics instruction; fostering deep understanding; creating conditions

to thrive; connecting critical intersections; and sustaining equitable practice. Each of the 5 strides has a PDF document or a zip file containing more information, strategies, and resources for the five categories. These files are comprehensive and provide more information for educators and students. The main page also has an option to sign up for a mailing list that sends updates about the toolkit as well as current issues surrounding equitable math instruction. There are also links to professional development sessions that center on each of the five strides. The links are on vimeo and can be watched for free. The website also has a glossary with definitions for words surrounding the topic of racial equity as well as the source the definition was retrieved from. The About section of the website highlights the work that was put into developing this toolkit to achieve a culturally responsive pedagogy. The section highlights the use of the Student Achievement Partners' *Instructional Priority Content in Mathematics* as a guide when creating this toolkit. The section talks about the importance of asset and research based approaches that are culturally responsive. There is also mention of more resources that were used to develop the toolkit. This section also acknowledges the effect of COVID-19 on the Black, LatinX, and multilingual communities as a driving force in creating this toolkit for the 2020-2021 school year. All of the resources on this website are free and are accessible on any device that can use the internet. There is a FAQ page that goes over the areas of math problems in the classroom, information about the toolkit, as well as applications to other groups.

References

A Pathway to Equitable Math Instruction. (2021). *Resources and guidance to support Black, LatinX, and multilingual students to thrive in grades 6-8*. Retrieved March 15, 2022, from <https://equitablemath.org/>



**Culturally linguistic
students with a math
concentration:
Coach Card**

COACH CARD 1: Word Math Scramble Puzzle

Joanna had six balloons.
Two popped. How many
does she have left?



English Language Learner students face many challenges compared to those who are fluent in English. When it comes to math, English Language Learners present higher difficulties when it comes to math word problems (The University of Kansas, 2018). Studies have shown that there is a strong connection between students' English ability and one's mathematics performance (Sistla & Feng, 2014). Math word problems are presented from Kindergarten to 12th grade. This can take a huge toll on students who are not given the proper support. Math word problems correspond with reading comprehension and vocabulary development, which English Language Learners tend to struggle with (The University of Kansas, 2018). In addition, not only are English Language Learning students presented with reading comprehension and vocabulary comprehension in everyday curriculum, but they also face high stake assessments in regard to math words problem (Driver & Powell, 2016). With the help of comprehension strategies and techniques that can help, aid, and support a student's understanding outside of math word problems, stress is limited and there are stronger outcomes for better math word comprehension and vocabulary outcomes (The University of Kansas, 2018). Some studies have been done in

regards to Schema instruction and English Language learners. Some strategies that have helped when it came to teaching math with connection to word problems were by making connections with the students' lives, providing vocabulary instruction, using visual aids, promoting classroom discussion, and assessing difficult word problems for the student to break down and work on, this is known as schema instruction approach (Luevano & Collins, 2020).

References

- Driver & Powell. (2016). Culturally and linguistically responsive schema intervention. *Learning Disability Quarterly*, 40(1), 41–53. <https://doi.org/10.1177/0731948716646730>
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<https://news.ku.edu/2018/05/29/study-shows-approach-can-help-english-learners-improve-math-word-problems-reading-problem>

COACH CARD 1: Word Math Scramble Puzzle

Description: The intervention Word Math Scramble Puzzle addresses the area of math vocabulary comprehension. The instruction focuses on breaking down vocabulary words that are commonly seen in math problems. An additional step that can be taken is to find corresponding items in their classroom that connect to the vocabulary term that is being defined.

Target skills: Math Vocabulary Comprehension

Location: In the classroom or remote learning

Materials:

- Worksheet template (can be done on Chromebook)
- Pencil or stylist if done on

Chromebook

- Examiner probe/lesson plan
- Items around the classroom/item at home if choose to expand (for box 4)
- Smart board with prepped words, and worksheet temple to display while explaining directions
- Plastic Ziplock bag
- Scissors

Frequency: 3 times per week for 15-30 minutes, individually/ small groups

Quick Overview:

The student will be given a total of 4 words.

Day 1: The student will work on 2 words

Day 2: The students will be working on 2 different words

Day 3: The student will practice and put the puzzle pieces together. The student will work independently and then switch to small groups created by their teacher. Independently the student will match their own puzzle together, when the students are in a group the student will be working on one classmate's puzzle at a time to match their pieces together. This will also allow the student to have more comprehension and get to see what their classmates drew and wrote for their puzzle piece.

Target Age: Kindergarten to 8th grade

Progress Monitoring: Curriculum Based Assessment (CBA) on math word problems.

This assessment was administered to see the students comprehension level when it came to math verbal comprehension (word problem) math tasks.

Sequence of Lessons/Sessions/Instructions (Script)

1. Meet with your students (classroom)
2. Introduce the activity (as the teacher needs the students help)
3. To start off the lesson, the teacher will pull up on the smartboard mathematical terminology (these are based on the student level from a Curriculum Based Assessment (CBA) on math word problems which will measure the student a student comprehension on math vocabulary)

- a. Tell the student that you need some help with understanding what the words on the board mean.

i. "Today we are going to be working on the two math words on the board. We will be learning the definition of the words and later make connections and think of examples of the words. But, I need your help."

ii. "It is super important that everyone clicks in their listening ears extra tight"

- b. The teacher will then look around the room to make sure all eyes are on the teacher and the students are ready to listen. The teacher then checks her ears to make sure they are on just right. (put both hand on ear and make a click sound)

i. "Oh I think my ears are on just right, how about you all?"

- The class will reply with yes (hopefully)

c. The teacher will then read the 2 words (These are examples of possible words that could be used: Increase, Decrease, Less than, Greater than.) out loud to the class one at a time with a few second break in between.

d. Then the teacher will ask a question to the class.

i. *“Do you guys know what these words mean?”*, *“I know I’ve seen them before, have you?”*

e. The teacher will then wait for students quick reply, which should be a one word or so answers (yes, no, maybe, or I don’t know)

f. The teacher will pause for a second look at the class and look back at the smartboard

i. The teacher will then *“MMMMMM”* super loud as if she was thinking

ii. Next in a quiet whisper voice: *“Okay guys, this is where I will need your help”*

- Whispering will allow the teacher to double check that the students are still paying attention. If you notice your students aren’t, I would repeat yourself again in the same manner until you notice that the class is listening.

g. Now the teacher will pick on a few students who might know the meaning of the words and write how the student answers on the smartboard for the class to see.

These statements can be used in any order or changed to fit the teacher preference

i. *“Can anyone tell me what _____ means to you ?*

ii. *“What about _____?”*

iii. *“Wait, this one is hard, does anyone know what _____ means?”*

iv. *“How about _____?”*

v. *“Okay class last one, what about _____?”*

h. The teacher will then reply with a reaction to each person who was picked on that gave their definition of the word

i. Example to use:

- *“ Oh wait that’s what that word means”*
- *“Omg now I remember, thanks”*
- *“ Wow, you’re so smart”*
- *“How did I miss that”*
- *“Hmm, are you sure about that?”*

i. The teacher will look at the board with the student definition and back at the class

i. *“Thanks for all your help, but now we need to double check that these are right before we truly learn these words inside and out”*

j. The teacher will than ask a question to the class

i. *“How can we truly know what the words mean?”* (hopefully the students will reply with look up the definition)

k. After students answer, the teacher will provide the definition for each word on the smartboard. The words won’t be placed all at once but individually as the teacher goes through them.

i. *“Well I did look them up, lest look as a class to see what these words mean and if they are similar to what you guys said”*

(These are the 4 words that are used for the 3 days intervention lesson, choose which 2 words the teacher would want to do for day 1 and then the next two words for day 2 to show on the smartboard)

- **Increase:** Make something bigger (in size or quantity)
- **Decrease:** Make something smaller (in size or quantity)
- **Less than:** The Symbol $<$ means less than (smaller)
- **Greater than:** The Symbol $>$ means greater than (bigger)

Math Is fun definition site: <https://www.mathsisfun.com/definitions/increase.html>

l. Once the teacher finishes going through the definition of the four words, the teacher will then introduce the next task.

i. *“Now that we sort of know the definition, it’s time for some fun. We are now going to be working on the Word Scramble Math puzzle. We will be working independently, but don’t you worry I will be here to help”*





m. The teacher would then hand out the worksheet for the students to work on individually (can be done in small groups, if the teacher prefers). The teacher will go over the worksheet and what the students will need to do to complete it. The work sheet template will be on the smart board for the students to see.

i. *“So now I need your eyes on me as I explain how to do the Word Scramble Math Puzzle”*





ii. *“As you can see there are 4 boxes horizontally (point across the sheet on the smart board) we will be filling each of these boxes in. The boxes state the word, definition, picture and connections to something in the classroom or home. You will be filling out each box. In the word box you will pick one of the words we talk about today, in the box next to it you will define the word in your own words, draw a picture that relates to that word, and then something you find around the classroom.”*

(If this task was done at home they would find something around their home that connects to that word).

