Making Quantum Technologies Accessible: Providing age appropriate, early exposure to prepare students for the next technological revolution

What are the Odds? Possibilities of Probability and Measurement to Young Children

Chola De Torres

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Author Note:
Chola De Torres is a Pre-School Family and Child Education (FACE) Teacher at Dishchii'bikoh Community School. Correspondence about this curriculum unit can be addressed to Chola De Torres, P.O. Box 80068, Cibecue, Arizona, 85911.
Email contact: chola.detorres@dishchiibikoh.org

"Learning and teaching should not stand on opposite banks and just watch the river flow by; instead, they should embark together on a journey down the water."

- Loris Malaguzzi

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Advocate of several strands of view of children as strong, powerful learners with rights- not just needs.

Introduction

This curriculum is student-centered and is based on seeing each child as unique, strong and full of potential. That the child's role in the classroom is to construct their knowledge and develop skills through exploration of their environment and what is around it. Thus, concentrating on not what young children think but how they think. Many educational approaches were based on allowing children to explore and become critical thinkers. Providing relevant learning opportunities to make sense of the world and develop language and literacy skills. Furthermore, explores opportunities for young children to make decisions, learn from mistakes, and solve problems. Students need to be in learning spaces where they can be introduced to new concepts of thinking, how these concepts can be processed through a variety of learning opportunities, communicate these activities to every possible language of learning, make reasonable responses to stimuli, and acquire multiple erudition.

Given that classroom activities can be communicated in a variety of ways, integration of culture and mapping them out to different subjects will provide holistic accommodation to learners especially when delivered in creative ways considering different learning styles and pace of young children. I believe that Apache students are naturally inquisitive and should be able to have a cultural connection with both mainstream education and traditional cultural teachings. Thus, educators should be able to provide creative ways to indulge them to new scholarships and feed this curiosity with good and meaningful knowledge and experiences.

Context

Fort Apache Reservation

The Fort Apache Reservation is home to the federally recognized White Mountain Apache Tribe. Located in the eastern portion of the United States in the Arizona state. It is the third largest reservation in the country consisting of 120 named mountains including Mt. Baldy (Dził Łigai Sí'án/White Mountain and the highest and most prominent) at 11, 421 ft in elevation.

The large portion of the reservation is covered by pine trees extending to the national forests and parks. The high desert landscape of the reservation shifts from hillsides into steep cliffs, canyons, and valleys. Though much of the land is forested, there are areas that are free of tree coverage which often feature sweeping red rock valleys and plateaus. However, major rivers in the area include the White River and the Salt River. It is surrounded by popular outdoor recreation areas and national parks including Tonto National Forest, Petrified Forest, Apache Sitgreaves National Forests, and many more. The Fort Apache Reservation was carved millions of years of

combination of erosion, ancient seas coverage, folding and tectonic shifts, and waterways from which it derived its beautiful and breathtaking landscapes.

White Mountain Apache Tribe (Dził Łigai Si'án N'dee)

"We believe that we come from the Earth, and that we belong to the Earth". White Mountain Apache Tribe is a beautiful home that was given to us by our creator. It is a home rich in tradition, resources, wildlife, and outdoor recreation. White Mountain Apache Reservation is a unique place starting at about 2,600' above sea level on the southwest side and ranges all the way up to 11,400' on the peak of Mt. Baldy on the eastern border, which is known to be the most sacred mountain, providing year-round recreation activities experiencing all four seasons. It includes some of the richest wildlife habitats in the state, and more than 400 miles of stream. It is home to the Apache trout, a species brought back from the brink of extinction through the efforts of the tribe and many partners including the tribe's wildlife and outdoor recreation division.

It became a home of the Bureau of Indian Affairs' Theodore Roosevelt Indian Boarding School in 1923 where it was abandoned by the army in 1922 which at first intentionally served the Diné (Navajo) children; the majority of the students at the school were Apache by the 1930s.

There are many different nations of Apache people and Apache nations such as Chiricahua, Mescalero, Jicarrilla, Lipan, and Kiowa Apache peoples. The White Mountain Apache Tribe now consists of approximately 15,000 members who mostly live on Tribal lands while others live and work all over the country and the world. Most of the population lives in and around Whiteriver, which is the seat of Tribal government, with others residing in the communities of Cibecue, Carrizo, Cedar Creek, Forestdale, Hon-Dah, McNary, East Fork, and Seven Mile.

Cibecue, Arizona

Cibecue, located in the heart of the White River Apache Reservation. It is a small town surrounded by breathtaking mountain scenery and lush forests. Given its elevation of 6322 ft. above sea level, it is a place for hiking, biking, camping, and simply exploring the area on horseback are what residents and visitors enjoy doing. Cibecue is a peaceful place where everyone knows each other, creating a strong sense of community spirit. Its primary industries include tourism and healthcare. It is in east Arizona, 50 miles south of Holbrook and 160 miles northeast of Phoenix.

