Unpacking Place Value

Place Value and the Navajo Stick Game

Jolene Smith

Diné Institute for Navajo Nation Educators (DINÉ)

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Author Note:

Jolene Smith is a fifth-grade teacher at Kayenta Middle School. Correspondence about this curriculum unit can be addressed to Jolene Smith, P.O. Box 4882, Kayenta, AZ, 85003. Email contact: dineteachersinstitute@nau.edu

Introduction

I have been teaching at the elementary level for the past thirty years. Throughout the years, the math curriculum within our school has changed as per resource, which usually had a scripted text program purchased from publishing companies. Currently, our district utilizes the Eureka Math K-12 series, implemented in our school for about four to five years. Yet our students are not doing well on the AZ Merit State Assessment in Mathematics.

When my district purchased a math program, administrators demanded teachers teach the program with fidelity when using the indicated models. The school district had spent vast amounts of dollars to purchase the program, and the administrators wanted to get their money's worth. The Eureka program required the teacher to teach a lesson a day, and it did not matter whether students were struggling with particular skills. The application states the skills students are learning are scaffold in each lesson and are building onto their knowledge. I find this is not so because this method is not accommodating all learners, especially the English Language Learners and the Special Education student population. Most students still struggle because they need the review and reteach, to see the process differently, or need visuals.

The district-purchased curriculums inhibited teacher's flexibility to explore and research the methodology of mathematics to help students learn the content and skills well. Educators in the classroom need a solid understanding of teaching the process of mathematics—for example, the place value chart. The chart has many avenues when teaching mathematics. When educators can explore in-depth what they know as student needs in terms of specific abilities when using the place value chart. Teachers can research a particular topic of mathematics then align the learned knowledge with the visual place value chart. The Eureka math program brought a lot of new ways of solving problems teachers were not familiar with and this led to some of the gaps in helping students understand the new math strategies.

When teachers read, study, and research, they have a strong background of knowledge when teaching the skill or topic. It becomes a personal knowledge and gives the teacher confidence when explaining the process to the students. Which is better? The teacher using a scripted text to teach or teacher researched content topics. I choose the latter because the common theme in education is to know your stuff and know what and how to interpret the content. Students will see the passion in your teaching and see the enjoyment when they are learning about place value concepts. In the end, teachers will be able to address individual student needs for English Language Learners, Special Education, and regular struggling students.

Context

The demographics of my community and school district is predominately Native American populations. The town and school are located in the northeastern part of the state of Arizona. The Kayenta community has about five to six thousand residents. Outlying rural communities like Oljato, Dennehotso, Baby Rocks, Chilchinbeto, Black Mesa, Shonto, and Inscription House come into Kayenta for shopping needs, fast food restaurants, the Black Mesa Theater (movie, before COVID), education and the sports program for their children.

The Kayenta Unified School District (KUSD) has four schools: the ABC preschool; the elementary school (KES), which has kindergarten through fourth grades; the middle school (KMS) grades fifth through eighth; and the Monument Valley High School (MVHS) grade ninth through twelfth. According to the Kayenta School Board minutes (May 2020), there is a total of 1,719 students who attend KUSD. Included with the student count are the feeder schools within a fifty-mile radius of Kayenta, who have students attending KUSD. The Bureau of Indian Education Schools like Kayenta, Chilchinbeto, Dennehotso, Shonto, and Black Mesa Community are a few of the surrounding schools. Included with the ABC preschool are the Navajo Nation Head Start and the FACE programs for the younger students. There are two Head Start classes and one FACE program within our community.

Our district has implemented the Inclusion Model and has been using the method for many years. The inclusion model means to commit to educating each child who enters the classroom regardless of the child's disability. Any support services for the child would come into the school to modify or accommodate the lessons taught for the day while addressing the child's Individual Education Plan (IEP) goals. In addition to Special Education students, the English Language Learner and 504 students are included in the classroom setting, too. These students need special accommodations and teachers need to have the training to provide different methods and strategies to assist with specific students who struggle with learning the concepts.
I believe our district has slowly moved into a Mainstream Model because, throughout the years, the superintendent had coordinators and principals move to different administrator positions. For example, the Special Education director move to an English language learner position. These changes had general education teachers responsible for accommodating, teaching, and completing paperwork for the students, whereas the support services has mountains of IEP's and EL paperwork. The Mainstream Model has teachers juggle with all the students who need the accommodations and differentiate instruction using various EL strategies.

Beside accommodations, my district has initiatives that will provide educational services to students for distance learning. These platforms available for online teaching will have teachers teach students. Currently my district has decided upon the Arizona Department of Education (ADE) scenarios for the coming fall semester is to implement distance online learning for all our students. This creates a hindrance in teaching my unit because our online teaching for fifth grade will follow the same pacing guide with the same lessons for all teachers to teach. Therefore, two out of the six teachers utilize the Yale and Diné units and these units will not align for the other teachers. Because they find it challenging and rigorous to teach. They are so used to scripted curriculums like the Wit & Wisdom and the Eureka math programs.

Rationale

My curriculum unit is designed to teach students to learn, understand and know how to use the place value system while playing the Navajo Stick Game. There are many concepts and skills when teaching the place value system and it is very adaptable for the Navajo Stick game. Our students need to know how to use the place value chart to their advantage when manipulating the chart. Place value encompasses the four operations (addition, subtraction, division, and multiplication), decimals, fractions, estimations, and rounding, and more. Teachers need to understand and to be able to teach the skills to students thoroughly and efficiently when using the

place value system. To explain it efficiently, teachers need to use the mechanical application, use different manipulatives, and stress the relationships between math skills because they are all interrelated and have connections to the place value system. When teachers make these connections when teaching then students have understanding and confidence in knowing how to use the place value.