Example**Day 1:**

Word	Definition (in your own words)	Picture/ Drawing	Connection to something in the classroom/ home
Increase	Make something bigger (in size or quantity)		
Decrease	Make something smaller (in size or quantity)		

Day 2

Word	Definition (in your own words)	Picture/ Drawing	Connection to something in the classroom/ home
Less Than	The Symbol < means less than (smaller)	<p>The duck on the right is smaller, less than</p> 	
Greater Than	The Symbol > means greater than (bigger)	<p>The duck on the left is bigger, greater than</p> 	

n. The teacher will then do the first one together as a class to make sure that the students understand the task.

i. *“Let’s do the first one together. It does not matter which word we decide to pick first. Hmm let’s do the word increase. In the first box, where above the box it says “a word” (teacher points to the empty box) we should all write the word increase. Now in the box next to that one, (teacher points to the empty box) you will see the title above state the definition in your own words”*

o. The teacher then will ask a question

i. *“ Now that we heard _____ (**the students name that was called on earlier for this particular word**) definition of the word and you guys heard my definition,. what should our definition be? Remember this is to help us remember and understand what these words mean. This will help you when we are solving math word problems and picking out specific words to understand what to do”*

- Wait for the students to volunteer and reply, and then write the response on the board, give feedback and correct if need be.

p. The teacher will explain the next step which is to go to the next box where it says picture/drawing.

i. *“ Okay everyone, let's move to the next box. The next box states picture/drawing. Let’s figure out as a class what is something that we can draw that reminds us of increase?”*

q. The teacher will wait for a student to reply

- (Some options to consider if guidance is needed)

- **An arrow pointing up**

r. The teacher will then move on to the last box which is connection to something in the classroom/home (the teacher will point to that box)

i. *“So now let’s move on to the last box where we will use our eyes and look around the room and find something that reminds us of the word increase.”*

s. The teacher will wait for a student to reply and if need be give guidance on objects around the room.

i. *“Yes, great job _____(student name)_____ that graph is showing an increase rate, now let’s draw that in that box.”*

t. The teacher will wait to make sure all students are done. Once she notices the students are done by doing a quick check in, the students are going to fill out the rest of the boxes on the worksheet.

i. *“Okay class now I want you to keep working and use the rest of the words that we talked about today and finish the rest of the boxes.”*

u. While students are working on the worksheet the teacher will walk around and provide help and feedback for students that need it.

v. When everyone is done filling out the worksheet the teacher will then go over the completed worksheet and have the students share their responses.

w. After going over the correct answers, the teacher will provide scissors so that the students can cut the worksheet up so that the word, definition, picture, and classroom connection are separated.

i. *“Okay class eyes on me! We have one more step to do which is to cut out each square individually. Once all the squares are cut, wait until I tell you what to do next.”*

ii. *“Now I am going to give you a Ziplock bag, please put all your squares in the Ziplock bag (Demonstrate in front of the class). Once all your squares are in the bag, close your Ziplock bag and shake the bag to mix your squares.”*

x. Then the students will dump the bag on their desks and find matches (behind each square does have indicators so students can check their answer on their own.

i. *“ Now open your bag and dump it on your desk. It is time to practice and find your matching pieces. Remember each Word Math Scramble Puzzle has 4 pieces.”*

y. The teacher will walk around the room to make sure all students are completing the task correctly.

i. *“ Please raise your hand so I can check your work.”*

z. Now repeat the process for the next day by adding two more words to the lesson and practice putting the puzzle pieces together. On day three the students will practice and put the puzzle pieces together. This will allow the students to have a better understanding of the words, definitions, and connections to the words. The students will work independently and then switch to small groups created by their teacher. Independently, the students will match their own puzzle together. When the students are in a small group, the student will be working on one classmate's puzzle at a time to match their pieces together. This will also allow the students to

have more comprehension and get to see what their classmates drew and wrote for their puzzle piece.

Copies for the class**Day 1:**

Word	Definition (in your own words)	Picture/ Drawing	Connection to something in the classroom/ home

Day 2

Word	Definition (in your own words)	Picture/ Drawing	Connection to something in the classroom/ home

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Materials: Pencils, Paper, Board, index card

Frequency: 17 sessions over a 5 week period, 20-25 minutes each session

Progress Monitoring: The Bateria III Woodcock-Muñoz: Pruebas de Aprovechamiento, Prueba 10: Problemas Aplicados (Muñoz-Sandoval et al., 2005), easyCBM math computation or fluency

Directions:

The students receive the intervention as well as the curriculum implemented by the classroom teacher.

Phase 1: Pre-teaching Concepts and vocabulary

- The students were previously taught math concepts, ideas, vocabulary, and terminology for each word problem less by systematic and explicit instruction.
- Each student is given an index card.
- The teacher modeled the activity by providing the definition in Spanish, writing the vocabulary on chart paper, and then applying the word in a math problem.

Phase 2: Teaching the Strategies

- Saberlo (Know it)
 - Used to activate a student's prior knowledge.
 - Two activities:
 - § Brainstorming
 - § Making predictions about how the problem may be solved
 - The teacher will read a word problem out loud and ask the students to think about the problem and find the question.
 - The teacher prompts the students to tell them what they know about the question and what they think they will learn from the problem.
- Buscarlo (Find it)

- Teaches students how to find critical information for meaning and understanding, how to use strategies to help them figure out unknown words or concepts.
- The teacher tells the students to monitor when they are having trouble understanding the problem.
- Muestralo (Set it up)
 - Students are taught to identify the main concept of a sentence by answering the following questions:
 - § What is this sentence about?
 - § Is this information needed to solve the problem?
 - Students are encouraged to write the information down.
- Resolverlo (Solve it)
 - This takes the previously learned strategies and uses them to write a number sentence about the problem.
 - The teacher and the students discuss how to solve the problem.
 - Check for understanding is used for generating and answering questions about what they have read and review what they have learned by summarizing the key ideas, solving it, and checking it.
- Comprobarlo (Check it)
 - This strategy is for teachers to present the students with algorithms to solve the problem, explain how and why they work, and reinforce the idea that there are multiple ways to solve a problem.

Phase 3: Cooperative Learning and/or Student Pairing

- Students were encouraged to use collaboration approaches between teacher and student.
- Students were asked to take on the teacher role to teach the teacher the strategies they used to solve the math problem.
- If the problem was solved incorrectly, then the problem-solving process is repeated and mistakes are explained.
- If problems persisted, then the teacher would use specific strategies by reciprocal teaching.

APPENDIX A

Estratégica Dinámica de Matemáticas (EDM) Probe Sheet

Examinador: “Un problema de palabras hace una pregunta. ¿Puedes encontrar la pregunta en el siguiente problema de palabras?”

Examinador: “En cada pregunta siempre hay palabras importantes. ¿Puedes subrayar las palabras en esta pregunta que piensas que son importantes para resolver este problema?”

Examinador: “En cada problema de matemáticas siempre hay números que necesitas para resolver el problema. Puedes circular los números que necesitas para resolver este problema?”

Examinador: “Los números se utilizan para formar y resolver un problema de matemáticas. ¿Puedes utilizar estos números para formar el problema de modo que puedas resolver el problema de la palabra?”

Examinador: “Después de resolver el problema de matemáticas, debes de revisar la respuesta. Puedes comprobar tu respuesta?”

APPENDIX B

Estratégica Dinámica de Matemáticas (EDM) Probe Sheet (English Translation)

Examiner: “A word problem asks a question. Can you find the question in the following word problem?”

Examiner: “In each question there are always important words. Can you underline words in this question that you think are important to solving this problem?”

Examiner: “In each math problem there are always numbers that you need to solve the problem. Can you circle the numbers that you need to solve this problem?”

Examiner: “Numbers are used to set-up and solve a math problem. Can you use these numbers to set-up the problem so that you can solve the word problem?”

Examiner: “After solving the math problem, you need to check your answer. Can you check your answer?”

APPENDIX C

Estratégica Dinámica de Matemáticas Cue Sheet (abbreviated example)

Examinador: “Ejemplo de problema de palabras: La mama de Rosa compró 15 perlas amarillas y 24 perlas rojas. ¿Que es la suma de perlas que compro la mama de Rosa?”

Examinador: “Un problema de palabras hace una pregunta (apunta a la pregunta): ¿Cuales la suma de todos las perlas que compro la mama de Rosa? Después, subrayaré las palabras importantes en la pregunta.”

Examinador: “Sé que las palabra suma significa el número total. Se puede reemplazar o sustituir la palabra suma con la palabra total. ¿Cuales el total de todos las perlas que compro la mama de Rosa? Sí, esto tiene sentido. Suma también significa total (+) o combinar.”

Examinador: “¿Cual es la suma de todos las perlas que compro la mama de Rosa? El problema de palabras dice que la mama de Rosa compró 15 perlas amarillas y 24 perlas rojas. ¿Cual es la suma de todos las perlas que compro la mama de Rosa? Voy a circular estos números, ya que estos son los numeros que necesito para resolver este problema. Compró 24 perlas amarillas y 15 perlas rojas, ya se que estos son los numeros que se necesitan para resolver este problema. Bueno, vamos a resolver el problema. Ella compro 15 perlas + 24 perlas = 39 perlas. Mi respuesta es 39 perlas. La mama de Rosa compro 39 perlas.”