Cibecue is a city located in Navajo County with a population of 1, 423 in the year 2024. It has a land area of 6.0 sq mi

Dishchii'bikoh Community School

Also known as Cibecue Community School which offers public education operated by the Indian Education Division of the Bureau of Indian Affairs. It offers K-12 education with accommodations to Pre-School Education and Family and Child Education (FACE) Programs starting academic year 2024-2025. Located on the northwest of Whiteriver on the Fort Apache

Indian Reservation. Businesses and facilities were operated by the White Mountain Apache Tribe. Situated in Cibecue, Arizona. It is home to 298 students (2022-2023) from kindergarten to 12th grade.

Rationale

Background Information

Have you observed how things around us work? How do things happen around us? How do things around us process? From waking up in the morning surprisingly having sunny days, rainy days, winter days, windy days, or cloudy days, from bumping into the same person going to school, getting to school and getting home at the end of the day the same time as yesterday, drinking the same flavored juice in the cafeteria the whole week, or having a great day or bad day. What are the odds of having the same number of students from Monday to Friday, same interaction with the same students, or having the same responses from them during class discussions?

Every day we experience different things, meeting new people, getting to different places, being in different situations, and even getting into different conversations regardless of who or where we are at. This is enigmatic for all of us. We are puzzled about how this is possible or impossible. We think about the relativity of different scenarios from yesterday to today or to tomorrow. Thus, if we think about these things, most probably, our students might also think about it. It may not be obvious for them to speak up or ask directly about all the things but what if they do? Think about the possibilities of one student, one day, asking about *"What are the possibilities of him/her getting a perfect score in Math test?"* or *"What are the possibilities of him/her winning a classroom game?"*, as a teacher, how are you going to explain this? How about we turn the table upside down. How are we going to lead our students to think like this? And if that happens, how are we going to facilitate these ideas and thoughts? It is very important to encourage our students to think outside the box and to be acquainted with probabilistic thinking. According to Kitch, B. (2023), thinking outside the box means thinking in a creative and innovative way, often looking at and approaching problems and situations with an open mind and thinking unconventionally.
Furthermore, in the same journal he wrote about benefits of thinking outside-the-box including fostering creativity and innovation, better problem-solving, and more. As we train their minds to think outside the status quo, probabilistic thinking enhances the precision and effectiveness of coming up with our decision-making in solving problems for instance. Probabilistic thinking is trying to estimate using our knowledge, beliefs, logic, and math to estimate the likelihood of any specific outcome (Gan, I., 2021). While we teach our students different academic concepts in Math or ELA, we should also encourage them with these thinking models. Again, "*Children must be taught how to think, not what to think"* – Margaret Mead.

Classroom Need

Education in most, if not all schools all over the world has switched or at least lead their path (if not fully), towards innovation. Different teaching pedagogies and strategies were introduced and have begun to be adapted by several schools. These innovations include creating opportunities for technology and EdTech resources, different instructional platforms, and

different approaches to instruction. However, despite the progress on these innovations, most states in the US rely on a one-size-fits-all public education model. But thanks to the passing of House Bill 2862, which allows schools to move beyond and adopt new models for teaching and learning, several schools in Arizona have led their education to this. In fact, in Arizona, recent legislation has supported efforts to advance student-centered learning. This is just one of the innovations in education that is taking place.

One of the innovations that has been out of the context of traditional school setup is class discussion. Class discussion is very vital in encouraging students to articulate course content in their own words and learn from one another. It is an active learning technique that can help students learn and process information in a variety of ways such as critical thinking. It allows students to examine, criticize, and validate ideas. Now, as teachers, it is our responsibility to lead discussions in which students contribute meaningfully to learning.

According to John Hattie (2018), an excerpt made by Greenwood-Lang (n.d.) in her journal, teachers can ask between 200 and 300 questions a day whereas students typically ask clarification questions only. It was mentioned in the same journal that teachers should only limit their time to 20-30% of their class time to teacher talk and 80% of the class time should be dedicated to allowing students to express their thoughts. Meaning, by reducing teacher talk, discussions in the classroom provide more opportunities for students to interact with each other. That is to integrate activities into students' daily routines that create more of a "volleyball discussion" by asking students to listen to one another and respond to each other's ideas before tapping the ball back to the teacher's side of the court" (excerpt from Boryga, A. 2023). Research shows that student participation and peer-to-peer interaction are positively linked to the development of critical thinking skills.