However, there are unique factors educators need to be aware of, especially this year - the loss of teaching time in core academic skills. For example, when COVID19 hit the Diné Nation, it affected the schools and entirely shut down our communities on the Reservation. Our community identified as a hot zone because the Kayenta Indian Health Center identified the first Covid19 patient from the small town of Chilchinbeto. For the next three months of March, April, and May, our school was in total shut down, teachers were locked out of the school building and their classrooms with no access to resources. The district administrators announced that all teaching would be online using resources available on the internet. The online schooling was an altered contrast to teaching because not all students have access to the internet. For some who had internet, it was unreliable. Some just had their cell phones, and most students had no laptops. In addition, some students checked out and decided that school was done. They had a free range of choices to do school work or not because their parents had to work and did not have time to check on their child or children.

For the students who did not or rarely did online school work, they regressed and lost the retention of essential skills in the core subject areas. Especially, students who have IEPs, classified as 504s or English Language learners (ELs) who needed the core skills. They need additional learning to build their background knowledge so they can understand the critical content. They need differentiated learning; they need the scaffolds, for their enduring understanding so they are able to apply their learning into other subject areas. Most of the students identified in the categories mentioned have low math assessment scores, and need structured learning to help them sustain their knowledge of mathematics skills. Three months of online teaching during the Covid19 lock down hurt many students' education.

Why the place value system? Well, the chart is in most math curricula and programs. For example, our district utilizes the Eureka Math Curriculum. Within the program, it uses the place value chart, but it does not adequately address the reasons for how and why it is essential. The program does not address all learners, especially for students who are at the lower percentile on the learning curve. Besides, district assessment scores show many student scores are below the curve. According to the Arizona Department of Education (ADE), the AZ Merit 2020 state mathematic scores show our middle school math results for fifth through eighth grades, which is not very promising. The number of student who are considered "passing" at their grade level are those who tested proficient or highly proficient. There are many contributing factors of why students have low-test scores. The family cultures are different; do families stress the importance of succeeding in school and value education? Are teachers teaching with passion and rigor? Do students have a strong prerequisite skill in mathematics accumulating from the previous grades? Does the math curriculum have accommodations and support all students? The chart below shows the 2019 math score at the middle school grade levels. You can see we need to do better in helping more students to achieve and move into the proficient range.

Mathematics	Number tested	Number passing
5th grade	124	23
6th grade	114	17
7th grade	123	15
8th grade	128	19

Teachers need to know what they are teaching and to make sure each student understands and knows how to manipulate and solve math problems. The place value chart is a vital tool students can use at any grade range. Students can move digits using the chart while multiplying and dividing whole numbers or decimals. Additional learning skills in how to use base units from millions to thousandths can help students learn to move digits will help them with other math skills like fractions. The chart is a visual diagram that students can create themselves to use as their own visual and can manipulate it to help them understand the skills they are learning. It can be a simple addition, subtraction, complicated decimals, or fraction and even word problems. The chart, the digits, and the place of each value can be color-coded, and pictures of each value displayed on the table provide visual images for students who are visual learners. Students can analyze patterns, compare, and manipulate digits to solve for the answers. In Roger Howe's article, he stated to have students begin with small numbers using one digits then two digits then gradual two then three digits. This allows them to get used to the notation and attach meaning to the place value before being overwhelmed with the formal aspects (Howe, 2018) This process needs to begin early during the school year because math concept become complex as the year progresses, then student will begin to have confidence and have a solid understanding.

Content Objectives

Using the place value chart for multiplying and dividing digits is usually the introduction of a math lesson in fifth grade. When I introduce the value system to the class, the majority of the students lack understanding of the grid itself and how to manipulate digits to the appropriate value and how to distinguish the difference between tens, hundreds, or tenths, and hundredths. In addition to numbers, students need to know how to state the placed numbers orally and how to read the numbers in word print. Many attributes come into play when students work with the number grid. By fifth grade, we, as teachers, would think students at this level have a solid understanding of how to use the place value chart when decomposing numbers. However, not all students know how to use the place value chart. I have discovered teaching students how to decompose numbers by regrouping tens, hundreds, tenths and hundredths is a struggle to them because they do not have the strong ten base knowledge. For example, the numbers 100 and 1,000, how do the two numbers connect to the place value chart and how can students decompose the numbers using the four operations and decimals.

As an experienced teacher, I know students' instructional learning levels in math varies at different grade levels. Teachers need to understand how children process and comprehend numbers if we are to help students feel confident and succeed in working with numbers.

Knowing Piaget's theory and research about the nature of number concepts and presentation explains how children learn numbers as physical knowledge, logico-mathematical knowledge, and social knowledge (Kamii 1986). Piaget began with the physical knowledge and stated knowledge of object that exist in physical reality. For example, the color and weight of a chip are examples of physical properties that are in objects in external reality, and can be known by observation (Kamii, 1986) Therefore, physical knowledge is the knowledge of what is observable. The logico-mathematical knowledge is how the individual constructs the relationship between colors and objects. For example, a red and a blue chip, the individual think they are different because a mental relationship is created by putting the two objects in a relationship. A younger child may not have the relationship and is unable to put the objects in a relationship, so the difference would not exist. The chips would be chips with no color or weight. Piaget located the ultimate source of logico-mathematical knowledge in each child's mental action, rather than in set of objects. (Kamii, 1986) Children expand their logico-mathematical knowledge by coordinating the relationships they learn math vocabulary words like "same," "different," "more," and "less," to name a few. Then, they are able to deduce comparison with objects and numbers. For example, there are more animals than cows in the world or the relationship between two and two makes four (Kamii, 1986). The social knowledge are standards set by people, like the do not stand on the table, a chip is a chip, January 1 the New Year begins. The main characteristic of social knowledge is that it is largely arbitrary in nature. (Kamii, 1986) It also depends on the culture and language of the people. For example the written words, one, two three, and symbols of numbers 1, 2, 3 belong in social knowledge. Thus, social knowledge has connections to logico-mathematical.

On the first day of school, the fifth-grade math lessons begin with decimal activities that will continue through the next sixteen lessons with short quiz assessments during the lesson. There is a mid and end of the module assessments. The introductory lesson begins with no background history information about the place value chart. Prior to the math module, there needs to be a thorough explanation about the history of the place value system so student understand why they are learning the math skills and why it is important for them. The lessons within the Eureka math addresses the state standards and each lesson begins with fluency practice (practice the skills need to know for the lesson), an application problem (word problem), concept development and problem set (direct teaching of practice problems), exit ticket (quiz), student debrief (question about the problems) and finally the homework. The Eureka format is a good method to use, but teaching a lesson a day is too fast for a majority of the students, especially for students who do not have a strong knowledge of the basic skills.

