

Math Problem Solving Seminar

Making Sense of Everyday Real Word Problems through Mental Math Strategies

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Introduction

Ya'at'eeh, I was born a Diné (Navajo) and reside on the Navajo Nation in Tsaile, Arizona. I am currently a third-grade teacher at Tsaile Public School. I have been in the education field for the past 30 years. For most of my teaching career, I have worked with Native American students on the reservation in Kayenta and Tsaile, Arizona. Kayenta is located in the northern part of Arizona. In addition to teaching, I have worked as a School Improvement Specialist in Sells, also located in Arizona, but in the southwestern part of Arizona on the Tohono O'odham reservation. Baboquivari School District was awesome experience for me. There I worked with teachers of middle school and high school students. In addition to my teaching career, I have been an academic coach and worked with teachers at all three places. Being an academic coach provided me with an overview of what an effective teacher is. It was challenging, but what I learned, I put it upon myself to enhance my own teaching methods in the classroom. Before I took on the position as a teacher again at Tsaile, I was first hired as a School Improvement Coordinator with the school and held that position for 3 years. Because of the love I have for working with children, I requested to be back in the classroom as a teacher. Also, in working with other schools, I learned many great effective strategies while working with the Arizona Department of Education and Baboquivari School District in Sells. They have provided many wonderful professional development opportunities with well-known educators and consultants across the country, such as Robert Marzano, with whom I have worked with one on one. This encouraged me to step back into the classroom and apply what I believe will work with students at Tsaile Public School. Since then, I continue to search and research for strategies and content knowledge.

I have a passion for teaching and have the urgency to find the most effective way to teach students. It is one of my strengths and desires to become an effective teacher in the classroom. Joining the Diné institute has provided me the ability to research and to be able to strengthen my teaching while working with university professors to reach the same goal, which is to increase student achievement in a collaborative effort. For this reason, here I am writing a curriculum unit to maximize the ability to solve word problems and to completely understand the process of algorithms. I have been fortunate to become a fellow with the local Diné Institute with Northern Arizona University and at the national level, the Yale National fellow with Yale University. I believe working together in a collaborative effort to strengthen the minds of the students is the key to a successful future for the children. Our district, the Chinle Unified School District has a motto and guiding principles and values for the students to become, "Competitive, Unique, Successful and Driven" which sums up my intention for students to be able to be independent and successful.

Context

School Demographics

Tsaile Public School is operated under Chinle Unified School District (CUSD). CUSD has a total of 7 other K-8 schools within the perimeter of Chinle, Arizona. The school district has an enrollment of 3,300 students which makes it the largest school district in the Navajo Nation. The

district encompasses the communities of Chinle, Many Farms, Tsaile, Luckachukai, Wheatfields, Nazline, Cottonwood, and Tselani. Tsaile is also located on the Navajo Reservation in the upper four corners of Arizona. It is 29 miles east of Chinle. It is based against the Chuska mountain off of Route 12 and Highway 64. It is located in Apache County. Tsaile Public School is nestled in the ponderosa trees of the Chuska mountain. It is located in a beautiful quiet area with a population of at least 1,400 people (U.S Census 2020). Tsaile has a convenience store for gas refill and some grocery items from food to automotive needs. There are two churches within range of the store, a Mormon church and Christian Church that serve those who live in Tsaile. There is a small clinic branched off Chinle Hospital. It provides an Ambulance service, but not set up for patients. The Clinic is only in operation on weekdays.

Nearby is a community college operated by Navajo Nation. Diné College is the first Native American Tribal controlled college that was established 1968. It is an accredited college that many of our students' parents attend or have attended in the past. Its enrollment is currently at a low due to the pandemic. The walk from Tsaile Public School to Diné College is about a 15-minute walk. Near the college campus, there is Tsaile Lake. It is a five-minute walking distance. In addition to the lake, there is also Wheatfields lake. Wheatfields lake is at least 12 miles east of Tsaile. The lakes offer camping, fishing or small boat excursions for the community. The lakes are pretty popular spots not just for the local people, but people outside Tsaile who come out to enjoy family activities on the lake. Most of the students that attend Tsaile Public School relate to fishing as one of their weekend activities or family outings.

Tsaile Public School is a K-8 school with an average enrollment of at least five hundred students. Unfortunately, due to the pandemic, the number of students participating in in-person school has declined. For the past school year, 2021-2022, our enrollment for online classes was about 200 students at Tsaile Public school. The Navajo Nation has implemented a restriction for the reservation to keep the numbers of COVID patients down and to prevent the spread. For this reason, our school district promoted the option for families to allow students to attend school online under "Hozho Academy" for this past school year or to attend in-person school. The bad outcome of this is some students switched from the Hozho Academy to in-person schooling several times and then back to online. They went back and forth and I think it was to the needs of the parents. These students who started online and then transitioned to in-person schooling showed a significant decline in attendance and their academics, especially in mathematics and reading. In addition, the school has lost a lot of money because of the attendance. Because of how students transfer within the school year, this unit is developed to help students across the school, whether in person or online, to promote students to become problem solvers.