Greenwood-Lang (n.d.) mentioned in an excerpt from the journal Teacher Talk Time and Student Talk Time (2015), that when this approach to class discussion is introduced, many advantages can be noticed such as; students will learn discipline in listening to the teacher when talking since they will give vital information during the small time frame, increase the students retention because they talk about the material, students more likely to collaborate more to gain better understanding of the material, and allow students to think things through their own which increases the challenge of the task and therefore promotes high percentage of participation and purposeful student talk. She compared academic conversations and traditional class discussions where academic conversations promote longer response time to students to answer or converse than the later. Also, there is no teacher approval or disapproval in academic conversations while teacher judgment and emphasis on correctness happens in traditional class discussions. Students also have ownership of the flow of the conversation and students listen primarily to their peers as per teacher owns the flow and students listen primarily to the teacher.

Once these innovations in class discussions and promotion of critical thinking to student-led academic conversations are pushed through, several potentials on teaching and learning process will take place. Which means that teachers must help each other in promoting valuable use of class time and encouraging students to think outside of the box, question possibilities around them and get intrigued in the probabilities of flipping traditional concepts of instruction into something new.

Quantum technology has not been purposely taught in the classroom although experienced daily. How about introducing this concept to young students to promote critical thinking, elevate student discussions/student talk, and expand their thinking beyond what is obvious. To develop instruction as per encouragement on teaching how to think and not what to think, modernizes the learning concepts that teachers normally teach into something innovative and would integrate culture in complex systems appropriate to the students' age for the next technological revolution. According to Park City Mathematics Institute (2017) Teaching probability to young learners is finding probabilistic knowledge, pedagogical and technological strategies and materials to engage students to:

a. develop critical thinking about the meaning of chance, and.
b. value the importance of applying the concept of probability in real life.

Teaching probability enhances students' way of thinking and challenges them to evaluate how they think, prove their thinking through different trials and experimentations, and provide decent proof of their theory based on the outcomes of their learning experimentations. Thus, they make sense of the role of probability in their lives and in mathematics. Different approaches to probability include the frequentist, classical, and subjective, among others (Batanero et al., 2016). Although not all approaches have equal importance to early childhood education, students need to be able to compute probabilities of events, model random data, interpret the results and make decisions accordingly in a variety of real-life situations they are likely to meet.

Content Objectives

Come to think of it, at first glance, we normally encounter making decisions and what would these decisions result in or guessing what the weather be or what will happen the next day, but have we put this thinking into concrete concepts? What is the probability of getting a tail when a coin is tossed twice? Or what is the probability of winning a tic-tac-toe game after playing for several times? We know that these concepts were introduced in higher education because of the stigma that they can learn these concepts better than the rest of the grade levels. However, challenging the status quo on introducing quantum technology in the form of probability and measurement with younger learners is a bit out of the equation.

Soon after birth, children learn different things from solving problems through their senses to make decisions by evaluating these perceptions. As early as one, they learn to evaluate situations happening around in their environment by reacting to them in forms such as crying, smiling, and many more facial expressions and body language. They learn to comprehend the ending results of their actions when they experience pain after touching something sharp or touching something hot for instance. They recognize that if they touch certain objects around them, that is, they are either going to get hurt because it is sharp or hot, or not. When they cry because they are hungry or need changing, and they observe the response from their parents, they recognize the probability of whether they will get noticed or not. That way, they react accordingly to the situation they have experienced. They cannot name or draw logical conclusions of these experiences, however, the idea of possibilities from their actions or of something to happen is realized.

Many educational philosophies suggest that children learn best through experience and that early experiences are especially important and significant for brain development. When children experience situations leading to learning firsthand, they are more likely to remember them. Hence, when they are trained to think critically in complex ways and perform student-led classroom academic conversations, they will remember what you teach. VanDerLinden, A. (2024), enumerated 10 ways to help children remember what teachers teach. In his article, listed the following; *give the kids opportunity to talk, share, and speak, utilize images, pictures, and videos, keep it simple, less is more, repetition is the key to learning, reach all the different learning styles, honor attention spans, utilize common objects, clearly define how to apply the lesson to their lives, engage five senses, and engage their emotions.*

In this curriculum unit, emphasizing training young children to be aware of their surroundings, questioning what is obvious, thinking critically through making assumptions and conclusions, deciding, solving problems, and evaluating possibilities of something to happen as a great contribution to learning. In the process, children are encouraged to be engaged in academic conversations or student talk in exploring the content of the curriculum.