History of Numbers

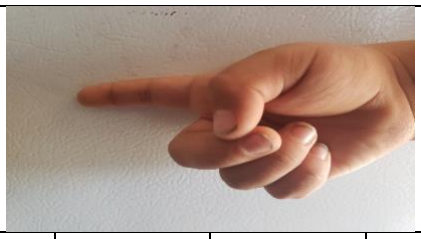
The concept of numbers has been around since man has used the value of trading and bartering system. It was and is common in ancient and current cultures globally, the exchanging of goods for valued items. As time progressed, the system advanced to counting numbered amounts using fingers, limbs, head and torso, and other parts of the body for accounting for more than ten. As history moves forward, evidence of marking of numbers discovered in many parts of the world. All over the globe, people have used a variety of objects for this purpose: shells, pearls, hard fruit, knucklebones, sticks, elephant teeth, coconuts, clay pellets, cocoa beans, even dried dung, organized into heaps or lines corresponding in number to the tally of the things needing checking

(Ifrah, 1998, p. 19). I will explain important concepts of numbers that will lead to the place value system so when reading this unit you will have an understanding of the history of numbers and a background of the place value system. I know teachers teaching math and students learning math need the purpose of learn why math is important and how it will be useful in their daily lives.

History shows that a broad range of number systems used over time around the world, from the sexagesimal system used by the Babylonians to a hieroglyphic, base ten symbology used by the Egyptians (Heap, 2009). Historians agree that a place value system was in use in India by the end of the 6th century AD (Heap, 2009). Numbers 1 to 9 were used, which created the value arrangement of each of the names, and the zero came later. The number concept spread into the Arabic scholars, then to Greek scholars. Arabic scholarship was able to combine the practicality of the Indian system with the rigorous discipline of Greek mathematics to refine further and disseminate it (Heap 2009). Knowing the history of how numbers were used and how digits were recorded throughout time is good background to know because teachers and students alike need to know the purpose of mathematics. Why teach math concept if you do not know the origins of how it can to be. For example, where is the place value system come from and how it initiated and established the grid and values. I will begin with the basic of numbers which are on the extremities, our fingers and toes. We know all humans have ten fingers and ten toes. Our fingers and toes are universal extension on our bodies that are accessed readily and used for groups of ten to powers of ten.

Finger Counting in History

In the second century CE, Nicomachus of Gerasa, a neo-Pythangorean from Judea, wrote an *Arithmetical Introduction*, which, in its translations, influenced Western mathematical thinking throughout the Middle Ages (Ifrah g. , 1994). For Nicomachus, the number 10 was a “perfect” number, the number of the divinity, who used it in his creation, notably for human toes and fingers, and inspired all people to have their counting systems on it (Ifrah G. , 1998). There are more uses with finger than just counting single digits, we have knuckles, the between jointed three bones, and two on our thumbs. On the other side of the hand, more digits can be added and even on the fingernails. In Southern China, Indo-China and India, for example, people have counted one for each joint including the knuckle, working from base to tip of finger (or in reverse) and from little finger to thumb, pointing with a finger of the other hand. Therefore, can have digits up to fourteen and added with the other hand it totals to 28. Another way of using finger counting is how the hands are position. Up, sideways, palms up or down, in how buyers negotiate. For 1, 10, 1,000or 1,000, he grabs a hold of one index finger to indicate one, two fingers (index and middle fingers) to indicate 2, 20, 2,0 or 20,000 and so on for 3, 4, and 5. Although, six, seven, eight, and nine use both hands. Nine for example, the first hand has five fingers and the second hand had four finger with the thumb finger fold, which indicates 9, 90, 900, 9,000 or 90,000. This does not, lead to confusion because the two negotiators will have agreed beforehand on roughly what the price will be (whether about 40 or 400) (Ifrah G. , 1998). The finger counting is a very old counting system and documented in painting of the ancient pharaohs in Egypt in the Old Kingdom, in ancient Greece, and even during the Roman era. Their counting method found on evidence of paintings, small counters, tokens, on bone or ivory, which represented certain amounts of money.

							
1	10	100	1,000	9	90	900	90,000

It is amazing how the hand, fingers, and thumbs can represent many numbers by bending, curling, crossing, folding, and when positioning upright and sideways. These many examples show how numbers formed by fingers of speech. These ancient finger methods lead to etymological today, as in digital computing. There is no longer any question of literally counting on the fingers, but the Latin words *digiti* ("fingers') and *arcticuli* ("joints) came to represent "units" and "tens" respectively, in the Middle Ages, whence *digiti* in turn came to mean the signs used to represent the units of the decimal system (Ifrah G. , 1998). Calculations when multiplying with the fingers is another feature the ancient used. The method of multiplying digits had been part of bartering and trading of bulk items The Arabic used calculating methods with the use of memory and ingenuity of fingers to aid the difficulties of mass products quickly.

> For example, to multiply 8 by 9, closed on one hand as many fingers as the excess of eight over five, namely 3, keeping the other two fingers extended. On the other hand, closed as many fingers as the excess of 9 over 5, namely 4, leaving the fifth finger extended. Then mentally multiply by 10 the total number (7) of closed fingers (70), multiply together the numbers of extended fingers on the two hands (2x1=2), and finally add these two results together to get the answer (72): 8x9=(3+4)x10+(2x1)=72 (Ifrah G. , 1998).

Currently, this is quite different from how teachers teach students to solve using their fingers for the nine multiplication facts. For example 8x9=72. The eighth index finger bend to indicate fingers up counting from left to right seven and two which shows 72. Other fingers bent shows other facts of nine. Yet, this is how teachers in the classroom teach our students because their fingers are readily tools they can use to help solve the basic operation facts (addition, subtraction, multiplication, and division). Students today use finger counting when it comes to solving basic operations. For example below is 8x9=72.