Environment and Cultural Perspective

I was raised on the Navajo Nation which allows me to make the connection to the lifestyle of the people, the problems, the barriers, and the rich culture of the Navajo people. In addition, I am aware of the resources, such as jobs available to people on the reservation. The Navajo Nation is a vast area with limited access to what is considered civilized by western society. It is pretty much a rocky dry place and the only green area would be near the Chuska Mountain. I am just

located near that area but had the privilege to live in the desert and monuments of the reservation. To many, this is a beautiful place to live within the boundaries of the four sacred mountains. Mt. Hesperus to the north, Mount Blanca to the east, Mount Taylor to the south, and San Francisco Peak to the west. One traditionalist man, Paul Long, tells of the 12 mountains that are sacred as well, but the four signifies the four directions with a representation of the stones in colors (Long, 2022). The four directions and the four colors are a special number that makes the connection with the way of Life. The people in Tsaile practice these four sacred rules or beliefs. Tsaile Public School also signifies the number four with representation to the traditional aspect of the culture. Navajo language and culture is taught based on the Navajo Nation Standards. There is only one Navajo language teacher or culture teacher assigned to each school across the district. The language teacher or cultural teacher reinforces the value of the way of life of the Navajo people. For some of the students, they understand the value, belief and the way of life. For some, it is their first and first exposure to the Navajo language and culture. Furthermore, religion and the Navajo way of life is not practiced by all students. For some, their religion is Christianity or Native American Church.

At least 50 percent of the students attending Tsaile Public School can speak and understand the Navajo language. As for the rest, English is the predominant language. The percentage of Navajo language speakers has decreased by 25 percent since 2009. This entails the changes occurring at Tsaile in regards to values and beliefs. As for education, although students work with numbers and parents see and use numbers in their daily activities, many Native American students struggle with mathematics. It should make sense that the importance of working with numbers should be valued and practiced daily, but unfortunately parents and students do not make it of importance. Could it be the environment or the modern lifestyle and limited jobs on the reservation and make it appealing as it would in a city? Most of the activities relating to math concepts are not seen as a need by the students and parents. Students are not relating to math as “oh this is a math skill I am using!”, but rather busy work that requires a lot of thinking. For example, “I am playing a video game”, or “bring in some woods”. It is all work, but without the concept of, “How am I applying math here?” or “I need to know math skills,” it becomes more of a routine and drill. Which is not the way to learn math. So, this affects the students’ ability to understand math. Although there is math, it is not taken as understanding, explaining, or reasoning. Therefore, parents are not encouraging their children to become great or masters at math skills. At the same time, some of the parents feel that they are not good at math.

Rationale

Mathematics builds mental discipline and encourages one to become a problem solver, to use deductive and inductive reasoning, to be creative thinkers and to communicate through reasoning. Verbal skills and comprehension skills are also a great part of math. Math skills are needed for jobs such as holding a job as an accountant, engineer, scientist, architect, business, medical field, computer or financial analyst. In addition, in the home environment when it comes to making or selling goods, taking care of livestock, planting, shopping, and creating artifacts or jewelry, math plays a large role. Learning mathematics takes more than the students doing the math, but the most important key to effective learning is the instruction from the

teacher. The teacher improves instruction through enhancing, empowering, energizing, and engaging to increase student achievement (Linwand, 2009). When teaching math problems, it takes more than just a quick answer; engaging students in discussion, rationalizing, reasoning, and justifying will have a lasting effect and further make the connection with other math skills other than word problems.

On the other hand, Native Americans used mathematics long before European colonization. Many were able to use their math skills in designs of homes (architect), artwork, astrology, and so forth. In today's society, math has become complex for many because its instruction was not thought out. The connection to the real-world situation may have not been clearly defined for the students, so it is misinterpreted as a drill. This is one piece of evidence that shows when students take the state assessment. It is more of guessing on the test, and not seeing the steps, and sequences of a problem to solve. Math is taught out of textbooks rather than making a connection to a real-world situation. Math is definitely in our culture and is seen in the artwork of many artifacts, such as patterning, rug weaving, jewelry making or silversmith, and even used in tending to animals. Math encourages students to be mentally disciplined. It also encourages logical reasoning, to be creative thinkers, to be abstract or spatial thinkers, and the ability to problem-solve through the communication of math skills (concrete to abstract).

Students at Tsaile Public School do not perform as well as they should on state assessment. Furthermore, this is seen across the school district and on to the Navajo Nation. The math performance on the state and school assessment shows the need for a change in the lessons and structure of the math implementation. Students in my community and across the Navajo Nation use math on a daily basis. Math is an integral part of our lives on a daily basis, but there seems to be a disconnect between the math that is taught and assessed in schools and the math that students encounter in their lived experiences. This unit, with its focus on problem-solving, real-world applications, and cultural connections, attempts to bridge the gap between the mathematics students encounter and use in the classroom with the math and problem solving they use on a daily basis.