The curriculum unit explores the topic of teaching probability to young students. While it has been proven that the study of probability in the early grades provides a stronger foundation for higher grades, it is more likely to also help young children to build upon this knowledge to more complex and subtle concepts. According to Bruner (1960) as stated by Taylor (n.d.), if the understanding of number, measure, and probability is judged crucial in the pursuit of science, then instruction in these concepts should commence as early as possible given that it is consistent with the child's form of thought. From there, let these concepts be developed and redeveloped in later grades.

The unit will alter technical terminologies to suit the audience vocabulary but will still adhere to the prescribed usage of words. Given that the topic can be associated with different subject matter, the unit will weave more than one subtopic from Math, English Language Arts, Science, and Reading for better understanding. Subtopics' difficulty level will also progress to encourage critical thinking.

Counting probability, telling their predictions, reviewing math concepts which can be combined into the discussion will be great opportunities to use Apache language. Integration of culture to my lessons for my Apache students will introduce them to the usage of their native language and later enhance their vocabulary and cultural awareness.

To dig deeper into the content of the curriculum in application to promoting educational innovations in teaching young children, it must deal with narrowing down and understanding elements of quantum technology to probability and measurement. Quantum technology works by using the principles of quantum mechanics including quantum entanglement and quantum superposition. Narrowing the topic even more, the unit concentrates on quantum mechanics also known as quantum physics. At a basic level, quantum physics/mechanics predicts very strange things about how matter works that are completely at odds with how things seem to work in the real world. Quantum mechanics is the study of how atomic particles exist and interact with each other. In simple words, it is the study of things that are very, very small. It investigates the

behavior of matter and the activities happening inside of atoms to make sense of the smallest things in nature. Understanding the behavior of atoms will help us understand the bigger things happening to us daily such as possibilities of two things that would likely to happen, or one of these two occurring. However, limiting the concept in such a way that young children can successfully grasp, the unit will focus on basic information of quantum mechanics on predicting specific outcomes without quantifying every outcome.

Probability is important in quantum mechanics because it can help predict the outcomes of experiments and make physical predictions. In this unit, altering terminologies is essential to help young children understand the concepts.

Scaffolding the lesson

Introducing new concepts and how to think in accordance with the new concepts are very difficult for students, especially the young ones. That is to avoid trying to pass on too much information to kids and have one focus. Also honoring their attention span is another consideration. Therefore, the unit will backbone its lessons on the following topics.

What is Quantum? What is quantum mechanics in relation to quantum technology?
This part of the curriculum lays its foundation on academic discussions on what quantum is. Introducing the term and providing a relationship of the term to the real world through sensory activities will build the pillars of the lesson. It will serve as a great way to introduce the new concept to children in visual representations and make connections to real life. From explaining what matter is as anything that takes up space and atoms as basic particles of the chemical elements which consist of protons, neutrons, and electrons. Obviously, these concepts will be altered through visual representations to model matter and atoms comprehensively in a simple way.

Furthermore, the unit will describe quantum technology and how it is related to quantum mechanics. That is quantum technology is all about using principles from the subatomic world to process information in new ways. As per quantum mechanics, it studies how these atomic particles exist and interact with each other. In other words, it describes the behavior of nature at the atomic and subatomic level and, as these atomic and subatomic particles interact, they form the idea of quantum probability.

What is quantum probability? What is its relationship with quantum mechanics?
This part of the unit will explore how quantum probability defines randomness of something to likely happen. As Albert Einstein debated the idea of even with the most precise measurement and carefully controlled experiments, there will always be some level where the outcome is effectively an educated guess. This unit will hold the idea of how likely something will happen between two or more possibilities like tossing a die. A regular die for example would obey the rule of classical mechanics where after tossing it the outcome of landing on one side would depend on the throw, the environment, and the surface it lands on. If the dice is controlled and obeys the rule of quantum mechanics, in this case, after throwing the die and before landing into the outcome, the die is in the state of superposition of all the possible results of six options from 1 to 6 until it settles for one when finally observed after landing on the surface. However,

Scientists have noticed that the way particles act between the starting point and the ending result does not make sense if the result is predetermined. That is, when quantum probability arises where there are many possibilities of having a certain outcome. In the case of the die, that is 1 in a 6 and in this case as well, when we do the measurement, there is 1 in 6 that one number will collapse (ending result) thus, we must account for every possible outcome. In the quantum case, it is impossible to predict with certainty until we do experiments over and over, then, therefore, we can say with incredible precision what the distribution of results looks like. In the end, everything is quantum and everything we observe is determined by probabilities.
Activities on this part of the unit are determined by several experiments on probabilities and measuring these probabilities in graphs, drawings, and/or texts.