Examinador: “Bueno, necesito revisar mi respuesta. En los unos pon 5 más 4 es igual a 9, en las decenas pon el 1 más 3 es igual a 3, mi respuesta es 39 perlas. Esto es correcto. La mama de Rosa compro 39 perlas. Ahora es tu turno.”

APPENDIX D

Dynamic Strategic Math Cue Sheet

Word Problem Example: Rosa’s mom but 15 yellow pearls and 24 red pearls. What is the sum of pearls that Rosa’s mom bought?

Examiner: “A word problem asks a question (point to the question): What is the sum of pearls that Rosa’s mom bought? Next I will underline the important words in the question.”

Examiner: “I know that the word sum means to total. If I replace or substitute the word sum with total, does this make sense? What is the total of pearls that Rosa’s mom bought? Sum can also mean total (+) or combine.”

Examiner: “What is the sum of pearls that Rosa’s mom bought? The word problem says that Rosa’s mom bought 15 yellow pearls and 24 red pearls. I am going to circle these numbers, as these are the numbers I need to solve this problem. Okay, let’s solve the problem. She buys 15 pearls + 24 pearls = 39 pearls. My answer is 39 pearls; she buys 39 pearls.”

Examiner: “Okay, I need to check my answer. In the ones place 5 plus 4 equals 9, in the tens place 1 plus 2 equals 3, my answer is 39 pearls. This is right. Rosa’s mom bought 39 pearls. Now it is your turn.”

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Coach Card 3: Paraphrasing Interventions and Problem-Solving

Accuracy: Generative Procedures



Math can be a difficult subject to learn for anyone. Although numbers are considered universal and are understood throughout the world's different languages, it can be difficult to learn math when learning a new language as well. Teachers have identified word problems as one of the most prominent areas students struggle with, due to needing to be able to understand the text that the problem is written in and knowing which strategy to use to solve the math problem. The process is intricate and includes five phases: reading the word problem and considering the situation, concept formation thinking of which rules can be used to solve, planning a strategy to use, deciding on a plan, and checking if the strategy used was correct or not by receiving feedback (Kingsdorf & Krawec, 2016). The complexity of this process can make it a daunting lesson for teachers. One intervention that has been found to increase problem solving accuracy is a paraphrasing intervention. This requires students to rephrase questions in their own words and identify relevant information that can be gathered and manipulated to solve the problem. Studies have found this can help all students, including ELL and those with learning disabilities (Kong & Swanson, 2019).

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- **Description:** Generative learning is a way for students to enhance their math problem-solving skills by paraphrasing all relevant information, including the question and numbers necessary to solve the word problem. The student will work with a tutor or teacher and receive explicit and direct instruction related to paraphrasing which includes the main question the problem is asking and the relevant number propositions within the problems that lead to correct solutions. The student will also solve practice problems and receive feedback. Initial lessons of the interventions (lessons 1–10) include about three to four sentences with one or two sentences of irrelevant information. Later lessons (lessons 11–15) can include five to six sentences with two to three sentences of irrelevant information. The last few lessons (lessons 16–20) should have about seven to eight sentences with three to five sentences of irrelevant information.
- **Target skills:** Word problem-solving skills and accuracy (Word problem-solving includes basic math skills (computation), reading comprehension, use of linguistic information, identifying relevant information, and constructing the appropriate problem statement)
- **Location:** Classroom
- **Materials:** Booklet with math problems/worksheets

Pencils with erasers

Script for teacher/tutor
- **Frequency:** 30-minute period twice a week for a period of 10 weeks, for a total of 20 lessons in all. Individually/small groups
- **Target Age:** 3rd grade

- The mathematics topics can be modified to work with other age groups' developmental level
- **Progress Monitoring:** Wechsler Individual Achievement Test, word problem-solving accuracy was measured by the Test of Math Abilities. If unavailable, easyCBM.
- **Sequence of Lessons/Sessions/Instructions (Script)**

Lessons include 4 phases:

1. Warm up (5 min): Students will complete one practice math problem that requires calculation to find missing numbers and geometric shapes.

Direct children to open up their booklets to the first page and work on the first problem on the page. After about five minutes, check to see if the student is done with the problem. If so, move onto the modeling phase. If not, encourage students to finish up the problem in order to move on.

i. Please open up your workbooks to page _____. Work on the first problem on the page.

2. Modeling (5 min): The tutor will model how to specifically solve the practice problem. The tutor will instruct the students to read the problem, restate the question, and later solve the problem.

Read the first problem out loud and then ask the students to verbally restate what the problem is asking. After the students verbally restate the question, ask, "What other information is important?" They will then state the important information (sentences that *included the necessary numbers for solution*). Provide feedback on whether the information they stated is

relevant or if there is more to be stated. Restate the question, and then state which information is relevant to the problem. Then have the students write the questions and all of the important information in their own words in the booklet. Ask what they would now do to solve the problem. Solve the problem together.

i. The first problem says _____. What is the question? (students respond)
What other information is important? (students respond, provide feedback)
The question is _____, so the important information is _____. Please
write the question and all of the important information down in your
workbooks using your own words. Now what should we do to solve the
problem? (students respond, solve the problem together)

3.Guided practice (5-6 min): Tutor guides the students on how to solve one problem. Students will restate relevant information in their own words without looking at the problem and record this in their workbook. Students will share what they've written in their workbook to the group or tutor. Students will then solve the problem. Students will not move on to the next problem until mastery of the guided strategy steps has been demonstrated to the tutor.

Read the questions out loud to the students once. Pause, and then read the question again out loud. Direct the students to cover up the problem or close their booklet, and restate the problem in their own words and identify relevant information needed to solve the problem. Direct the students to write the information down in their workbook. Then have students share what they wrote to the tutor and the group. Discuss which information is relevant or

not. Then have students solve the problem in their workbooks. Go around and check to see if the answer is correct before they move on to the next phase.

i. *Question number two says _____. (pause) Can someone please read question number two out loud for us? Now, please cover up the question with your hand and write the important information for this question down in your own words, without looking back at the question. (students write) So what is the question asking? (students respond) What other information is important for this question? (students respond, discuss relevant information) Try solving this problem now on your own.*

4. Independent practice (15 min): Students solve three word problems, similar in difficulty as the two previously modeled and guided practice word problems.

Direct students to look at the three word problems on the bottom of the page and to try working on these problems by themselves just like we did with the previous problems. Remember to ask yourself which information is important to solve the question. Allow 15 minutes for students to work. Walk around to see if students are actively solving problems. Collect workbooks at the end and check answers to determine progress on strategy implementation and problem-solving accuracy.

i. *Now look at these three problems at the bottom of the page. I want you to complete each one on your own just like we did for the last two questions.*

Checklist for tutor/teacher

1- Tutor or Student Reads problem out loud to group. Y N

2- Tutor asks, "What is the Question?" Y N

3- Tutor asks, "What other information is important?" Y N

4- Tutor states, "The important information is _____."
“(Restate)” Y N

5- Teacher asks, "What would we do to solve the problem?"

Problem is solved together. Y N

Guided Practice

1- Tutor or Student Reads problem 2 times Y N

2- Tutor asks, "Write the important information in your own words" Y N

3- Tutor asks, "What is the question?" Y N

4-Tutor asks, "What other information is important?" Y N

5- Tutor instructs students to solve on their own. Y N

Independent Practice

I want you to solve the problem just like we did. Y N

___YES___NO ____% yes



Mixed add / subtract / multiply / divide

Grade 3 Word Problems Worksheet

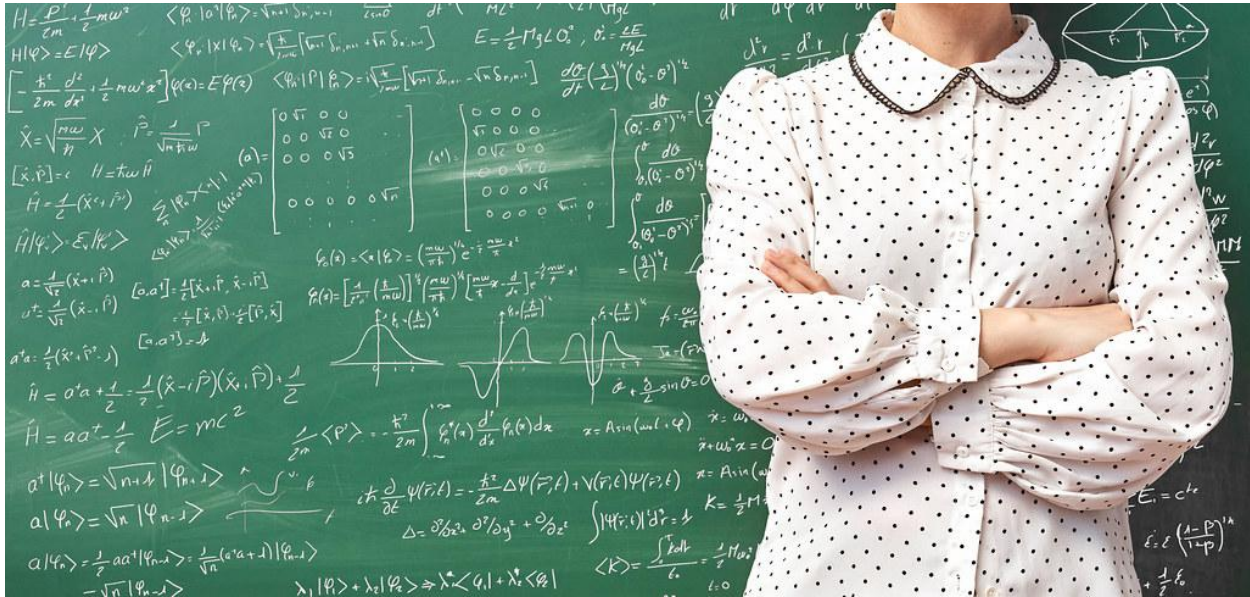
Dave is working to improve the yard at his house.