Content Objective

Problem Solving

Problem solving is an everyday activity that everyone does without knowing or knowingly. As for mathematics, it is one of the most important roles and skills for students to learn. Problem solving for 3rd grade is a big step, and students need to use strategies in solving math problems. In addition, they will need to justify and prove their answers. According to a research team in the article, *Why is Teaching with Problem Solving Important to Student Learning?*, the strategies do not have to be taught separately (NCTM, 2010). Students should learn to use strategies as they are ready to solve word problems. Having students analyzing the situation and connecting to real world situations is best. In addition, having students put themselves in the situation or story as if it occurred to them, would make it more meaningful. Also, to have students explain the situation and justify what the problem is. When most students at TPS are reading word problems, they

tend to just look for numbers without understanding the situation; therefore they just add any numbers even if it is irrelevant. Stories often involve sequencing, especially in word problems. Understanding the story, internalizing the cause and effects in the story from the beginning. What can teachers do to help students do better? One way is to have them explain the story in a word problem. Students can be grouped together, or partnered up and have a discussion on what the content of the story is. This allows for students to better understand and explain as well justify what they know, learned or understand and relate to the keywords. Furthermore, there should be more time spent on explaining, having the student get used to explaining as a habit will benefit as they learn to problem solve. An example of a word problem, see example 1.

Example 1. This could be a possible discussion between partners. Use of pictures, drawing or a small play or drama can also be a way to reinforce understanding in helping students picture it.

Teacher problem given: Tim bought 5 balloons. He gave 2 balloons to his little sister. How many balloons does Tim have now?

A conversation between student to student could go like this:

Students or students explaining and having a conversation might go something like this: “the story starts out with Tim buying balloons. He bought 5 balloons, but then he gave some away. He gives 2 to his sister. That would change the number of balloons that Tim has. The questions say how many balloons Tim has left after he gave two away. I also know or I learned that left or taking away means minus (subtraction). So, when something or objects is given away, that would mean he would have less than five. It would not make sense if I add it, because he gave it away! So I could draw five balloons, cross out two, and get my answer!”

In addition, students can ask each other questions such as, “How do you know?, What word or sentences tell you to _____ (subtract/add). This is a strategy that allows them to use questioning skills. Another important skill.

Students having to explain and talk through the problems will definitely take time. Allowing students to work together also causes less anxiety especially for those that are struggling and have trouble understanding. They can be role models for each other. Peer to peer teaching is more effective because they can be at the same level without intimidation.

Number Sense

Number Sense is understanding numbers and operation, and having the flexibility to manipulate numbers in meaningful ways, here in problem-solving. Since the beginning of time, numbers have been difficult to work with. Numbers were needed for everyday life such as counting animals, money, building, creating artwork, interaction with objects involving counting. For many years, the number system has been going through changes to make numbers work without too much misconception. Place value was discovered by the Mayans, the Babylonians and the Hindu people. In addition, the number zero was also in place to make the numbers roll over to

the next place and increase the value. This concept made it easier to keep track of objects for people as they begin to work with symbols. Understanding numbers, the symbols and their representation, along with algorithms is a big learning concept as well. In the years that I have taught, I get students from second grade well below their grade level in problem-solving in mathematics. This year, the pandemic was not a help. It seems that the students went one to two years below their grade level. The previous third grade students that I worked with could not understand two-digit addition and subtraction, especially when numbers were written in two to three digits. Although they moved on to fourth grade, they are still lacking the skills needed to provide that foundation in problem solving.

What do students need to know as they understand number sense? Again, in problem solving, students should understand the math problems through drawing models, make a connection with the story problem, explain and justify their answers. Therefore, a lot of academic vocabulary should be introduced to students and should be consistent. Words such as place value, ones, tens, hundreds, add, subtract, regroup, borrowing from the tens, hundreds, need to sound fluently. The goal is to get the students to visualize and talk about numbers and make the connections as they would be using it in a real-world situation. Having the students put themselves in the story as if it was their real problem will help them to understand. Another is Some relations to numbers is given as an example.

Example 2. Teacher can discuss numbers with students, but must ensure that she or he models and teaches the concept of numbers. Students could also have discussions with each other. The conversation may begin as such, *“I know numbers with zeros are , 10, 20, 30...”*, *“ 36 is close to 40”*, *“136 has 1 hundreds, 3 tens and 6 ones”*, *“Sometimes whole numbers like 1,2, 3 can be divided, which is called a fraction”*, *“I can round my numbers to the tens or 100 if I am estimating and that is okay!”*

Learning numbers involves talking, discussing, and making connections, which I think is the important part of mathematics. At any age, even adults like to use representation to clarify or connect with objects or numbers. Some representation could involve use of counters, objects, ten frames, graphic organizer, chips, or any objects.