8x9=72

Number, Value, and Money

In ancient time, people lived in small groups living simple lives. They used nature about them and found what they needed. As the small groups expanded and became larger communities the sense of culture developed then the need to communicate with other communities became a way to barter with each other. People began to create objects of use to trade. Eventually materials became items of use and desires. These raw materials were distributed for trade and exchanged for need and want articles. In the beginning the main bartered items was food, which was exchanges for other food. Salt for example was an important commodity for preserving meat, so the demand for salt was a need in some communities.

Eventually the growth of communication and the increase of trade, barter became increasingly inconvenient, depending on individual needs and wants or on endless negotiations for commodities. The need grew for a stable system of equivalences in the value of items as fixed units or a standard of exchange for commodity items. This system, individuals can evaluate the transaction of the trade and had settle social matters like a bride price. In pre-Hellenic Greece, the earliest unit of exchange found was the ox (Ifrah G. , 1998). According to Homer's *Iliad* (XXIII, 705, 749-751; VI 236, eighth century BCE), a "woman good for a thousand tasks" was worth four oxen, the bronze armor of Glauso was worth nine, and that of Diomedes (in gold) was worth 100 (Ifrah G. , 1998).

In different part of the world, many cultures used various means of a consistent value of bartering objects for exchange. Bartering animal pelts for example were means of regulating unit value established by the Russian government. The government needed a means to collect taxes from the people. In the Pacific Island, shells, pearls, and seashell necklaces were valued goods used in exchanged for items. The Algonquin Indian tribes of the northwest used wampam that were polished clamshells and whelk shells made into a belt or necklace. The wampam were valued in trading among the tribes. The Mayans of Central America also used cotton, cocoa, bitumen, jade, pots, pearls, stones, jewels, and gold. The Aztecs had certain standard of value used for exchanged, the qualchtli (a piece of cloth). The length of the cotton cloth had values equivalent to cocoa beans. One hundred cocoa beans were to one length of qualchtli. Image how much three hundred cocoa beans are in qualchtli, a lengthy cloth. The same kind of practice in China was adopted prior to the money system. From the Shang Dynasty the metal tokens were adopted in preference to other form money management. The value of commodities was measured in terms of weight, with reference to a standard weight of one metal or another (bronze, copper, silver and gold). Metal forms were flakes, nuggets, bars, and rings were used to weigh the value of the items sold or purchased. Finally, the coinage idea came into use during the seventh century.

Place Value System

Many historians have studied the numerical system among ancient civilizations. Civilizations like Egyptians, India-Indians and Chinese have had an impact in adopting the base ten number system. The nine digits and zero are essential units that depend on the place value system. According to DATTA & SINGH, the first epigraphic evidence of numerals in India written in the decimal place value notation is in 595 A.D. (Lay-Young, 1986). In addition, the Chinese had known and used the numbering concept for over two thousand years. The idea was created when counting rod for numeral computation were used. The individual knew the character, positional notation form on the counting board and his ancestor's decimal number system. The origins of

character numeral could be traced back to the oracle bones character of the Shang dynasty (14m century B.C. to 11th century B.C.) (Lay-Young, 1986) The counting rod system was a simple method for transcribing number to perform addition, subtraction, multiplication and division. No more than five bamboo rods represented the nine digits rod numeral model were the beginning of the place value system. The inventive way of how the Chinese represented the rod for numeral 6, 7, 8, and 9 using five bamboo sticks were simple in form but also simplified mathematical operations. The arrangement of how the rods are place from left to right beginning with the highest value represents the place value system today. The Chinese were able to compute the digits in large and small numbers. Computation the digits they have established the idea on zero as a number within their number system. The current idea of the circle (zero) is the symbol of what the ancient Chinese used as the blank space when computing. Eventually, the outcome of the place value led to the decimal fraction and the decimal point.

There are more examples of what the Chinese contributed to the place value system, which led to other cultures to borrow and expand on the numbering concept. The history of the place value system is valued information our students need to know in terms of when, where, why, how learning how to use the place value system is a useful information. Not only, students, but teachers, and other educators, too. Knowing the background of the numbers system and the origins why and how numbers came to be, I know will help students ease their anxieties when learning the place value system.

The Navajo Stick Game

There are various stories about the Navajo Stick Game. The old ones say Changing Woman taught the Diné, some say the game came with the Diné when they emerged from the lower world into the upper world, others say Coyote created the game and finally, a few say two women made up the game long ago. Traditionally, women commonly played the game. Today, anyone can play the game and usually students with a facilitating knowledgeable adult. Within all the stories, there are everyday items, and structures used to play the game: circle of colored smooth rocks, the three sticks with black and white sides, a large flat stone for the center.

I prefer the story of how Changing Woman taught Tsidił to the Diné people and how she told stories while explaining the game. I prefer her story because she is in many of our legends, and she is a pillar example of how a female character conducts herself. The Stick Game story will be part of the unit I will teach my students.

Changing Woman teaches Tsidił

Before the clans travel back to their homeland, Changing Woman gave the people gifts. She taught them prayers and songs to use in their ceremonies and healings. Each group designated a sacred gish (cane) and a holy stone of white shell, turquoise, abalone, and jet as guides for their journey (Mose, 2011). She gave them additional survival items like food, seeds, herbs, and corn pollen to use during their trip home and to sustain themselves when to reached their homeland.

In addition to gifts, she included a recreational activity the Diné could use traveling long-distance and at their homeland. She gathered the clans in a circle and began to explain the game. She stated she learned the game from the Holy People. She starts with three smooth flat sticks about five to six inches long (about the length of her hand) and the three sticks made from t'iis

bitł’óól (cottonwood tree root). Each side of the rods painted white (symbolizing yikai-dawn) and black (symbolizing chahałheeł-night).