1. There are two kinds of soil to choose from. If brand A is \$50 for 5 kg and brand B is \$48 per 4 kg, which brand is cheaper?
2. There are two pine trees at the front entrance. The tall one is 16 feet and the short one is 7 feet shorter than the tall one. Dave has a ladder that is 14 feet tall. Compared to the shorter pine tree, how much taller is his ladder?
3. Each pack of pumpkin seeds costs \$8 and each pack of tomatoes seeds costs \$5. What is the total cost for 3 packs of tomato seeds and 4 packs of pumpkin seeds?



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Coach Card 4: Growth Mindset and Combating Gender Bias

Research has demonstrated that stereotypes regarding gender-identity and mathematics proficiency may begin to be pervasive as early as elementary school. It has been reported that some female-identifying students will state that “girls are bad at math” if they experience difficulty with assignments; this mindset may also lead to homework avoidance which lowers their exposure to mathematics (Cvencek et al., 2011). Researchers believe that these students combine cultural stereotypes (“Math is for boys”) with gender identity (male, female, non-binary) and one’s self-concept in regards to math (“Math is not for me”) (Cvencek et al., 2011). To combat these stereotypes and negative self-perceptions, educators have been implementing growth-mindset strategies. “Growth mindset” refers to the perception that an individual can change and improve their skills. A study by Degol and colleagues demonstrated that the association between promoting a growth mindset in math and improved performance in math was stronger for female students than male students, although it was shown to benefit both

binary genders. More research is required to determine the effects for non-binary students. This intervention may be more effective with female populations.

It is important for researchers and educators to study math-related self-efficacy in schools because it significantly correlates with students' intentions to choose a career in STEM (Science, Technology, Engineering, and Mathematics) fields (Huang et al., 2018). Access to occupations in STEM fields increases students' opportunities to experience positive life outcomes and success. The concept of natural superior ability to understand mathematics is present within many minoritized adolescents; this belief negatively impacts their level of self-efficacy (Wang et al., 2021). The presence of a growth mindset increases one's likelihood to increase their self-efficacy (Huang et al., 2018). Female-identifying students have been shown to experience lower levels of self-efficacy and higher levels of math anxiety when compared to their male-identifying counterparts (Huang et al., 2018). Therefore, their need is more prominent when considering growth mindset interventions. It has also been shown that students from socioeconomically disadvantaged backgrounds need support regarding math engagement (Wang et al., 2021). Researchers have found that it is culturally responsive for teachers to create classroom environments in which students can control, monitor, and direct their learning, while interpreting their progress through the lens of a growth mindset (Wang et al., 2021).

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Description A growth mindset intervention encourages students to change their perception about their capabilities in a certain area of functioning. Growth mindset allows students to view challenges as surmountable obstacles. This intervention will target gender stereotype threat regarding mathematics abilities.

Target Skills This intervention targets student self-efficacy, perseverance, and motivation. Self-efficacy is one's belief that they can successfully perform a specific skill. If students experience elevated performance in these areas, their academic performance will hopefully improve as a result. However, academic skills are not directly targeted through this growth mindset intervention.

Location This intervention is meant to be implemented in general education and honors classrooms during math instruction. It can be implemented in-person as whole-group instruction.

Materials For this intervention, the instructor will require the following materials:

- Scripts containing growth-mindset and gender equality activities
- Pencils
- Colored pencils
- Brain diagram/Brain workout worksheets
- Individually-wrapped candy
- Presentation: exceptional female mathematicians
- Lined paper
- Blank paper

- Poster paper
- Comic panel worksheets
- Reflecting on my strengths worksheets
- What I learned about bias worksheets
- White board (Dry-erase markers)/Black board (Chalk)
- Self-Report survey

Frequency The script and activities should be incorporated into math lessons during class at least once a week for 8 weeks. However, data will be collected at least twice a week for 8 weeks (see *Progress Monitoring*).

Target Age This intervention can be implemented with students in grades 3-12. Intervention scripts should be modified to match the developmental level and understanding of the students. This coach card will include a guide that is appropriate for children in grades 4-5. This age-group was chosen because it is important to combat gender stereotypes in the early developmental periods. Students are able to understand the concept of bias. Additionally, the demands of mathematics classes begin to increase during this period of instruction. As a result, student self-efficacy may begin to decline and require attention.

Progress Monitoring Students will receive a self-report survey with the following prompts to measure specific areas of interest. The intervention will ideally occur on Wednesdays; students will complete this survey on Mondays and Fridays of every intervention week. Students will also be given an opportunity to complete this survey twice a week on the same schedule during the 3

weeks prior to implementing the intervention lessons. The survey items will be structured on a Likert scale (1-5). The numbers will represent the following statements:

- 1) Strongly disagree
- 2) Disagree
- 3) Neutral
- 4) Agree
- 5) Strongly agree

The survey items appear on this coach card under the category they measure. The following categories are directly targeted by the intervention:

- Stereotype Beliefs
 - Mathematicians are always boys.
 - Boys always have the right answers to math problems.
 - It is possible that boys have the ability to do math better than girls.
 - Overall, boys may be better than girls at math.
 - Girls need more help with math assignments than boys.
- Self-efficacy/Growth-mindset
 - No matter how much math ability I have, I have the power to change it.
 - I can train my math muscles in my brain to be stronger.
 - Math can be fun for everyone.
 - I think I am good at math.
 - I can do better with practice.
- Perseverance
 - Even if problems in mathematics are difficult, I strive to solve them.

- I will try at least every math problem on a test or on my homework once.
- When a math problem is hard I don't give up. Instead, I ask for help.
- Motivation
 - I look forward to the math lesson.
 - I can help others complete their math work.
 - I want to do well in math.
- *It could be of interest for teachers to monitor female, male, and non-binary responses individually. The intervention may prove more effective for a certain demographic of students.*
- Optional Measures: These categories are not directly targeted by this intervention, but could be positively affected by the results. They also may be recorded at a frequency other than twice a week.
 - Attendance: how often a student attends school/class
 - Number of assignments turned-in
 - Test Anxiety
 - I feel uneasy or upset when I take a math test/quiz.
 - I always do badly on math tests/quizzes because I am nervous.
 - When math tests/quizzes start, I feel like I forgot everything I learned.
 - Academic Performance
 - If students receive multiple benchmark exams, the teacher may consider monitoring the difference in the class median score on the math section.

- The teacher may consider comparing the class median scores on certain exams to those of their previous students (these students would not have been exposed to the intervention).
- The teacher may consider comparing the class median scores on certain exams to those of students in another class who experience the same curriculum (these students would not have been exposed to the intervention).

Sequence of Lessons

Each of the following lessons contains a portion that addresses growth mindset and gender bias.

Teachers have some flexibility in their choices and are encouraged to consider the responses of their students.

Lesson 1

- Growth Mindset Component: Drawing a “Mathematician”
 - Begin by asking students “What is a Mathematician?” You may provide the answer “a person who is an expert in mathematics.” The use of the term “person” is key to eliminating gender stereotypes. If a student responds with an answer that includes a gendered term such as “man” or “woman” you may correct them by asking “Can a mathematician be any gender?” or stating “A mathematician can be any gender.”
 - Next, ask students to draw themselves as a mathematician.

- If students are having difficulty producing a response, you may provide examples of mathematicians, such as “math teachers” or “engineers.”
- Gender Equality Component: Teaching Gender-fair Messages
 - Once students have completed their drawings, review the following gender-fair messages:
 - “Math can be easy and fun for *everyone!*”
 - “Everyone can learn math!”
 - “Anyone can be good at math!”
 - “Anyone can be a mathematician!”
 - Teachers can identify why these phrases are important. They may tell students:
“Any person can learn math skills. All students are capable of doing well in math. If we practice, we can always get better.”
 - Students can choose one of these messages to include on the page with their drawing. Teachers may consider displaying these images on the classroom walls. Students can take pride in their work, as well as have a constant visual reminder that they have the ability to learn math skills.

Lesson 2

- Gender Equality Component: Guess their Jobs
 - Teachers may present photos of individuals that identify as either male or female. They can then ask their students which person belongs to a certain occupation that is typically aligned with gender stereotypes. (Ex. Police officer, nurse, flight attendant, teacher, fire fighter, mathematician). Teachers may consider labeling

the pictures A-F so students may refer to the people in the photos by these letters rather than physical descriptors.