Solving Word Problems

In this unit, in order to improve my students' ability to solve math problems using a variety of problem-solving strategies, the main focus is to understand word problems to a greater extent by walking through the story. The reason being is that state assessments for third grade students are composed of a variety of word problems for multiple standards. The standards for solving word problems in the areas of addition, subtraction, fraction, multiplication, division, measurement for weight, money and time, as well as geometry. Currently, the majority of schools or teachers decide or create an anchor chart for solving word problems and for most causes misconception about solving word problems. The focus of the anchor charts varies for students. Some teachers will teach it to focus on the steps only. Others may have way too many steps for one problem. An anchor for problem solving should be developed for its purpose, which is to solve problems

that one may encounter. So a major struggle or barrier is not reading the word problem or the story problems. In addition, story problems involve sequence. If and when students learn that math will also have multiple steps, they will then learn to think of all the steps involved in solving math problems (R. Howe, 2022). For the students at Tsale, I feel that the big part is missing, which is comprehension. The comprehension of the story is avoided, and students do not make a connection to real world situations. Then it becomes meaningless for the students. Solving word problems is essential and students should make a connection to every problem because it is a part of their daily lives.

As I observed students that I have worked with many times, I find that they do not comprehend the sequences of events in a story of a word problem. Their strategy is basically to look for keywords that may or may not have meaning in the problem. This strategy leads to a very procedural way of thinking rather than making the connection and understanding the problem (Karp, Bush, & Daugherty, 2019). For many years, Tsale Public School has used the acronym “FALCONS”, which is our school’s mascot to encourage the students in solving word problems. The strategy is set up for students to follow in this way:

F = Find the question- Underline the question sentence. What is being asked to solve? Put an arrow under the thing or object that is counted in the question.

A = Analyze for keywords. Circle key words in the question that will help the what is being counted and the operation that will signal what to do to solve the problem.

L = Look for relevant information. Underline important words from the question to ensure you are solving what the question is asking for. Any irrelevant information should be crossed out to avoid confusion.

C = Construct a picture. Draw a picture of what is being counted and work out the problem whether to cross out objects for subtraction, or adding objects to show addition.

O = Operation/Equation. Write out the equation for the story or problem.

N = Answer the question by writing the answer.

S = Solve and Justify- This last step allows students to solve by justifying why they added, subtracted, multiplied or divided by using the keywords. i.e. “I added 4 apples and 2 apples because it says more, so more means to add.”

The “FALCONS” is a strategy, or algorithm, that provides a step-by-step procedure for solving word problems. From K-8, the teachers were or are encouraged to use and teach the FALCONS strategy. I say “were or are” because most teachers are now using other steps, and some still stick to this strategy. At one time, this was a “must” for all teachers to follow because the data showed significant low numbers for this standard, which is solving word problems. As a result of this strategy, there were some positive and negative outcomes of using the “FALCONS” strategy. The students were able to recite the steps from the acronyms. The problem was applying the

strategy. Only a small handful of kids were able to grasp the process. The rest followed well with guided instruction, but when they practiced independently, it was very difficult.

Another problem that I have noticed is for students to read the story problem. I believe it is a “won’t do” attitude to avoid thinking about the problem. Some of the words are difficult for the students to read. Furthermore, they don’t understand the keywords. The meaning of the words is not internalized to match what is happening in the story. Which makes it more meaningless. This unit focuses on how a student can make sense of math problems in the real world, through making a connection, mapping or strategizing, and connecting with real-world problems.

Most 3rd grade students at Tsaille Public have a misconception of how to solve word problems or were misinformed. This is true not only at the third-grade level but below and above the 3rd-grade level. According to the Tsaille Public School data for assessment, it shows that the majority of K-8 students on the Arizona state assessment do not do well on word problems. Especially if the word problems involve multi-steps. What is the problem? In doing a further investigation of the problem, I observed the students while they completed a problem. A few drew out the problem, while others looked at the story problem and underline numbers (or some just answered. I asked the students; how did they solve the problem? I got a response such as, “I see 2 numbers and I added them.” Another question I asked is “Did you understand what happened in the story?”. Student response, “aah, yeah!”. “Ok, well can you tell me about it,” would be my next response. Their response is, “I forgot”. These conversations with the students informs me that students are misinformed about solving word problems to begin with. They do not read the story itself, nor make the connection, but literally, just go through steps on a poster that was taught to the students. Most students skim the story or do not bother to read the content. They look at numbers and underline any visible number they see. They assume that you simply just add or subtract numbers. Another problem is students are able to identify the keywords, but do not understand the exact meaning of the keywords such as: in equal groups, left, combined, etc. They do look for keywords and highlight or underline keywords, but it is a misconception on how to solve real world situation problems. This further causes confusion about the operation and the disconnection with the story. Hence, students are most likely guessing the problem and solving how they were taught or used to by previous teachers. So is solving using “FALCONS” a good strategy? In my opinion, yes some steps are good but we don’t spend the rest of our life underline and looking for keywords, in addition it will be all about completing steps, not the content of the information.

Math Word Problem Strategies

Knowing the Keywords is the Answer?

According to the article, *Avoiding the Ineffective Keyword Strategies*, this approach should be avoided. The students should be making sense of the story or word problem. Having students use the approach of finding essential keywords to make sense of it would have students misinformed about the whole story (K. Karp, S. Bush, B. Daugherty, 2019). The strategy is to solve word problems and understand the story, but not to look or seek for keywords. I admit, I

did that myself at one time just so the student would move on to the next part of solving a word problem which now I believe is a far cry from becoming successful in understanding algorithms. If we want students to be long learners and connect with making a difference in this world, then they have to understand the problem. The problem of the story has to be understood first before the next step of how to solve it, what to use to solve it, and how else can it be solved.