What are the basic probability rules?
By the probability of a particular outcome of an observation we mean our estimate for the most likely fraction of several repeated observations that will yield that particular outcome. Therefore, there are different probabilities that may occur depending on what is being measured. In such, this part will deal with different basic probability rules.

a. Possible values for probabilities range from 0 to 1 or yes or no.
   0 = impossible event
   1= certain event
b. The sum of all probabilities for all possibilities outcomes is equal to 1.
c. Addition rule – the probability that one or both events occur.
d. Multiplication rule – the probability that both events occur together.
e. Conditional probability – the probability of an event happening given that another event has already happened.

Teaching Strategies

This curriculum unit is backbone from the common algorithms of probability which happen in everyday life. From framing the likelihood of an event to occur rather than just being told so in terms of thinking about multiple iterations of the same action with different potential outcomes, which is very different from just knowing what the outcome will be than the other way around. In early years of education, children can apply this concept in practical situations where they may or may not even notice. Some may be thinking or imagining them already just like getting a treat after finishing learning outputs or playing in the playground if they are behaving well. Imagine putting these concepts into sophistication where they are taught the labeling of these thoughts through proper word usage or terminologies which no doubt would very most likely attract a structural paradigm of thinking and build constructive ideas as one.

While the idea of probability is there, predicting multiple outgrowths from a single event requires the ability to grasp careful thinking thus probability revolves around being able to predict whether the outgrowth is certain, possible or impossible. Henceforth, being able to relate that information to existing ideas of young children is a tremendous step to awareness of quantum technology. The basic concepts grow and develop into a more mathematical understanding of likelihood as children learn to quantify their understanding (Jensen, 2022).

The whole curriculum dwells its foundation on getting the young children to think critically while enjoying play-based activities that provide opportunities for them to explore the wonders of probability in familiar child play. By supporting children's vocabulary with child-friendly usage of words yet not diverting the concept into misconceptions, this curriculum unit will tackle both STEM concepts and familiar play-based activities. Hence, giving that non-intimidating exposure to probability in English Language Arts, Mathematics, Reading and Science coincide with the notion of integrating all these concepts into one whole idea applicable to almost all activities that children do daily.

The unit is divided into sections where each section comprises mini lessons with vocabulary focus corresponding to certain topics and learning activities. Each section leads to production of output-based activities to tell how likely it is that something will happen or the possibility of something occurring on a certain event.

At the beginning of the unit, an introduction of the topic will be in a whole group discussion. Our discussion will be to focus on building the background of the lesson and introducing new concepts at the same time. Checking prior knowledge of the students as one of the introductory activities. Prior knowledge is important as it serves as a foundational building block for new knowledge. Activating this prior knowledge helps students see the connections between their previous learning and new instruction. When this happens, students will have a better understanding of the new information thus providing meaningful connections of what they are learning. On the other hand, teachers gain formative assessment information to adapt instruction.

Basics of Quantum Mechanics (Probability and Measurement)

As part of the introduction, talking about matter and atoms to explain the tiny particles that are existing around us. In doing so, we will be using some visual representations to explain the topic further. The class will go on a nature walk to find different types of matter. To build that introduction of explaining quantum mechanics further, students must conceptualize that everything around them comes up from very tiny particles or elements that exist and interact with each other just as how water flows, air is felt, and things are touched. These interactions within themselves and around them create the possibilities for things to happen. Have the students use their senses to activate the thought of the concept as it is their basis of connection to what we teach. Drawing a child's attention to the five senses and discussing them increases understanding of and communication about the world around us. Here are some other strategies that will be used to communicate new concepts and make sure students practice new thinking innovations discussed previously.

There are different strategies in this unit that are adopted in Developmentally Appropriate Practice (DAP) for early years of education, that is child development appropriateness. Some of these strategies are to *Implement Play-based Learning, Practice Two-Way Communication, Use Multisensory Instruction, Establish Rules,* and *Implement Hands-on Experience.* The unit will

Classroom Activities

While there are ever-growing values and competencies necessary for learners to thrive changing the world and technological innovations, the wide range use of data for prediction and decision-making has made mathematical instruction to help students develop their statistical and probabilistic reasoning (Franklin, 2007). This means that amidst different learning activities offered to early childhood education students, there are other objectives that are attached to those. Thus, all activities are interconnected to different learning objectives and dimensions which develop probabilistic thinking and reasoning for young students.

One of the essential elements of early childhood education is play. Friedrich Froebel, one of the fathers of early childhood education, believed that play is the highest expression of human development in childhood. He believed that play was vital in the learning process of young children. Thus, this curriculum will break the concept of probability and measurement into play.