- Teachers may ask students to describe what skills or personality traits someone might need to do a certain job. For example, “What are some traits of a good firefighter?” Students may respond with answers such as “strong, brave, kind, etc..” The teacher may write these descriptors on the board so they can discuss them later.
- As a class, students can decide which individual matches each occupation. Once they have completed this activity, the teacher may discuss why they chose each person for each profession.
 - The teacher can ask the students “can both men and women do the same job?” They may also refer to the list of traits on the board and say “can men and women both be strong, brave, and kind?”
- Growth Mindset Component: Career Process Pathway
 - The teacher may ask students to choose a certain career that they want to explore as a class. They can present the students with a flowchart that they can fill-out to show them the steps for how people can join that profession.
 - For example, if students chose a nurse, the steps may include: “graduate high school, go to college, apply for nursing school, get training and graduate from nursing school, pass an exam, and get a license from the state, apply for a job at a medical practice/hospital.”
 - The teacher can ask the students “can anyone follow these steps to become a nurse (or any profession they choose)?” They can also ask “Can you do

any job you want?” Then they may emphasize that all the professionals they discussed that day needed to train to get better at their jobs. The teacher can relate it to their class by stating “Like these professionals, we can train to get better at math. Hard work helps us succeed.”

Lesson 3

- Growth Mindset Component: Letter to a Friend
 - The teacher may ask students to write about the challenges they have in math class. If students are having trouble producing work, a teacher may provide prompts such as “are you nervous when you take tests?” or “can homework be hard to understand sometimes?” The students will identify these issues, how they feel when facing these challenges, and how they believe they can overcome them.
 - The teacher can then state “What advice would you give to a friend who is having the same problems?” They can instruct the students, write a letter to this friend, giving them advice about what they can do to overcome these challenges.”
- Gender Equality Component: Challenges for Women in Math
 - After the students have completed their letters, the class may discuss the following: “What challenges may female mathematicians face?” Teachers may call to the students’ attention wage differences and the gender bias associated with the quality of work produced by women in this field.
 - The teacher can write what the students share on the board. The students can use these prompts to write a second letter to a female mathematician, or an aspiring female mathematician. The teacher can prompt the students by saying “Write a

letter to a female mathematician who may need encouragement. Give her advice to overcome the struggles she may be facing.”

Lesson 4

- **Growth Mindset Component: Talk to a Peer: Let’s Talk About Math**
 - The teacher will pre-assign their students into groups, and arrange the classroom to facilitate peer discussion (i.e. putting desks together, moving chairs to be paired-off around the room, allowing students to sit on the floor, etc.). Teachers may group students together who do not typically interact to foster student relationships and a connected classroom community.
 - Teachers may avoid allowing students to choose their partners so a peer does not feel excluded from the activity. A safe, inclusive environment is required when talking about sensitive subjects such as personal challenges and bias.
 - Teachers will provide students with the following prompts to discuss for a 15-minute period:
 - 1) What are some troubles we are having in common with math?
 - 2) What do we like about math?
 - 3) Why is math important?
 - 4) How can we improve our math skills?
 - Once students have finished discussing their questions, have the groups share one group-wide response for each prompt. The teacher may ask a student from each group to write their response on posters with the following headings:
 - What we can work on:

- What we like about math:
- Why math is important:
- How we can improve our math skills:
- The last prompt “How can we improve our math skills?” reinforces that students are not stuck being “bad at math.” There are steps that they can take to grow their knowledge and skills to improve their performance. The discussion with other group members demonstrates that they are not alone in facing challenges in math.
- Gender Equality Component: Talk to a Peer: Let’s Talk About Bias
 - The teacher can provide the groups with new prompts about bias. The teacher can provide the following definition of “bias” to guide students: “Bias is favoring one person or group compared with another in an unfair way.”
 - The teacher can give students 10 minutes to discuss the following questions:
 - Why is it important to battle biases?
 - Why is it important for all people to have access to math?
 - How can we be unbiased in our class?
 - Once the students finish their discussion, the teacher can ask each group to share ways to be unbiased in the classroom. The teacher can write these ideas on a class agreement (“I will be unbiased in this class”) and have each student sign their name.

Lesson 5

- Growth Mindset Component: Train the Brain
 - The teacher will introduce a simplified diagram of the brain to the students either on a worksheet or the main board (some teachers may choose to use both). The

diagram must highlight the parietal lobe as well as the frontal lobe. The teacher can ask the students if they know what parts of the brain they use when they do math problems.

- The teacher will state that “the parietal lobe areas help us calculate and process numbers” and “the frontal lobe areas are involved in recalling numerical knowledge and working memory.”

- The teacher may define “working memory” as: holding information in your mind for a short amount of time as you solve a problem.

- The teacher may include the following “brain workout” on the brain diagram. Students will work together as a class to solve each component of the problem. The teacher can also ask their students what part of the brain they are using while solving each step. Students should raise their hands to share the answers. The answer to each section should be entered into a final equation (Ex. #1 + #2 - #3 + #4 = ?). If the students are able to solve the final equation correctly, they may receive a prize, such as candy. Please see the following script to help guide this lesson:

- How much money are the coins representing in step #1?
 - What part of the brain are we using to get the answer?
 - The parietal lobe
 - How many total participants are represented on the chart in step #2?
 - What part of the brain are we using to get the answer?
 - The parietal lobe
 - What is the answer to the multiplication fact in step #3 (Ex. 8 x 7)?

- What part of the brain are we using to get the answer?
 - The frontal lobe
- What is 25% of 100 as a simple fraction in step #4?
 - What part of the brain are we using to get the answer?
 - The frontal lobe
 - Let's put all our answers into the equation and see what we get.
- After finishing this “brain workout” the teacher may ask the students some follow-up questions:
 - Can we workout our muscles to get stronger? How?
 - Students may respond with “sports, exercise, weight-lifting, etc.”
 - Can we work out our brains? How?
 - Students may respond with “Brain workouts (like the one we just did), cross-words, puzzles, games, riddles, etc.”
- Gender Equality Component:
 - The teacher can begin a discussion by asking the students “Who are some women you know that work out their brains?” and “How do they work out their brains?”
 - The teacher may share an example such as “my mom works out her brain every day by doing the New York Times crossword puzzle.”
 - Once students are able to think of an example, the teacher can have them complete the following sentence to write on their brain diagram worksheet:
 - I will work out my brain like _____ by _____.

Lesson 6

- Gender Equality Component: Women in Mathematics

- The teacher may prepare a powerpoint that showcases accomplished women in the field of mathematics. They may follow the example presentation included in the Appendix of this handbook.
- Teachers may introduce the presentation with the following statement: “Although many representations we see of mathematicians we see in movies, textbooks, and TV shows are men, there are several women who have shaped, are shaping, and will shape the field of mathematics for years to come. It is important to acknowledge their contributions to the field, as women may be overlooked by other professionals. Their efforts and accomplishments are important regardless of their gender.”
- Teachers may highlight a past female mathematician. For example, they may choose Dorothy Vaughan, “the human supercomputer.” They can highlight her background (where she is from and her education) as well as her contributions (her computations allowed NASA to send astronaut John Glenn into the Earth’s orbit in 1962). They can also emphasize that her achievements in mathematics impact our world today (she helped send the first satellites into space for the United States; these satellites can help us monitor potential natural disasters, predict weather and climate, and help farmers identify what crops to plant).
- Teachers may then identify a more current mathematician, such as Valerie Thomas. It is important for students to know that women are currently active and accomplished in the field of mathematics. The teacher can once again include her background (where she is from and her education) as well as her contributions (Thomas was able to patent her invention, the illusion transmitter, in 1980; this

device creates an optical illusion by using two concave mirrors to make images appear real). The teacher can also emphasize that her achievements in mathematics impact our world today (The illusion transmitter is the base technology used to create 3D effects used in modern television, video games, and movies).

- Future: The teacher can report that in 1970, women made up about 38% of the U.S. workforce, but only 8% of STEM workers. The teacher may ask if students are aware of what STEM means. If a definition is needed, they may state: STEM encompasses jobs that involve science, technology, engineering, or mathematics. By 2019, women made up about half of the workforce, and made up about 27% of STEM workers. Teachers can state “the population of women in STEM is increasing and can continue to increase.”
- Growth Mindset Component: Where do Mathematicians Come From?
 - The teacher can ask their students “Where do mathematicians come from?”
 - Students may respond with “schools, colleges, or (ideally) anywhere.”
 - The teacher can emphasize that anyone can become a mathematician, or grow their math skills. The teacher can ask the students the following questions to encourage the development of a growth mindset:
 - Did the mathematicians we learned about today know how to do math when they first started school?
 - Did these mathematicians have to work hard to accomplish their goals?
 - Do you think these mathematicians ever faced math challenges during their careers?