Furthermore, Karp, Bush and Daugherty, states that when students are just using keywords, they are not practicing how to read mathematical situations and are not connecting the situations to their prior knowledge. Therefore, they believe that math problems don't require them to think, but just to grab numbers and compute the number and easily solve them. This strategy makes

Making Connection to Real Word

In the article, *Avoiding the Ineffective Keyword Strategies*, there are many strategies to help students become aware of sense making and operations in problem solving (Karp, Bush, & Daugherty, 2019). Supporting students to make sense of a word problem is important. The primary goal is understanding the situation before moving into solving the problem.

Unfortunately, reading word problems can be a challenge for many students who cannot read fluently or with comprehension, especially when they have to make the connection. For the current grade level this year, I have students who are reading two years below grade level. I have half of my students reading at first grade level. Due to the pandemic, they are the ones who started sheltering from the COVID pandemic since they were in first grade. It makes it seem like they are barely coming out of hiding and getting back in the real world. The only difference is that they are two years older and in the third-grade classroom. Time is of the essence to get the students to grade level ability, if not close. In addition, there are at least 7 of the students who are classified as English language learners. The importance of reading is a priority and, in addition, making connections with what they are reading rather than just procedural drills with numbers. Furthermore, all teachers need to work together and have a plan to get the students on board to grade level learning.

Cultural Relevance

In order for students to learn effectively, students learn better if they are taught through their environment or a topic, they are familiar with. Just as in any culture, Navajo Nation is surrounded with many cultural relevance that can be tied into their unit or curriculum. Navajo teaching has long been about observation and hands-on. There is or was never instruction written or steps written for people or children to learn in the Navajo society. Grandparents and parents tell their children to watch, listen and learn the steps by doing. The art work and the cultural lifestyle of the Navajo people have numeration and quantification that are naturally in place or expected for the people to learn (Trumbull, Nelson-Barber, & Mitchell, 2002). Some of the art work includes weaving rugs, farming with corn or squash, making silver jewelry, trade and buying goods, caring for livestock, and basically everyday living, such as hunting and fishing. These involve some sort of computations. Navajo children are expected to learn the context and then serve as a model or facilitators to other younger siblings or children. Furthermore, when teaching students to learn using their cultural background, teachers must also remember to make

the connection to the students' background. In the unit activities below, you may have to modify to incorporate your student's cultural environment so students can understand and make personal connections.

In addition to using students' cultural background, it is also important to have students get hands-on instructions as they are working through math problems. This is an effective way for all students who need the support to comprehend the context and skills. During my research of this unit, I had to think of a way that I can get my students to start making sense of math, especially word problems. For every standard that is taught, word problems go along with each standard or skill. In the appendix A, you will find the anchor chart that I have developed so the focus of problem solving is to understand the importance of real-world problem solving (see Appendix A). This chart will be used to teach the students to problem solve for word problems. The chart is not too lengthy, but structures the understanding of making the connection and understanding how to solve a problem in a given situation. Furthermore, to get the students to be in control of their own learning in problem solving. To have students learn that problem solving is a part of everyday life and should be understood that there are multiple ways and steps in solving word problems.

Teaching Strategies

Visualization- Hands-on strategy/Use of Manipulative

Some visualization to use with your students could be visual aid such as audio, photos, video clips, plays, graphic organizers, and maps. Most importantly, modeling for visual learners. Students who are struggling with a concept tend to learn better when they work with manipulatives and by creating images in their heads. They learn best by hand as well, especially lessons that involve concrete instructions. They visually have to see objects or steps in order to make it clear and understand any process involved. Through hands-on explorations, students engage with both the left and the right sides of the brain. The learning is stored and will often be remembered and relate to the problem solving. Manipulative uses such as using counters, or drawing helps the students understand exactly what is happening in the problem. They get to see and follow well like they are the ones experiencing it. It also discourages students from misbehaving or causing disruption in the classroom. Native American students learned better when placed in a hands-on student structured environment. A study was conducted by John E. Penick, of Florida State University, his finding is that Native American students learn more effectively when students use manipulatives to learn the concept of mathematics. The students spent more time on learning than the teacher telling the students the steps (Bradely, 2002). Exposing students to think and process using manipulative or acting it out helps students to place him or herself in the situation. This leads to students learning to independently make the connection and think of problem solving. Students will use manipulatives or drawing as they solve word problems. In addition, some of the math activities will require students to try the bar method as a graphic organizer to solve math problems.

Cooperative Learning

Cooperative learning strategy has always been a favorite of mine. This strategy gives the students an opportunity to collaborate and use what they know, learn and share their own knowledge with others. It also gives teacher feedback on exactly what the students understood in the lesson. The teacher will observe and listen to the students as they share. Cooperative learning is when students are grouped together, either in a small group, or pairs, or teams. Cooperative learning allows students to take risks without the pressure and support one another. Students usually work in teams or partners. For this activity, students will work in pairs and in a small group when they have to create a word problem.