Then, she gathered forty smooth colored pebbles from the river bed. She stated the stones represent the stars, and each colored rocks in groups of ten represent the Diné's pure colors from the four directions. The pebbles arrange into a circle represent the home. She organized the stones beginning with ten white pebbles between the east to south in a circular formation. The white rocks are called yoołgai (white shell). She proceeded to the next set of ten blue stones, arranging them from south to west. The blue stones are call dootl'izhii (turquoise). Next, is the ten sets of pebbles arranged from west to north. The rocks are diichili (abalone shells). Finally, the ten clusters of stones arranged from north to east. The black nuggets are called bááshzhinii (jet). The circle is complete, and gaps are at the four cardinal directions, which represent the rivers that flow onto the homeland. In the center of the perimeter of rocks, she placed one round flat rock about ten-inch in diameter. She said the flat rock in the center represents Nihima Hahasdzaan (Mother Earth).

After explaining and demonstrating the preparation for the game, Changing Woman distributes each player their counting stick to use as a place marker between the rocks when counting. Each player begins at the gap in the east river and their stick clockwise the way the sun moves. She continues to explain how to use the three flat sticks. She says when it is each player's turn, tap the bitł’óól on the center flat rock four times. On the fourth tap, allow them to fall and leave them where they land. The way the sticks land determines how many spaces you can move: two white and one black – move two areas, two black and one white – move three spaces, three black – move five spaces, and three white – move ten spaces (Mose, 2011).

The goal of the game is to move your stick around the circle and return to the east. There are additional rules when playing. For example, when landing on a river space, you have to go back to the previous river space. When you get closer between the north and east rivers, the rules change. When you are three moves from home, and you toss the sticks and get three black sticks, you can choose to move back five spaces or move forward two and give the three moves as a gift to another player. The player needs to move during your turn and still gets his time when it is his time. Finally, depending on your own the stick toss, you will step back the numbers of spaces, and reach home, the exact throw must land on the home space.

Changing Woman informed the Diné people that anyone (children, teens, adults, and the elderly) could play Tsidił any time. During the summer, winter, or any time of the year. She said to show respect while playing the game.

The Place Value and the Stick Game

The teacher will gather the required materials for the stick game. The game requires one flat stone; three stick dice (white on one side and black on the other side), a stick marker for each player, and about forty smooth pebbles. The teacher will explain how to set up the game and explain the rules of the game. Students will initiate the game with no modification for two or three rounds to get used to playing the game, which may take a day. After they are comfortable playing the game, the teacher will adjust the game by adding tens, the hundreds, and finally,

thousands units. Using the tens, hundreds, and thousands will help them think about manipulating the place value chart when working with digits.

Adjusting the game to tens will modify the black and white sticks' value and the circle of rocks' weight. The black and white bar markings depend on how they fall, will determine the value for counting. For example, one black and two white – move 20 spaces, which means ten count the each rocks in the circle. One white and two black – move 30 stretches, three black - move 50 plays, and three white rocks - move 100 spaces. Students need to understand they will not always move forward and will need to count by tens. When they land on a gap space (river), students may have to go back to the previous gap space and proceed from there.

Students will track their movements on a place value chart on a whiteboard by adding or subtracting the tens units as students play the game. As students' progress and get used to playing the game using tens, the next round of matches will change to the hundreds and eventually to the thousands, as students feel confident in playing the game using tens, hundreds, and thousands. The next game level is to challenge the students to play using all the unit value. The rocks beginning with the east to the south will represent the ones, south to west, representing the tens, west to north, representing the hundreds, and north to east, representing thousands. The black and white sticks will begin with the one-digit value until students are comfortable with the one unit and eventually move up to the ten value and so on.

After the students are comfortable with the game, they will play the game using the Navajo language. Introducing the items used for the Tsidil game, t'iis bitl'ool (white and black sticks), the gaps represent the rivers (east river – Bika' Tooh, south river – Bit'iis Nineez, west river – Bi'aad Tooh, north river – Bits'iis Doo ninit'i'i) and the center stone – Nihima Nahsadzaan. Other essential words students will express are the four directions (east – ha'a'aah, south – shadi' aah, west – e'e'aah, north – nahookos). Of course, the necessary Navajo numbers of one through ten, the ten, hundred, and thousands. Creating word cards for students will help them practice using the words while playing the game.

Teaching Strategies

Estimation Strategy: In the real world, students will need to know how to estimate enormous numbers. When grocery shopping for their parents or grandparents, their items like clothing and school supplies or livestock purposes like feed, hay, and water. Some may even need to cook a meal, do laundry, and other chores around their home that require some estimation.

Teaching students to learn how to add, subtract, multiply, and divide large numbers because the estimation process will help them take an educated guess and calculate number value are essential skills students need to learn how to use. For example, estimating groceries for grandma needs to be within her budget because she is on a fixed income. Then, she needs to have enough hay, feed, and water for her livestock. The estimation calculation needs to be correct and to avoid careless errors.

Using estimation will give an approximated answer, and students need to learn how to compare their estimates to the precise answer. The estimate and accurate answers should be close to the

estimation, and then students will know both are accurate. However, suppose the estimation and precise response is out of range. In that case, something is wrong and students will need to recheck their estimation and the precise calculations until both are within a narrow range.

Below are examples of Addition, Subtraction, Multiplication, and division estimations.

Estimation of basic addition: 44 + 41
Estimate 34 and 31, keep in mind the 3's is the left digit, the next digits on the right are four and 1 when estimating 4 and 1 are less than 5. If the number were 87 and 89, then the seven and nine would round up because both seven and nine are more than five.

44 + 41 estimation 40 + 40 = 80; precise calculation 44 + 41 = 85.

As you can see, the estimation is very close to the precise calculation. Students may think they have completed the problem, but thinking about their thinking, known as metacognition, requires students to think further than the solved problem. Questions like how you know you are correct. If your answer is correct, how do you do know? Explain the process of your estimation and your precise answers.

Estimation addition in hundreds, larger numbers: 504 + 616
Estimate 504 and 616, leave a hundred digits (the left digit) that are 5 and 6 in place when rounding. The next digits on the right are 4 and 16. The two numbers are a bit tricky when estimating hundreds. 504 has no ten value, and 616 have a ten-value. Students need to keep in mind and think about the outcome is to estimate the value of the hundred.