Lesson 7

- Growth Mindset Component: Math Comics
 - The teacher can present students with a 5-panel comic outline in which they can depict a story of someone who is having trouble in math class. The teacher may state the following instructions: “Today we will be creating comics about students who overcome challenges in math class. Each panel will show a different part of the story.” The teacher can provide prompts for panels 1-5:
 - 1) Draw and caption the student having a problem in math.
 - (Ex. a student is nervous to raise their hand in class)
 - 2) Draw and caption how the student feels about the problem.
 - (Ex. the student feels embarrassed and scared they will give the wrong answer)
 - 3) Draw and caption how the student plans to solve the problem.
 - (Ex. the student plans to read their notes from the day before the night before class so they are prepared)
 - 4) Draw and caption the student carrying out their plan.
 - (Ex. the student reads their notes right before they go to bed and they are able to raise their hand and give a correct answer)
 - 5) Draw and caption how the student feels now that the problem is solved.
 - (Ex. the student feels proud that they overcame their nerves and they feel confident in their knowledge of the material)
- Gender Equality Component: Bystander vs. Bias

- The teacher may prompt the students by asking: “How might this story look if a character in the story experienced bias?” and “What steps could someone take to defeat the bias). The teacher can have students add 2+ additional panels to depict this situation.
 - 6) Draw and caption the occurrence of bias.
 - (Ex. the teacher is always calling on the boys in class, even when she is raising her hand)
 - 7) Draw and caption how someone can help neutralize the bias.
 - (Ex. another classmate raises their hand and says “I think *student’s name* had her hand up too. I want to hear her answer.”)
- The teacher can remind students of their list of ways to be unbiased in the classroom to spark ideas for their comics. The students can display these comments in the classroom, or in the hallway for other classes to see. Students can take time to look at other comics for a 10-minute period. Once the period has ended, the teacher can ask students to share something they liked about someone else’s comic. The activity encourages students to compliment each other’s creative work; this behavior will hopefully generalize and students will compliment each other’s efforts in a math-focused setting.

Lesson 8

- Growth Mindset Component: My Powerful Brain
 - The teacher can give students a worksheet to help them identify positive events they experienced throughout the intervention. The worksheet may contain the following prompts:

- What are 3 things I improved in math class over the last 8 weeks?
 - Students may respond with “my note taking, my study habits, my confidence when giving answers in class, my stress when taking a quiz, etc.”).
- What are 3 strengths I have that can help me overcome more challenges in math?
 - Students may respond with “intelligence, problem-solving skills, risk-taking, willingness to ask questions, etc.”)
- What do I hope to achieve in math class by the end of the year?
 - Students may respond with “get a perfect score on a test, complete all my homework on my own for a week, help a friend with an assignment, etc.”)
- Gender Equality Component: Math is for Everyone!
 - The teacher can hand out an additional worksheet that asks the students to write 5 sentences about the most important thing they learned about gender bias in mathematics.

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Peer-Tutoring



It can be extremely challenging to teach students who are learning English. One strategy that can benefit students and teachers alike is peer tutoring. Peer tutoring allows students to engage with each other as well as learn from one another. This intervention has positive academic approaches for a wide range of topics, so it can be used for multiple subjects and lessons like math and reading (McMaster & Fuchs, 2006). It is also flexible and can be done using different formats and activities for elementary and secondary schools. Different reinforcements can be used for activities to encourage students' participation such as point systems, tangible rewards, positive words of encouragement, and having an overall fun experience (Hawkins et al., 2009). It gives students an opportunity to receive a form of one-on-one attention and support that they may need, but the teacher may not have been able to provide before due to time and needing to teach numerous other students (Fuchs et al., 1997). Students learning English will also have the opportunity to practice their conversational and social skills with their peers. This can encourage positive interactions and relationships between peers which contribute to a positive classroom environment, which promotes learning and growth. It is also beneficial for students to teach their peers in a tutor tutee format because this helps them both process and retain information that can lead to mastery of the subject (Tsuei, 2014).

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COACH CARD 5: Peer-Tutoring

Description Peer-tutoring is a strategy that allows students to work collaboratively and engage in learning and teaching. Students can take the role of the tutor, or the tutee; it is common for students to change roles as well. When given the opportunity to teach, the student can view themselves as the “expert.” This role gives students an opportunity to review the previously-taught classroom material. It can also increase the students' self-efficacy if they are able to successfully help their peers understand the material, or if they are able to make improvements with the “tutor’s” guidance. This intervention strategy is culturally responsive because it can minimize dynamics of power and control. Students are actively involved in their learning and the teacher is not the sole source of instruction; this activity increases students’ independence and motivation. Teachers take a hands-off approach as a supervisor and students are able to support and encourage one another. Through collaborative efforts, students act as the tutor and tutee and they are able to experience success in both roles. Additionally, the students are receiving the same instruction at the same time, so even if they are the “expert” in one instance, they may not act as if they are in a role of authority over another student. Peer-tutoring fosters classroom

relationships between teachers and students, as well as strengthens the classroom community. A positive, safe classroom community facilitates a successful learning environment.

Target skills A peer-tutoring strategy can be implemented to facilitate the learning of many subjects. This coach card will address the skill of math-facts fluency (including addition, subtraction, multiplication, and division). Indirectly, this intervention may positively impact students' sense of belonging and their levels of joy.

Location Peer-tutoring can be used in-person in general education classrooms, ICT classrooms, or in 15:1 special education classrooms. It may be implemented as whole-group instruction. This strategy may be particularly useful for ICT classrooms; teachers can choose to pair special education students with general education students who may have a better understanding of the material. Students who have a grasp on the material will reinforce what they learned through tutoring, while students who struggle with the subject receive extra support. There is evidence to support that peer-tutoring is an effective strategy for diverse populations in school. It can be an appropriate classroom practice for urban districts, which often include a population of at-risk students that could benefit from cooperative teaching practices.

Materials For this intervention, the instructor will require the following materials:

- Worksheets of 100 mixed addition, subtraction, multiplication, and division facts (25 of each)
- Worksheets of 50 math facts in each area of operations
- Pencils

- Good Tutor Card
- Math-Facts Flashcards (addition, subtraction, multiplication, and division)
- Game materials
 - Access to a SMARTBoard or Promethean Board for Kahoot.com
 - Dice
 - Flashcards
 - Whiteboards and Dry-erase markers
 - Individually-wrapped Candy
- *Optional* Self-Report Survey

Frequency This intervention can occur four times during a week (Monday-Thursday) for a 10-minute period after the instructor has completed the scheduled math curriculum lesson for that day. If the students are able to complete the intervention tasks each day, they may be rewarded with a gameplay activity on Friday. This intervention can be implemented for a period of 8 weeks (*see Progress Monitoring*).

Target Age: This particular intervention could be effective for a 3rd-Grade classroom. The mathematics skills that peers practice may be modified to align with the developmental capabilities and knowledge of other age groups. Implementing this intervention with this age-group could be beneficial. It is important that students learn to work collaboratively and support one another at an early age. Additionally, an increased sense of belonging may promote future school engagement. The supportive relationships and subsequent social skills established

through this intervention will help students improve their future ability to function and thrive in an educational setting.

Progress Monitoring The instructor will be able to measure students' progress by measuring how many math facts (of a certain type of operation) they can complete accurately in 1 minute. Each worksheet may contain 50 math-fact problems. Each operation measure will correspond with the flashcards practiced by the students that day. For example, if peer-tutors drilled addition flashcards, students would complete a worksheet of addition problems. Students can complete the math facts before and after the peer tutoring session; this provides a pre and post measure of accuracy and fluency. In order to prevent students from experiencing test anxiety, teachers can explain that this assessment is not included in their grade. Teachers may refer to the activity as a "Math Bonanza" to assist with decreasing anxiety. This will allow teachers to observe how the students' knowledge generalizes to a written-response, independent, test-taking setting. Teachers can also give a weekly measure on Friday in which they give students 60 mixed-operation (15 of each) math-facts to solve in a 2-minute period. This measure may represent students' ability to engage in cognitive switching, as well as integrate the material that they learned into a more complex assignment. Teachers can record the number of problems students are able to answer correctly during the time period. The mixed-operation questions can also be provided as a baseline before the intervention is implemented.

- **Optional Measures**
 - The teacher may consider creating a self-report survey that students could complete Monday morning before the peer-tutoring session and every Friday after

gameplay. This survey will help to measure sense of belonging and levels of joy.

The prompts can be structured on a Likert scale (1-5).

- This survey may include the following prompts:
 - Please, rate your level of Joy on a scale of 1-5
 - “I feel included in the classroom.”
 - “I feel accepted by my peers.”
 - “I feel like I belong in my classroom community.”

Sequence of Sessions

Monday-Thursday Peer-Tutoring Activity

To assign students to their pairs, the teacher can take overall grades or progress based on assessments of students and match lower performing students with higher performing students.

This activity can occur after the primary lesson; using the remaining instructional time, students will pair up and use flashcards to practice math skills. Students will work for 5 minutes as the tutor and 5 minutes as the tutee. This arrangement may differ depending on each student's ability-level. Each student will be provided with 25 flashcards to complete within the 5-minute period.

The teacher can provide the following directions to students:

“You will have 5 minutes each to get through your flashcards with your partner. If your partner gets a fact correct, tell them ‘good job’ and move onto the next card. If your partner gets a card wrong, tell them to ‘try again.’ If they do not know the answer, you can tell them the answer. Then, move the card to the end of the pile so they can try it again later.”