Vocabulary Instruction/Enriched Language

As students are taught the academic standards, they are also immersed in the academic language to use. This is to support each student's verbal and written communication so he or she can use it to comprehend the increasingly complex texts. For third grade, students are developing language that they will hear throughout the next couple of years. So this is crucial for students to learn the words, as well as understand the meaning. There are at least 5 ways that vocabulary can be introduced or increased to the students. They are through the systematic approach, reading for meaning, teaching the vocabulary in context, word association, teaching specifically to the content. These approaches are to develop vocabulary so the students can use it and can comprehend the words associated with mathematics. Especially for keywords, because some of the words that are included in keywords do not specifically carry out a meaning, such as the word product. It basically does not tell a learner to do something, but to give a product.

Technology

Students are so used to using technology more than ever, especially since the pandemic happened. Students are more likely to be more motivated when technology or media is used when lessons are implemented. There are many videos from YouTube, Math Manipulatives and other resources teachers can use to encourage students to learn as teachers show and model while students are involved as well. Technology encourages students to be better prepared as well as they take the state assessment. Most assessments in schools are administered through the use of technology.

Total Physical Response (TPR)

Total Physical Response (TPR) is used to encourage students to engage in vocabulary development as well as make the connection as students are doing and using the language. Since some of the students are English Language Learners, using TPR will be best for them. Not only will the ELL students get the most benefit from this, but the regular students will also get benefits of learning the English language effectively. In most word problems, students need to act out or use a manipulative way to understand the story. Students using TPR to get the first-person point of view. The students are able to put themselves in the word problem stories, and make that connection. As students use the TPR, they also develop and reinforce language development. As students are solving, the teacher helps the students explore the situation so they

can own it and see real world situations. TPR will be used in some of the word problems that are presented or created. Allowing students to speak

Classroom Activities

This unit is intended to be covered in 15 days from the introduction to the implementation of this unit. The strategies and lessons taught will continue throughout the year in math problem solving. The strategies taught will be carried as a tool in solving word problems. The activities for problem solving will involve strategies listed and other strategies can be taken into account. The purpose to keep in mind is that students will need to learn to problem solve in real life, so they have to ensure that they will connect to real world situations by adding, subtracting, multiplying and dividing. Furthermore, another important part is to have the student read carefully and understand the context. The most important concept for week 1 is to have students prepare to follow steps, listen and understand a problem or situation, and knowledge of keywords and the steps or sequence in any story. The thinking behind is the concept or the content of the information. Students should be involved in solving the steps, rather than focusing on numbers.

Week 1 Day 1 Understanding Problem Solving through stories

Students will review addition and subtraction strategies. Teacher will review with the students on what happens and what it means when one adds and subtracts. Teachers will use question strategies for students to think along stories. An example question might be, “Where have you been or in a situation where you had to add or subtraction?” or “What was happening around you? As you added or subtracted, what happens to the numbers?” This activity will also involve think-pair-share for students to express or explain their answer. Students can be grouped in small groups of 3 or 4 students if you prefer. For this activity, students will write out the problem they have been involved in or seen to explain what happens and how it happened. As students share, they will be allowed to use words or equations to connect to the story.

Day 2

Students would /should have been introduced to multiplication and division at the beginning of school. Just as on the first day, the teacher will guide students to think about situations or problems that involve multiplication and division in a real-world situation. Guiding questions will be used for students to think of problems involving using sets of numbers. The interaction of students will have them thinking and connecting to real world situations.

Day 3

Teacher will read or view a video of the book, *Frybread* by Kevin Noble Maillard. This activity is to have the students listen to stories and think about the many problems and solutions that involve problem solving. For this activity, students will listen to the story. After the story is read, the teacher will use the questioning strategy, and pose a question. This activity is based on Steve

Leiwand's Book, *Accessible Math 10 Instructional Shifts that Raise Student Achievement* (2009). "We have just heard the story, *Frybread*. It is a popular kind of food for many different cultures. What would you like to know or learn about Frybread?" If a student reverts from asking questions, a teacher can begin by posing these questions, "Why is bread so popular? And what do we know about frybread?" Students should be asking many questions as the teacher writes questions from the story. This activity is intended to help students hear a real-world story and then create their own questions based on the story. Creating their own contextual questions will help students think about questions in other problem-solving contexts.

Student: What kind of ingredients are in the frybread? How much salt? How much baking powder? How much flower? How much water? What makes it fluff? How much grease do I need to fry it? How many frybread from one small dough? How much flour do we need to feed 100 people? How many tribes? How many minutes do you need it? How big are the frybread. How can I share a frybread? What can I eat the frybread? How many lettuces? How many tomatoes? How long do I fry it?

These are examples of some of the questions posed by the students. As each student asks a question, write it down on a chart. Then at the end, ask the students how I will be able to solve some of the questions. Have students do the thinking. Some of the questions posed can be a part of a word problem that can fit into your weekly math practice. It is important that students take ownership of their own learning.