504 + 616 estimation 500 + 600 = 1,100; precise calculation 504 + 616 = 1,120

Again, as you can see, the estimation is very close to the precise calculation. Metacognitive questions will be asking, and students should be able to answer.

Estimation in thousands, larger numbers with addition: 1,234 + 5,678
Estimate 1,234 and 5,678 leave a thousand digits (the left number) because it is less than five. However, round up five in the thousand digits because five or more the digit is rounded up to the next digit, six. The two numbers are a bit tricky when estimating thousands. Students need to keep in mind and think about the outcome is to estimate the thousand value.

1,234 + 5,678 estimation 1,000 + 6,000 = 7,000; precise calculation 1,234 + 5,678 = 6,912

Again, as you can see, the estimation is very close to the precise calculation. Metacognitive questions will be asking, and students will answer the questions.

Estimation with Subtraction larger numbers to the ten-thousands: 27,898 – 1,389
Estimate 27,898; leave the ten-thousand digits (the left digit), two, and view the seven in the thousand value. The seven is more than five, so it will round up the 2 to 3. The three in the hundred value is less than five, so the one in the thousand value will remain. These numbers have different number values because 27,898 and 1,389 have five digits and four digits.

27,898 – 1,389 estimation 30,000 – 1,000 = 29,000; precise calculation 27,898 – 1,389 = 26,509

The estimation of subtracting digits and precise calculation are very close. Students will be able to explain their rationale of why they are correct in their estimation.

Estimations with Multiplication larger number hundreds to the thousands: 789 x 3,389
Estimate 789, the hundred digits (the left digit) is more than five, so it will be round up seven to eight. The thousand number three leave the digit because it is less than five. Students can see the numbers multiplied have different values. Seven hundred eighty-nine have three digits, and 3,389 have four digits.

789 x 3,389, estimation 800 x 3,000 = 2,400,000; precise calculation 789 x 3,389 = 2,673,921

The estimation of multiplication digits and precise calculation is very close. Questions about the estimation problems are part of students thinking about their thinking (metacognition).

Estimations with Division large number hundreds: 879 ÷ 240
Estimate 879, the hundred value (the left digit) is more than five, so it will be round up to nine. The two in the hundred value is less than five, so it will round at two hundred.

879 ÷ 240, estimation 900 ÷ 200 = 4.5; precise calculation 879 ÷ 240 = 3.6

The estimation of division digits and precise calculation is very close. Questions about the estimate are student's discussion and answering sessions.

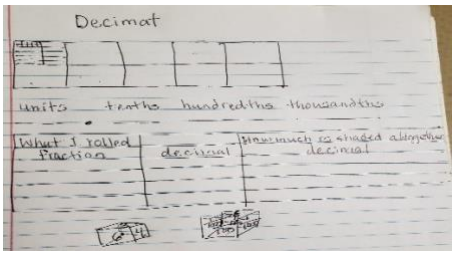
Numerous problems using the four operations ranging from three to six digits will be modeled and practice with students. The guided practice ensure students fully understand the estimation and precise of the four processes. In the classroom activities portion, students will have more approach with independent work.

Decimals

Division leads to working with decimals and fractions. Many students find decimals and fractions problems were confusing and difficult for students to comprehend. Even using manipulatives to assist the student in comprehending decimals was still confusing to students. Hundred square blocks, cubes, rods, and even coin money to help students concretely understand decimals. Many of these tangible materials create confusion for students—for example, the money concept using coins like dimes, pennies, and dollars. Therefore, students need have a solid base and know the money value when working with decimals and fraction. In the article, Anne Roche, explains a method in helping students understand the decimal system. It is known as “Decimat.” Decimit is a strategy helps students make sense of decimal size and decimal place value and encourages the use of fractional language to describe decimals (Roche, 2010). Decimat requires the partition of tenths or hundredths into ten equal parts and smaller parts. Decimat requires a large rectangle drawing, which represents one whole, divided into ten equal rectangular parts, becoming tenths. One of the tenth parts is divided into ten parts again, which

becomes hundreds. One of the hundredths divided into ten parts into thousandths. Creating this diagram helps students to see the different parts of partitioning.

To play the game, students have two die: a standard six-sided die and a blank die that has fraction labeled on the sides 1/10; 1/100; 1/100; 1/1,000; 1/1,000; 1/1,000 (Roche, 2010). The Decimat game board includes a rectangular mat to color the shapes. The first player to reach the whole number one is the winner. An extension to the game is to not use the tenths, and students will need to mark the tenths as zero as a place marker. It is essential to rover around while students are first to play the game because they will have errors. The more the teacher checks and assist, the fewer the errors. The teacher can make the game more challenging by adding higher digits like three tenths, 13 hundredths, and 17 thousandths. Team Task comes to play when students get support from their peers and or the teacher to solve for the answer. Students will need to regroup and decompose the digits. Students marking on the Decimat chart helps the student know to move from fractions to decimals, and the chart will match the shaded area. The chart helps remind student which place the decimal represent while shading the chart. Finally, have students explain and reflect on how they played the game. Ask questions like, "if you played the game again, what would you do differently?" or "what did you learn mathematically from the game today that you did not know when you walked in the door?" can help to maximize the effect of the game (Roche, 2010). Below is a diagram of an example Decimat.