In this curriculum, there are different learning activities incorporated in play. One of the components of a preschool classroom is Wonder Work Share where children are given opportunities to make decisions (Wonder), play uninterruptedly (Work) and express what they feel about their experiences (Share) during the day. In line with this, literacy, social emotional, physical, language, and cognitive areas of development were acquired and/or demonstrated. Whilst the children are making the most of what this component has, incorporating variety of activities in probability and measurement gives them a clear picture of what the concept means and how they encounter this in daily life. With probabilistic thinking, children will demonstrate literacy in what quantum technology is about by telling how the outcomes of each activity possibly happen after predetermined circumstances.

Personal Reflection

The teacher will post a question of the week "*What are the possibilities of something happening?"*. The teacher will explain the word *possibilities* and give examples of activities that children do every day in school and at home and ask them about possible things that may happen after certain events occur. With the given question of the week, the teacher will say different scenarios with 2 possible outcomes such as yes or no, possible or not possible and ask children to think of the possibilities that might happen after each scenario occur. These scenarios will be introduced to the children one at a time. As the children say their responses, the teacher will write them on the board to show how these possibilities can occur.

Brief Guided Discussion

As the children see their responses for each 2 outcome scenarios, the teacher will ask open-ended questions depicting how children decide their choices. Ask children how they come up with their response and what made them choose them. Children might respond based on their previous experiences at home, in school or elsewhere. Have the children share their thoughts. This time is the great opportunity to explain probability and measurement in simple terms such as possibilities and outcomes. Introduce the word probability and the words always, sometimes, and never, and possible and impossible. Explain how measurement comes in as they document them

responses on the board in graphs. Connect this discussion with the activities above. Introduce the learning goal and success criteria for the unit.

Differentiated Activities

In this part of the unit is where the children will demonstrate their skills in decision making and probabilistic thinking. Children will do a variety of activities listed below and determine the possibilities of something happening based on these learning activities which they will later be showing on a graph. The outcomes of these activities will be presented in forms such as bar graph and pictograph.

Learning activities are as follows:

1. Rolling dice – The teacher will place different attributes such as colors, shapes, numbers, letters, and photos on each face of the cube. These attributes will be introduced in English and Apache words and used in different instructional time and day. Children take turns to toss the dice while others predict the probability of 1 attribute as outcome. Each outcome will be recorded on the board and chart in a bar graph.

2. Tossing Coins – The teacher will introduce the two faces of a coin such as heads and tails. Then, model tossing a coin and identifying the outcome. Children will take turn if they can. If not, the teacher will be tossing the coin while children will predict the outcome and record the data on board.

3. Recording the weather –In a weather chart, children will predict the probability of having a rainy day, sunny day, windy day or a cloudy day. The days can depend on the season when the activity will commence. This is an opportunity to introduce or reiterate the days of the week and weather in Apache language.

4. Probability of attendance – Challenge the children to keep track of the current attendance of the day. Explain that they can predict if the next day would be a perfect attendance or not. Children make their smart guess of how the attendance would look like the next day. Teach how one can introduce her/himself in Apache as the teacher checks the attendance.

5. Possible and Impossible – Introduce the words “possible” and “impossible”. Read aloud the book “That’s a Possibility” by Bruce Goldstone. It is a book about what might happen and a good resource to explain the possibility and impossibility of something happening. Introduce a T- chart to compare, distinguish, and sort situations that are possible and impossible. Use situations on a day-to-day basis experienced by the children at home and in school for this activity so that students can relate. Interesting areas provide activities where children have the option to show their own possible and impossible ideas. This can be in a form of illustrations or writing for those who can. The next day can be a support day for children to strengthen their understanding of the concept of possibility and impossibility. Read aloud the story “Chicken’s only ones” by Ruth Heller. Talk about the large group/circle time, explain how chickens hatch eggs. Ask children to share different animals that they think hatch eggs. Elaborate on their responses. During the small group, prepare flashcards with different animal names and pictures. Children can choose an animal and complete the sentence “Can an (animal flashcard) hatch from an egg? That’s (possible or impossible)”.

6. Gumball Machine– to further support the concept of possibility and impossibility. Prepare a gumball machine with two different colored gumballs. Make sure that 1 colored gumball is more than the other (Ex. 4 yellow gumballs, 1 green gumball etc.) Introduce words such as certain, likely, unlikely, impossible and impossible. Explain that it is *certain* to get a gumball because that is the only thing inside the machine. It is *likely* to get a yellow gumball because there is a lot more yellow gumballs than green gumballs. It is *unlikely* to get a green gumball because there is only 1 gumball. It is *impossible* to get a red gumball because there are no red gumballs in the machine. It is *impossible* to get a toy because there are no toys in the gumball machine. Children can then change the colored gumballs to two different colored gumballs following that 1 is more than the other. Have them continue the same activity and complete the sentences accordingly.