“Make sure to look over your Good Tutor Card to make sure that you’re being the best tutor you can be! If each tutor can check off each item on their list this week, and everyone attempts all 25 math-facts each day, we can play a game on Friday!”

- It could be beneficial to base the reward-system on effort rather than performance on the math-facts worksheet. Students’ performances may be negatively influenced by test-like anxiety because they are being asked to work under a restrictive time-limit. Students may be discouraged and become unmotivated if their effort to do well is not being acknowledged, especially if they have not yet mastered their math skills.

Teachers may give the following instructions:

“We will now complete a math-facts worksheet with # of problems during # minute(s). Try to work as fast as you can, while trying to get as many problems right as possible. This is not a test and will not count toward your grades. Just do your best! Ready? Begin.”

Friday Game Day Activity

The teacher can choose to incorporate mixed math-facts into a variety of game formats.

Gameplay is also considered to be a culturally responsive practice. It provides students with opportunities to succeed within their classroom community; it challenges them to excel and maximize their potential outside of the typical learning environment. Additionally, it provides validation, as students observe that the skills they practice are applicable and are leading to positive outcomes.

Teachers may consider the following options for gameplay:

- Kahoot.com

- Teachers can create a Kahoot game outline in which students can work individually to answer math-facts and gain points.
 - This format also provides corrective feedback.
- Around the World
 - Teachers can arrange students' desks in a circle. One player moves around the room, attempting to answer math-facts flashcards more quickly than their opponent at each desk. The player with the first correct answer advances to the next desk. Once they have gone “around the world” they have won the game.
- Dice games
 - Students may be divided into teams and asked to roll 10 dice. The first team to add, subtract, multiply, or divide the combination of numbers and display their answer on a whiteboard first, can earn a point. Any ties or disputes can be solved through an unbiased method, such as flipping a coin.

Winners of each game can earn a desired reinforcer, such as candy. Teachers should ensure that the gameplay environment does not become overly-competitive and stressful. It could be helpful to reward all students for their efforts (1 piece of candy), while providing winners with extra rewards (a second piece of candy or a homework pass). If students work in teams during gameplay, the teacher must consider placing both high-performing and low-performing students on teams together, so teams are not unbalanced.

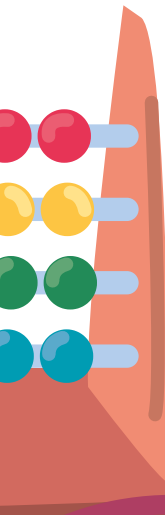
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**Draw yourself as a
mathematician!**





1 Count the change!



BRAIN WORKOUT

Frontal lobe

Parietal lobe

3 Solve:

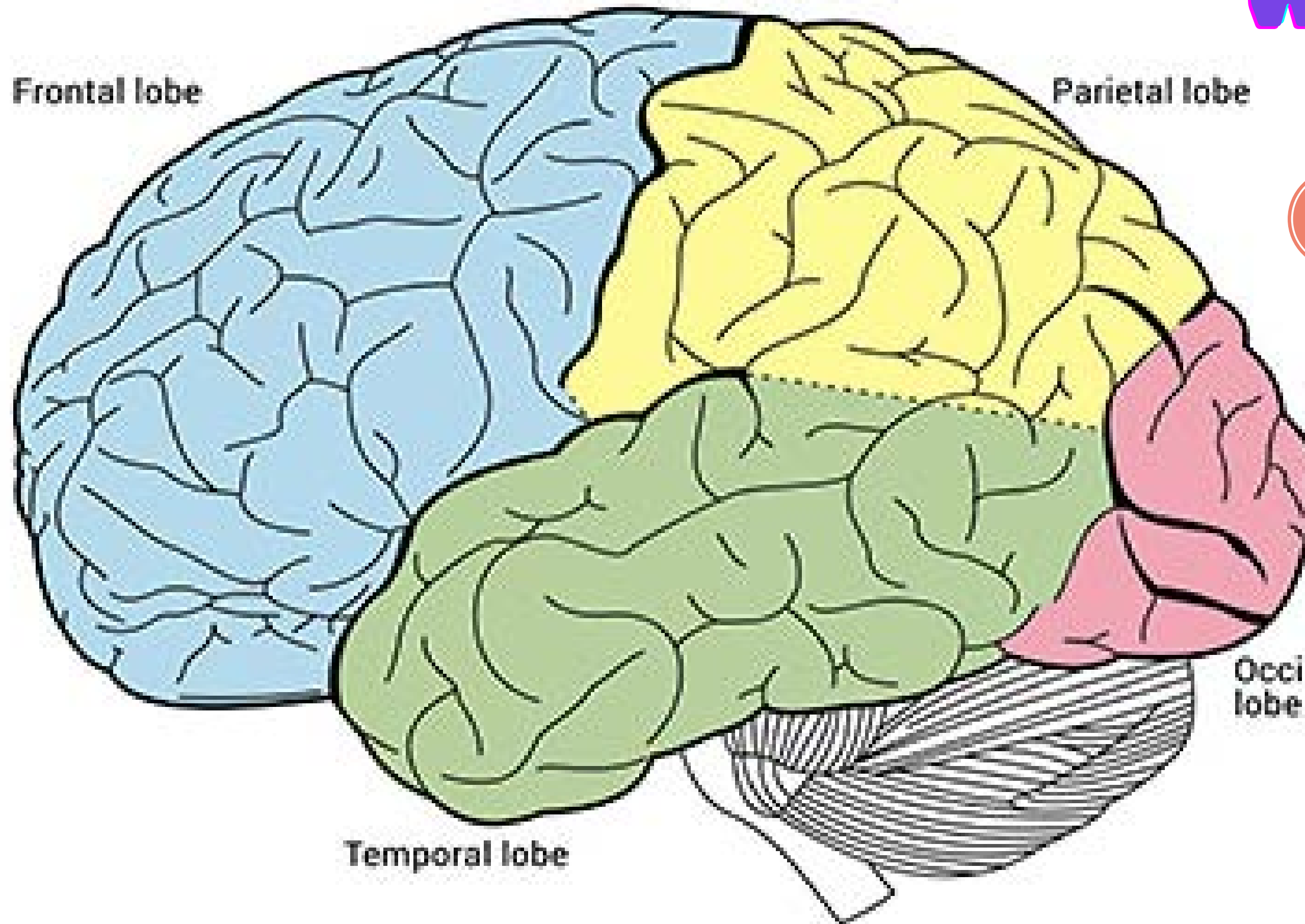
$$8 \times 7$$

4 25% of 100 as
a Fraction?

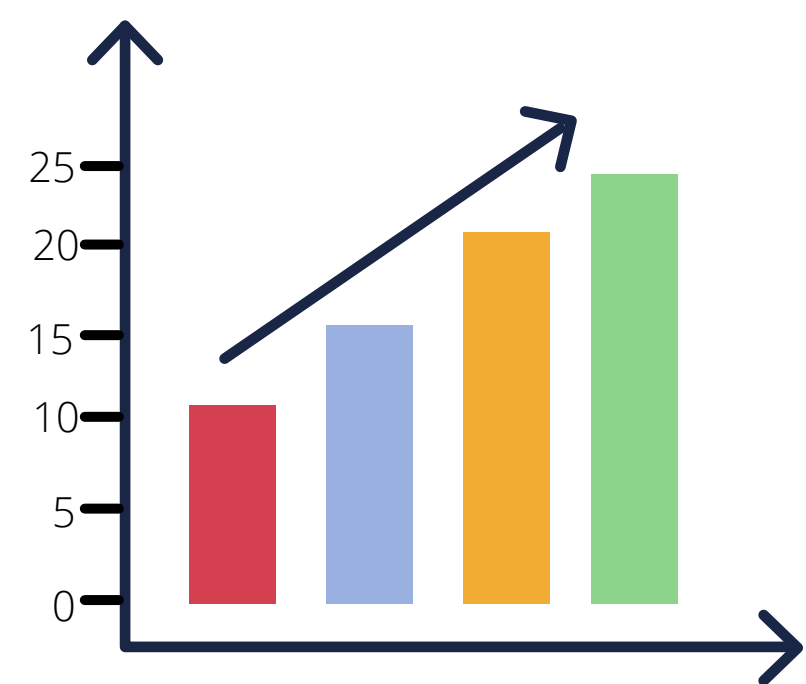


Occipital lobe

Temporal lobe



2



$$\#1 \text{ ______ } + \#2 \text{ ______ } - \#3 \text{ ______ } + \#4 \text{ ______ } = ?$$

LETTER TO A FRIEND

Math Advice

YOU CAN
DO IT!