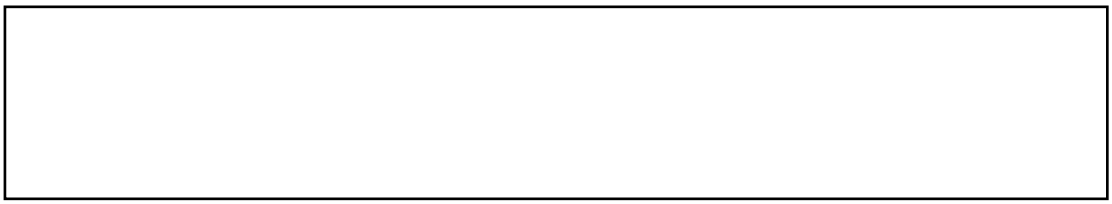


Classroom Activities

Estimating/Rounding tens, hundreds, and thousands: Students will practice estimating and precise answers with questions as guided practice, team tasks, and independent work. Guided practice is when the teacher assigned about six to eight problems, and students work on teacher guidance and observation problems. The guided practice approach ensures students fully understand and know how to solve and explain the problems. Then team task is when students are in assigned groups of four, and within the team, they discuss and share the example problems and help each other solve the problems. Team task is similar to cooperative learning that provides scaffolding to negotiate for meaning and comprehensible input. I usually prefer the four students in a group because the smaller the group, the more time students collaborate and promote oral discussion. Finally, independent work is when students work on the assignments independently without peer or teacher assistance. Students should complete the problems with ease and confidence because they had the previous practice with the whole class, guided practice, and team task. Below are examples of estimating/rounding tens, hundreds, and thousand problems to each process with questions.

An estimate may round to the nearest whole number, or the nearest ten, hundred, thousand, ten thousand, and so on. Answer each question on the line for each problem.

1. To the nearest 10: Is 38 closer to 30 or 40? _____. How do you know your answer is correct? _____ Explain and show how you know your answer is correct in the box below.

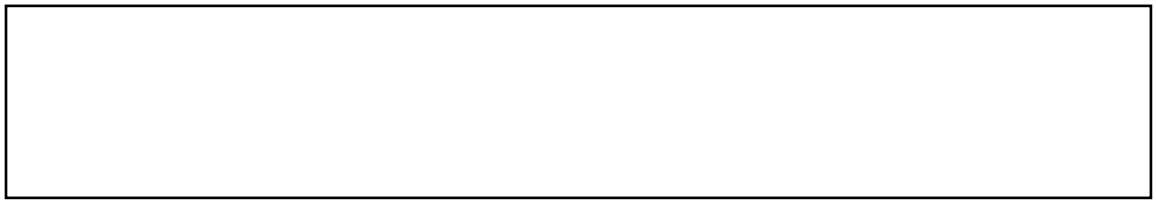


2. To the nearest 100: Is 115 closer to 100 or 200? _____. How do you know your answer is correct? _____ Explain and show how you know your answer is correct in the box below.

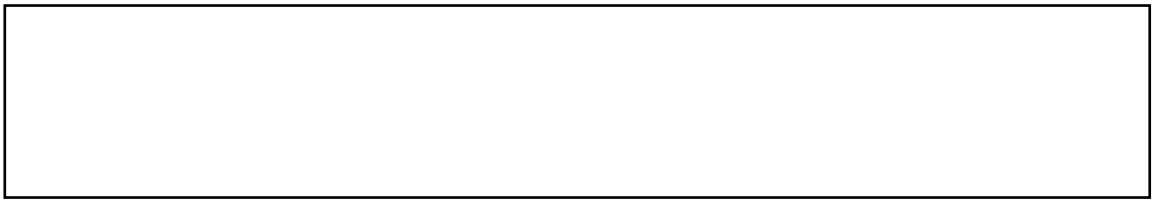
3. To the nearest 1,000: Is 2,776 closer to 2,000 or 3,000? _____. How do you know your answer is correct? _____ Explain and show how you know your answer is correct in the box below.

Round each decimal to the nearest whole number to explain how you know you are correct.

1. 513.9 would round to _____. How do you know your estimation is correct? Then sketch and explain your justification in the box below.



2. 6,593.9 would round to _____. How do you know your estimations is correct? Then sketch and explain your justification in the box below.



3. 499.87 would round to _____. How do you know your estimations are correct? Then sketch and explain your justification in the box below.

4. 78.143 would round to _____ . How do you know your estimation is correct? Then sketch and explain your justification in the box below.

What do you know about rounding numbers with digit 5? If the digit one place to the area's right rounded is five or greater, round up. If the digit one place to the right of the site round to is four or less, round down. Sketch and explain how you rounded to the nearest estimation in the box below using a vertical or horizontal number line.

A. Round 4,945 to the nearest 10, 100, and 1,000.

- to the nearest 10: _____
- to the nearest 100: _____
- to the nearest 1,000: _____

Sketch and explain how you round to the nearest estimation.

B. Round 68,057 to the estimation indicated.

- to the nearest 10: _____
- to the nearest 100: _____
- to the nearest 1,000: _____
- to the nearest 10,000: _____

Sketch and explain how you round to the nearest estimation.

C. Round 55,555 to the estimation indicated.

- to the nearest 10: _____
- to the nearest 100: _____
- to the nearest 1,000: _____
- to the nearest 10,000: _____

Sketch and explain how you round to the nearest estimation.

D. Round 138,223 to the estimation indicated.

- to the nearest 10: _____
- to the nearest 100: _____
- to the nearest 1,000: _____
- to the nearest 10,000: _____

Sketch and explain how you round to the nearest estimation.

Use the place-value chart for the problems below. Think about estimating to the nearest ten, hundred, thousand, ten thousand, hundred thousand and the tenths, hundredths, and thousandth of the number.

Hundred thousands (100,000)	Ten thousands (10,000)	Thousands (1,000)	Hundreds (100)	Tens (10)	Ones (1)	.	Tenths (.1)	Hundredths (.01)	Thousandths (.001)
9	8	7	6	5	4	.	3	2	1

A. Estimate the number in the chart to the nearest thousand, explain or show how you rounded your answer, and know you are correct?

B. Round the number to the nearest hundred, then doubled the number. What is the value of the given number and your answer? Explain how you arrive at the answer.

C. Estimate the number in the chart to the nearest ten thousand, explain how you rounded your answer, and how you know are correct?

D. Estimate the number in the chart to the nearest whole number. Explain how you rounded to a whole number and how do you know you are correct?

E. Estimate the number in the chart to the nearest hundredths. Explain how you arrive at the answer.

F. Estimate the number in the chart to the nearest tenths, then double the number. What is the value of the given number and your answer? Explain how you arrive at the answer.

Estimation usage to find a number that is close to an exact number. Study the estimation chart think about how to find an estimate.