Probability - discuss the concept and break down this concept into different learning activities through play.

1. What are the odds of getting a yes from a series of no options in a die.
2. What are the odds of getting red from a series of colored dice. etc.….
3. It is possible to get red from a series of 6 colors in some dice. How about a triangle in a series of 6 shapes? How about a number 1 in a series of 6 numbers? How about a letter A in a series of 6 letters?
4. How is it likely, unlikely, certain, impossible and possible to get an object from predetermined context.
5. How is it possible or impossible for something to happen?
6. Connect the results of each attempt to spatial positions of things around them in relation to self and other objects.

Measurement

1. Show data in bar or pictographs and a T-chart.

Student Assessment Plan

At the end of the unit, students will complete the learning goals that were set at the beginning of the unit. They will self-evaluate if they have accomplished all the set goals in the end. The teacher will also be doing pre- and post-tests through informal assessment. Observations by the teacher, collections of children's work samples, and performance on authentic activities such as outputs on visual art, group work, class academic conversations and individual performances in learning activities will support the success criteria of the unit.

Setting the learning goal and success criteria for the unit.
The teacher set the learning goals and success criteria for the unit at the beginning of the classroom activities. Thus, assessment will be based on these set norms.

Learning Goals:

1. We are learning to predict how likely it is that something will happen.
2. We are using the words always, sometimes, never, possible, impossible, certain, likely, and unlikely to express predictions of probability.
3. We are using graphs such as bar graphs and pictographs and a T-chart to show outcomes of different learning activities.

Success Criteria:

1. We can predict the outcomes of learning activities such as rolling dice, tossing a coin, recording the weather, probability of attendance, and determining if possible and impossible.
2. We can use the words always, sometimes, never, possible, impossible, certain, likely, and unlikely to say probability.
3. We can graph and chart the data of every outcome that will be shown in different learning activities using bar and pictographs and T-charts.

Alignment with Standards

This curriculum unit is aligned to Arizona Early Learning Standards. They are listed below.

Approaches to Learning Standard
Strand 5: Reasoning and Problem Solving

Language and Literacy Standard
Strand 1: Language

Mathematics Standard
Strand 1: Counting and Cardinality
Strand 3: Measurement and Algebraic Thinking

Science Standard
Strand 1: Scientific Inquiry and Application

Fine Arts Standard
Strand 1: Visual Arts
Strand 3: Creative Movement and Dance

The Bureau of Indian Education has the following standards for early childhood education that coincide with the objectives of this curriculum. These standards are listed below with several examples demonstrating the skills under which.

Operations and Algebraic Thinking
Understand changes in sets of objects
M-OA 1. Shows increasing interest and ability to match, sort and group items according to one or two attributes.

The child
• Chooses a matching game in the toy area and says, “Let’s match!”
• During Small Group Time, successfully sorts items into big red buttons and small blue buttons.
• While playing with dishes in the house area, put all the blue plates in one cubby and the pink plates in another. Says, “These green and black ones don’t match.”

Understand patterns, sequence and relationships.

M-OA 12. Recognizes and names repeating patterns.

The child

• Says, "The lines on my shirt go black, white, black, white, black, white."

M-OA 13. Extending simple patterns using a variety of materials.

The child

• When shown a series of dominoes, one up, one down, one down, child places the next two dominoes one up, one down.

• Child extends a rhythmic pattern: clap, pat, clap, pat. Then get rhythm sticks to repeat the pattern in a different way.

Measurement

Describe and use measures and compare measurable attributes.

M-M 2. Uses standard measures for simple measuring tasks (ruler, measuring cup, tape measure, scales).

The child

• Uses measuring tape to measure the height of a bookshelf.

• Measures a doorway with a yardstick to see if a wheelchair will fit.

M-M 3. Participates in measuring activities.

The child

• Joins other children at the sand and water table, filling up a sand bucket with measuring cups, and asks, "How many cups?"

M-M 4. Understands and uses descriptive words for size, amount and comparisons (more, less, same as, fewer or greater than, etc.)

The child

• Says, "Dora has more blocks than Jose."

• Rearranges the crayons on the table and says, "Now we all have two."

• Looks around the table at snack and says, "Mica needs another cookie to be the same as us."

Classify objects and count the number of objects in each category.

M-M 6. Sorts and classify objects into groups.

The child

• At Small Group Time, separate the pipe cleaners from the yarn into two groups.

• Sorts money into dimes, nickels, quarters and paper

• Talks about cows, sheep and horses being farm/ranch animals, but zebras and elephants are not.

M-M 7. Counts the number of items in a group.

The child

• Says, "Mrs. Smith's small group has six people and Mrs. Charley's small group has two."