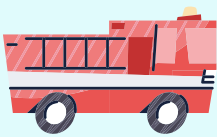




Career Pathway



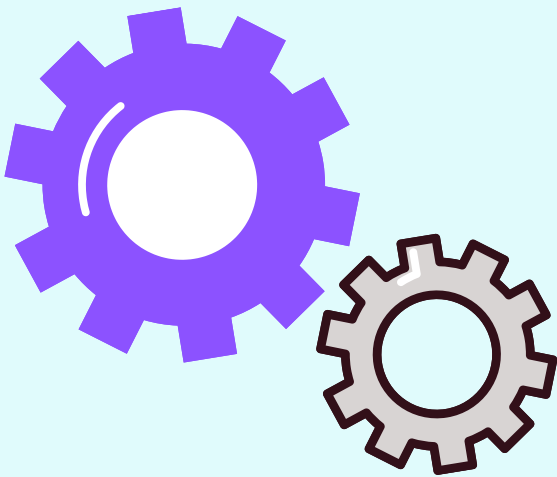
When choosing a career, it is important to think of all the steps you have to take to get that job! Anyone can follow these steps to do any job they want. Hard work helps us achieve our goals.



Education

Does this professional need to get a certain degree or finish certain classes?

STEP
01



Experience

Does this professional need to get training in their field?

STEP
02



Exams

Does this professional need to pass any special tests?

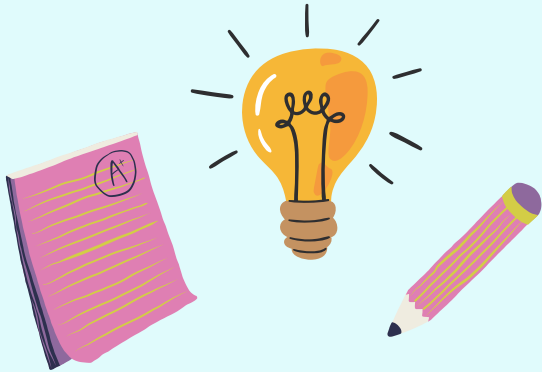
STEP
03



Certification

Does this professional need to get a certificate to start working?.

STEP
04

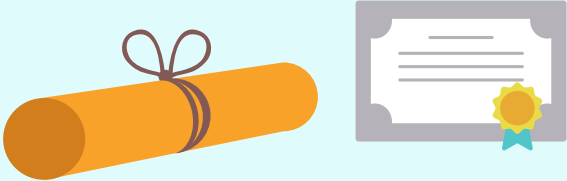



Application

Where can this professional apply to work?



STEP
05



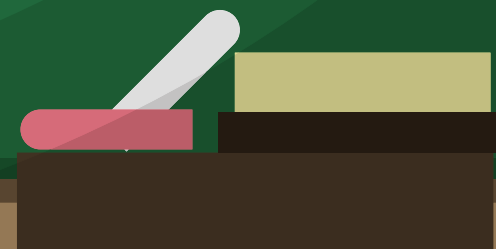
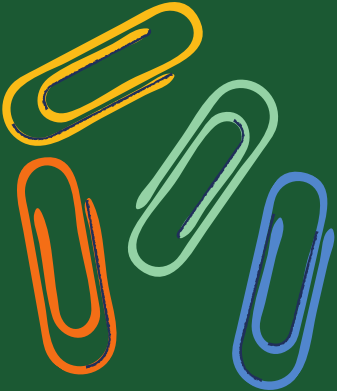
An illustration of a woman with short dark hair, wearing a purple long-sleeved shirt and an orange skirt, holding an open book and gesturing with her right hand as if reading to a child. The child, with dark hair and wearing a yellow long-sleeved shirt, is sitting at a desk with a book. The background is white with large, light orange rectangular shapes that look like pages or panels.



You are doing
GREAT!



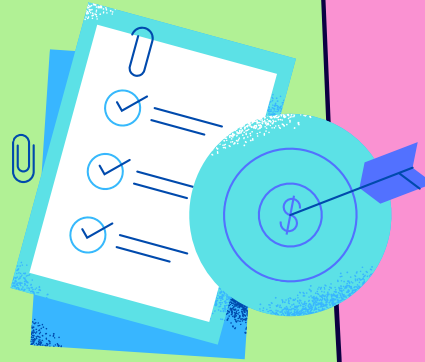
MATH IS FOR **EVERYONE**



My Powerful Brain



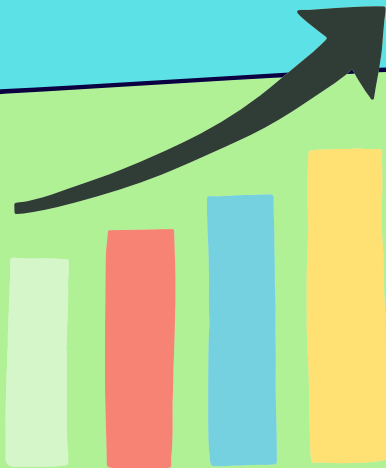
What are 3 things I improved in math class over the last 8 weeks?



What do I hope to achieve in math class by the end of the year?



What are 3 strengths I have that can help me overcome more challenges in math?





GOOD TUTOR CHECKLIST

☐

I will use kind words.

☐

I will stay on-task.

☐

I will encourage my partner.

☐

I will raise my hand if I need help.

☐

I will do my best to complete the task.

☐

If someone gets a question wrong, I will encourage them to try again. If they do not know the answer, I will help.



The background is a dark blue grid. A large, dark blue, irregular shape in the center contains the title. Various colorful mathematical symbols are scattered around the central shape, including numbers (2, 0, 5, 1, 9, 4), operators (+, -, x, =, %), and mathematical notation (infinity, square root).

Women in Mathematics

Past, Present, & Future



**Dorothy
Vaughan**

- **The Human Supercomputer**
- **From: Kansas City, Missouri**
- **Education: she graduated from Beechhurst High School with a full academic scholarship to Wilberforce University in Ohio**
 - **Degree in mathematics (19 years old)**
- **Teaching Career: 14 years**

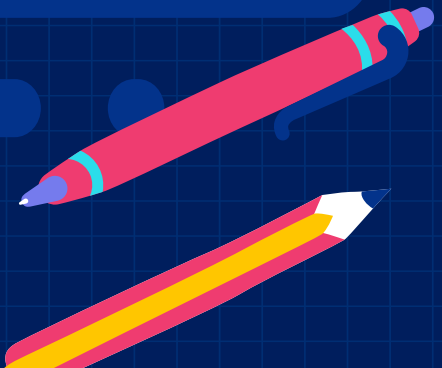




Contributions:

- Vaughan's computations allowed NASA to send astronaut John Glenn into the Earth's orbit in 1962.

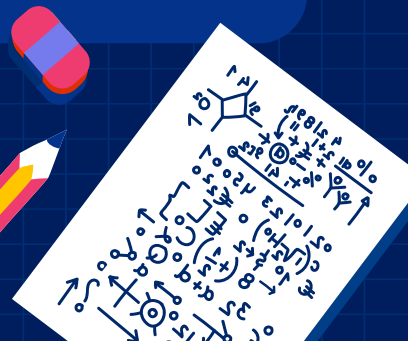
How her work helps us today:

- She helped send the first satellites into space for the United States; these satellites can help us monitor potential natural disasters, predict weather and climate, and help farmers identify what crops to plant.
- 



- **From: Baltimore, Maryland**
- **Education: she graduated with honors from Morgan State University**
 - **Data Analyst for NASA**

Valerie Thomas

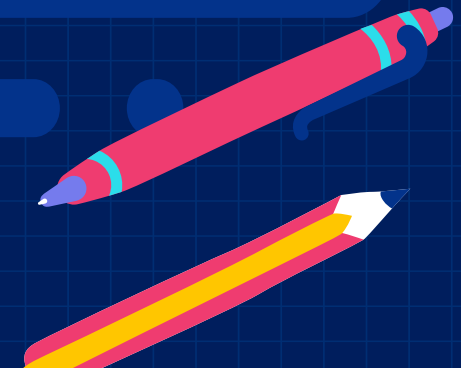






Contributions:

- Thomas was able to patent her invention, the illusion transmitter, in 1980; this device creates an optical illusion by using two concave mirrors to make images appear real.

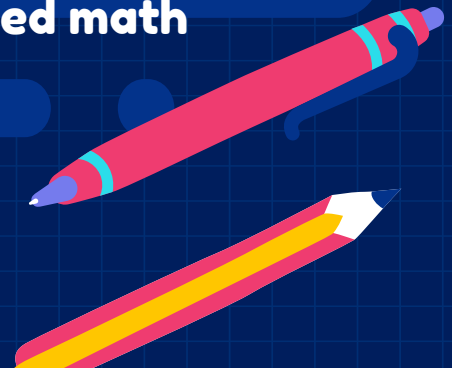
How her work helps us today:

- The illusion transmitter is the base technology used to create 3D effects used in modern television, video games, and movies.
- 

- 
- In 1970, women made up about 38% of the U.S. workforce, but only 8% of STEM workers.
 - STEM encompasses jobs that involve science, technology, engineering, or mathematics.
 - By 2019, women made up about half of the workforce, and made up about 27% of STEM workers.
 - The population of women in STEM is increasing and can continue to increase!
- 



- **Did the mathematicians we learned about today know how to do math when they first started school?**
- **Did these mathematicians have to work hard to accomplish their goals?**
- **Do you think these mathematicians ever faced math challenges during their careers?**





**Math is for
Everyone!**