Number	Nearest 10	Nearest 100	Nearest 1,000	Nearest 10,000
726				
19,736				
8,391				
571				
21,146				
7,939				

Number	Nearest 1	Nearest .1	Nearest .01	Nearest .001
6.327				
0.9				
5.462				
31.45				
2.5				
1.21				

Find the estimation for the given numbers.

Number	Nearest whole number	Number	Nearest whole number
5.42		171.36	
305		683.549	
6.09		0.7	

Word Problem Estimation: read the word problems and answer the questions.
Number facts about Arizona's state: Solve for the answer and explain how to arrive at the solution.

A. The population of Arizona in 2019 was 6,626,624, estimate at thousand and ten thousand.
B. Area Codes in Arizona are 480, 520, 602, 623, and 928. Estimate all numbers to the nearest hundred, and then add your estimate and precise answer. How do you know your estimation and precise solutions are correct?
C. The highest point in the state is Humphrey's Peak, which is 12,633 feet and 3,851 meters. Estimate the measurements to the nearest thousand.
D. According to the Bureau of Indian Affairs, about 284528 Native Americans live in Arizona during 2009-2013. Estimate the population to the nearest hundred, thousands, ten thousand, and hundred thousand.

There are different themes teachers can use to create math word problems connecting to the place value chart. The example above is about the state of Arizona, and as a teacher, I think about how I can make connections with my students. What are their interests, hobbies, literature, family involvement, sports, movies, and more? Create word problems as an attention grabbing for students, so they are engaged in learning the process while learning about the topic.

I have created various example problems using the place value chart in whole-class situations, guided practice, team tasks, and independent knowledge. I have made short four to six example problems, and teachers can create more for students who need more exposure to solving problems using the place value chart. There are extensive examples and resources on the internet and in teacher classrooms.

Distance Learning

Google Classroom, Zoom, Google Meets. Padlet, TedTalk, Kahoot, Splash Learn, Khan Academy, and Quizlet are some of the online platforms I have used since the Covid19 pandemic hit our schools. In March 2020, the virus hit our local community, and our school district closed, but learning continued. Online Google classroom use was a method our students used for teaching and assignments. Distribute earning packets to students who had no access to Chromebooks, IPads, or the internet. Teachers quickly learned how to use these online platforms. Many learning tools were online to help students accommodate their learning, and I have integrated them during my lessons and assessments. I will incorporate some of the platforms while I am teaching this unit. For example, Padlet and Kahoot are two useful models for questioning and answer sessions and assessments. In both models, teachers can create questions that emphasize the Navajo stick game or mathematics problems.

Student Assessment Plan

Quizzes, known as entrance or exit tickets, are short assessment for students. They are usually two to five problems. The exit tickets can be any skills taught to students after the main lesson and are typically quick when students end the lesson learn when about the leave the classroom for the next class or subject. Entrance ticket, students can take a longer time to complete the quiz. The tickets help me evaluate what students learn and know about their understanding skills, and I see if I need to reteach the lesson differently to help students comprehend. The tickets I create go from the easiest to difficult problems. I would analyze the challenging issues and see if students have difficulties or not. The ranges of the problem keep the students who know the process working and challenges the struggling students. The tickets also keep students accountable for producing what they have learned at the end of the math session. They know I will collect their exit ticket and grade them. It will tell students that what they have learned for the day is essential, so they need to pay attention during my teaching. It is their way of communicating their learning to me.

Student Assessments

Evaluation	Type of Assessment	Platform

Make various math problems connecting to the place value chart.	Pre/Post Assessment	Multiple-choice, short answers with explanation, fill-in-blanks and complete the chart/table.
Students read works of literature and answer questions.	Entrance/Exit tickets	Five questions about the text
Oral explanation of how to play the Navajo stick game.	Oral questions and explanation	Retell, summarize, and Wh-questions
Oral or demonstration of Navajo vocabulary when playing the Navajo stick game.	Oral or demonstrate	Oral sequence of the game by sections, then whole game.
Use the place value chart when decomposing numbers/digits.	Formal and summative	Sketch the place value chart, and then complete problems connecting to base ten, hundred, thousand, and ten thousand.
Read and solve math word problem using the place value chart.	Formal and summative	Answer and solve math word problems connecting to themes.

Alignment with Standards

Arizona's English Language Arts Standards -5th Grade (READING)

Reading: Literature, Changing Woman Teaches Tsidil to the Dine and the History of Zero, Exploring Our Place-Value Number System
5.RI.1: & 5.RL.1 Student quote accurately from a text when explaining what the text says explicitly and drawing inferences from the text.
5.RI.2 Students determine two or more central ideas of a text and explain how they are supported by key details and summarize it.
5.RI.3 Students explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text, based on specific information in the text.
5.RI.4 Students determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.

Arizona Math Standards 5th Grade

Math: while using the place value chart and playing the Navajo stick game.
5.OA.A
Students write and interpret numerical expressions.
5.OA.B Students analyze patterns and relationships.
5.NBT.A Students understand the place value system.

5.NBT.B Students perform operations with multi-digit whole numbers and with decimals to hundredths.
5.NF.B Students use previous understandings of multiplication and division to multiply and divide fractions.

Dine Standards: Changing Woman Teaches Tsidil to the Dine
Concepts 2 – Nahat'a
Nahat'a' bits'aadoo anootiligii bek'ehgo anisht'ee dooleel. (I will apply and practice the Dine way of life through planning.) PO1. Nahasdzaan doo Yadilhil bee nashidi'neesta;igii bass nahashne' dooleel. (I will retell my cultural teachings of earth and sky.) PO 3. Nilchi' al'aan anaa'niligii baa hane' yiisinists'aa;go shil beehhozin dooleel. (I will listen to and retell stories related to elements of nature.)
Concept 4 – Siihasin
Dinek'ehji na'nitin silahigii bohoosh'aahgo er bee siih dinisdzin dooleel. (I will apply and practice the Dine way of life with confidence,) PO 2. To daholoogoo shil beehozin dooleel. (I will locate the different water sources.)

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