Day 4 or Day 5

The list that was developed for day 3 can be used to solve a math problem, for this activity, the question could be involving measurement or adding the number of ingredients. Furthermore, the size of the dough determines how much frybread can be made for a number of students? If so, how can that be solved?

Day 4 Activity: Teacher and students will make a small dough to help students understand the steps to follow in solving a problem. This activity will engage students to be involved in hands-on activity so they understand steps and the importance of keywords and numbers, and in this case ingredients. In addition, find the outcome of a situation or problem. Does it make sense? Did we solve a problem? After completion of the dough making students are able to make fry bread with the assistance of an adult. They will enjoy this activity as they think about the math terms and steps involved.

Week 2 Steps in Solving Word Problems

Day 1- Day 5

Students will be reading a story or passages involving many algorithms from one passage. The idea is to have students think about many problems involving math from one situation. Students need to connect to real world situations and connect it to math in order to solve problems. Teacher will have students focus on the reading. Each time the students are reading, they will change the pronouns to first person. They will put themselves in the story so they are able to connect. Stories will be short so students can follow along. In addition, students will focus on vocabulary development. Students will be introduced to the anchor chart of solving word problems that I have established together, “Ready Set Solved” (See Appendix A).

Students will also be introduced and use the bar strategy to solve word problems. This will give the students an option to learn different ways of thinking and different ways of solving. As students are learning to solve math problems, it is important to have the students involved in the problems so they get to take ownership and be able to solve their own math problems as they connect to the real world.

Week 3

Day 1-Day 2

Students will work with story problems given. See Appendix B. This worksheet is developed to increase participation by providing story problems that are relevant to the students at Tsaille Public School. The story can be modified to the students’ background knowledge or familiar environment. The story consists of many math problems from one story. Teachers can create other stories familiar to Appendix B.

Day 3-Day 5

For the next couple of days, the students should be familiar with understanding real world situations involving computations and situations. For the next couple of days, students will be creating a story problem as a pair or group. Students will begin creating a story and they will add numbers to their problem. Students should be working on reading to comprehend, at the same time work on vocabulary in order to use those skills in word problem solving. The focus is to make sure the students are understanding the story and be able to read it independently. If students are not reading well, the teacher will need to practice reading to comprehend and then focus on math terminology used in problem solving.

Student Assessment Planning

Students begin every year with some sort of pre-assessment on problem solving and, in addition, teachers do a thorough and close observation of students’ steps in performing algorithms for word problem solving. Towards the end of the year, a post-assessment is administered again to show student achievement and growth for the year. For our district, we have a summative

assessment, through Performance Matters, that is administered at the beginning, middle, and end of the year, the District Formative Assessments (DFA's), and Quarterly Benchmarks. Each of the standards focusing on problem solving is where the students should use the process of solving word problems taught in this unit.

In addition, the students in Tsai'e will also be utilizing weekly to bi-weekly mini assessments to monitor growth and provide motivation by incorporating technology. The students will be doing a quick diagnostic assessment through IXL Learning and Achieve Math after each lesson. Students are showing their work through the steps of the *Ready Set Solve* anchor chart.

Besides the standardized assessment approaches mentioned above, this unit will also utilize formative assessment at the classroom level to see how students do with modeling word problems in different ways, how well they can explain their thinking to classmates, and how well a more open-ended approach to solving word problems impacts their learning. When telling stories as a way to connect word problems with everyday life, the teacher will listen to students explaining the problem situation to classmates and track (using a checklist) which students are able to explain the problem situation. Similarly, as students start to model the problem situation using manipulatives, sketches, or numbers, the teacher will observe student work and keep track of which students are on the right track and which might need help. The teacher will also be listening to student dialog to see how their models are explained to one another. If there are particularly good models the teacher will ask some students to share their ideas with the rest of the class and then have a whole class discussion on how this model or that model might be used to solve a similar problem.

Samples of student work will also be used as formative assessments throughout the unit. As students complete worksheets the teacher will look over student work to see how well students are understanding different models (e.g. bar strategy). Information from these worksheets will allow the teacher to know what elements of certain strategies need to be retaught and to which students.

Finally, a big part of this unit is student problem posing. When first posing problems after hearing a story, the teacher will informally listen to the types of questions students ask to see if they're on track with how to pull questions from real-life stories. As our work moves into more stories and more problem posing, students may be asked to write some of their questions down to share with partners or with groups. The teacher can collect questions made by individuals, by pairs, or by groups to further assess how well students are doing at problem posing.

One final task as part of this unit will be for students to listen to a story, pose a question based on the story, and then use one of our problem-solving models or techniques to solve the problem they posed. This is a great culminating assessment that provides students an opportunity to create and solve their own problems based on a meaningful Navajo story. This final assessment can be

done in pairs or small groups. If there is time, each pair/group will share their problem and their solution with the rest of the class.

Alignment with Standards

Math Standards

3.OA.D Solve problems involving the four operations, and identify and explain patterns in arithmetic. Third grade students will solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Utilize understanding of the Order of Operations when there are no parentheses. All of the activities in this unit will involve students to identify, solve and explain word problems in addition to understanding real world situations. Below is the Mathematical Practices that the students will use or will follow steps in solving word problems. The steps are connected to the steps in the anchor chart.