Geometry

Shapes, Spatial Relationships and Position

M-G 4. Describes the position or location of objects in relation to self or other objects.

The child

- Says, "Stand in line behind me," and points to his back.
- When asked if the tree is taller or shorter than her, she says, "Taller!"
- Says, "The ball is under the bush" when asked where the ball is.
- Says, "The puppy is in the middle," when looking at a picture in a book.

M-G 5. Understands positional terms (e.g. between, inside, under, behind, over, under, in front, behind, etc.)

The child

- Stands behind Tate when asked to move there by the teacher. Puts crayons in her cubby when told, "Put your crayons in your cubby."

Resources

A pinch of Kinder. 2016. Teaching probability in kindergarten. Retrieved from http://www.apinchofkinder.com/2016/05/teaching-probability-in-kindergarten.html?m=1
A resource on teaching probability to younger children.

A short note on types of probability (2024).
Retrieved from https://unacademy.com/content/jee/study-material/mathematics/a-short-note-on-types-of-probability/#:~:text=Probability%20is%20of%204%20major,0%E2%80%9D%20and%20%E2%80%9C1.%E2%80%9D
A resource on different types of probability and explain activities under each.

Batanero, C., Chernoff, E., Engel, J., Lee, H., & Sanchez, E. (2016). Research on teaching and learning probability, ICME-13 Topical Surveys, DOI 10.1007/978-3-319-31625-3_1.

Boryga, A. (2023, January 9). Small shifts to limit 'Teacher Talk' and increase engagement. Edutopia. Retrieved from https://www.edutopia.org/article/limit-teacher-talk-increase-student-engagement-achievement/
A resource explaining the importance of shifting to student talk to increase student engagement.

Bruce, Goldstone. (2013). That's a possibility! Macmillan Children's Publishing Group.
The primary text while reading aloud about what might happen. It introduces children to the ideas of something being possible, probable, or impossible.

Bub, Jeffrey. (2016). How to teach quantum mechanics to kids. Oxford University Press's Academic Insights for the Thinking World. Retrieved from https://blog.oup.com/2016/03/teach-kids-quantum-mechanics/
A resource discussing quantum mechanics for young children.

Cibecue, AZ (2024) Best places. Retrieved from https://www.bestplaces.net/city/arizona/cibecue
A resource about the Cibecue community.

Dishchii'bikoh Community School. Retrieved from www.dishchiibikoh.org
A resource of the school.

Gan, I. (2021). Mental models and product #4: Probabilistic Thinking. Medium. Retrieved from https://medium.com/mental-models-product/mental-models-product-4-probabilistic-thinking-4a470ee351e9
A resource explaining probabilistic Thinking.

Gift of Curiosity. (2024). A fun way to introduce your kids to the concept of probability. Retrieved from https://www.giftofcuriosity.com/a-fun-way-to-introduce-your-kids-to-the-concept-of-probability/
A resource on different learning activities to talk about probability to young children.

Greenwood-Lang, (n.d.). Teacher talk vs student talk. Emilyjlang. Retrieved from https://emilyjlang.weebly.com
A resource about the distinction of student talk and teacher talk.

Heller, Ruth. (1981). Chicken's aren't the only one.
A read aloud text describing animals that can hatch eggs. This will be used for the concept possible or impossible.

National Center for Families Learning. Family and Child Education. (n.d.). BIE Preschool Standards and Mathematics. Retrieved from https://face.familieslearning.org/resource-center/preschool/
A resource on the Bureau of Indian Education Preschool Standards.

Park City Mathematics Institute. (2017). The importance of teaching probability. Retrieved from https://projects.ias.edu/pcmi/hstp/sum2017/int/briefs/ImportanceofTeachingProbability.pdf
A resource on how children should be introduced to probability at a young age.

Perimeter Institute for Theoretical Physics, (2023). Quantum 101: Quantum probability explained.

Statistics Resources. (2024). National University Academic Success Center. Retrieved from https://resources.nu.edu/statsresources/
A resource on details about different resources on probability.

Scratch Garden. (2021). Simple probability math for kids: Certain, possible, impossible. Retrieved from https://scratchgarden.com/blog/simple-probability-math-for-kids-certain-possible-impossible/
A resource introducing the concept of chance and probability and the language used to make predictions about events.

VanDerLinden, A. (2024). 10 Ways to help kids remember what you teach. Crossroads Kids Club. Retrieved from https://crossroadskidsclub.com
A resource on helping teachers help young children to remember what they teach.

White Mountain Apache Tribe (2022). Retrieved from http://www.wmat.us/index.html
A resource on White Mountain Apache Tribe, Government, History/Culture, and People.