Standards for Mathematical Practices (MP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

3.MD.A Solve problems involving measurement.

For this unit, students will be involved in many math word problems from all scenarios. Students will be reading stories and applying solving words strategies.

3.MD.A.1b Solve word problems involving money through \$20.00, using symbols \$, ".", C.

3.MD.A.2 Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units. Excludes multiplicative comparison problems (problems involving notions of “times as much”).

3.OA.A Represent and solve problems involving whole number multiplication and division.

3.OA.A.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities. For this unit, the students also have the option to use the bar or the yellow tape strategies aside from the one used for the standard. This is to give the students the idea that math can be solved in other ways other than what is listed.

Diné Standards

Standard: I will understand the Diné way of Life. Concept 2 I will apply and practice the Diné way of life Through Planning. Students will be writing stories and sharing how the daily life in their own environment involves numerations and problem solving

Resources

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- Karp, K. S., Bush, S. B., & Dougherty, B. J. (2019). Avoiding the ineffective keyword strategy. *Teaching Children Mathematics*, 25(7), 428-435.
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- NCTM (2000). Problem Solving Standard. From *NCTM Standards and Processes for School Mathematics*. Reston, VA: Author.


APPENDIX A

READY, SET, and SOLVE for Word Problem

1. I will **Read(Focus)**, **Read(Fluency)**, **Read (understand and make a connection)** the story!

How? I will use context clues to figure out unknown words that I do not know. Put story problems in first person perspective by replacing nouns with pronouns I, me, myself to make a greater connection. What am I going to do? What if it was me?

2. I will talk/walk through the story in sequence (order).- pair share /TALK! **First, Next, Then, and Last**. Ask self-question to Understand, who? what? How many? What's happening?

3. I will read the question sentence carefully to know what I am problem solving for?  I will use **RwCURAJ** (Analyze). Ex. How many apples are left?

4. I will identify the meaning or the action of words(keywords) in the story to tell me whether I should $+$, $-$, \times , \div . (circle /highlight action/ keywords)

5. I will show and prove my work to solve the word problem (plan, draw and solve using a strategy). Know that there are multi-steps. Ask question- "Does it make sense?" Use strategy such as bar, representations, etc.

6. I will clearly write out my answer and explain. (What did you solve like a detective? How many _ _ _) *Ex. There are 14 apples.*

APPENDIX B

Dezbah's Camping Adventure

Last Saturday, Dezbah invited five friends for a weekend campout at Wheatfield lake. She couldn't wait for Saturday as she paced and fretted. When the campers, finally arrived, Dezbah's mother drove to Bashas' Grocery store in Chinle early in the morning to pick up some food for camping.

"We need to buy food for the campout," her mother said. Dezbah agreed and went in with her mother. As she shopped with her mother, she got more excited!

At Bashas, they bought:

- 16 ounce package of ten hot dogs @\$1.49
- 11 ounce package of hotdog buns @\$1.98
- 14.4 ounce package of graham crackers @\$1.25
- 10 ounce package of marshmallows @\$1.89
- 39 ounce of box of chocolate bars @\$3.09
- 16 ounce bag of potato chips @ \$3.29

Dezbah's mother paid for the grocery and they went home to get ready.

That afternoon, Dezbah, her friends and parents went to Wheatfield and set up their tents. Dezbah and her friends were having so much fun playing in the water and did some fishing. That evening, Dezbah and her friends got ready for their cookout. They took the food out of the cooler bag and opened the packages. Each paper plate had a hot dog bun waiting to be filled. Six roasting sticks sprouted hot dogs cooking over the low flames and fire pit. Dezbah and her friend were hungry.

After the girls ate their first hotdogs, Dezbah noticed that there were only four hotdogs left. There was not enough left for everyone to have a second hotdog. She asked how many girls wanted a second hotdog to eat. Three of her friends said they wanted another one. Dezbah was relieved that there was enough for those that wanted another hotdog.

When Dezbah look at the buns, she found only two buns were left. She told the girls that there was only two hotdog buns left. One girl said she can have hers without the bun and said that it always happens too at her home. When it came time for smores, each girl had two.

Everyone was happy and satisfied with the food. They told stories, tried to sing a song, told each other jokes, and Dezbah's parents told of the time when she was little and went camping just like this.

Use the information from the story to answer the questions.

Show your work in the space to the right.

<p>If there were four hot dogs left after each girl had eaten one, how many hot dogs total had been in the package?</p> <p>Answer: _____</p>	
<p>How many buns had been in a full bag?</p> <p>Answer: _____</p>	
<p>How much did the food cost with an added \$.67 sales tax?</p> <p>Answer: _____</p>	
<p>How much change did Dezbah's mother receive from \$20.00?</p> <p>Answer: _____</p>	
<p>How much did the ingredients for the s'mores weight?</p> <p>Answer: _____</p>	
<p>If each girl used one marshmallow per s'more, how many marshmallows were used in all?</p> <p>Answer: _____</p>	