Measurement alters state: Qubits, undergo state changes when measured

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Teacher Leadership Shiłgozhóó Institute

2024

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Acknowledgement

This paper and the research behind it would not have been possible without the exceptional support of my Research Director Dr.Ines Montano. Acknowledgement for the INE Team, Dr.Darold Joseph, Denyse Herder, M.Ed & Zoe Lawrence, M.A, thank you for allowing us to create a curriculum unit that focuses on learning about the culture of the community we serve. Thank you, Dishchii'bikoh Community School, administrators, staff, students, and community, for recognizing the importance of racial diversity in education. My paraprofessionals Tasha Lupe and Diane Early-Bendle for reinforcing this curriculum and for their dedication to our students with special needs. Lastly, to my husband Arch. Rei Minguez, children Benedict & Juan Felix and my father Engr.Rolando Beramo, for the immeasurable love and support.

Context

Cibecue is a village on the Fort Apache Indian Reservation, also known as the White Mountain Apache Reservation, northwest of Whiteriver, the primary tribal center. The 2010 Census estimates that there are roughly 1,700 enrolled tribal members in the locality.

Dishchii'bikoh Community School is a one-school district located in Cibecue City, Arizona's Navajo County. Alternatively referred to as Cibecue Community School. Since 1991, the Bureau of Indian Affairs has provided the majority of the funding as a K–12 Title I Grant school. Legally recognized non-profit organization under Cibecue Community Education Board, Inc. 501(c)3.

The purpose of the school is to provide for the needs of the families and children living in Cibecue and the nearby White Mountain Apache Reservation towns. The institution takes great pride in emphasizing both academic success and the preservation of Apache culture and language.

Students, ages 4 to 21, attend Dishchii'bikoh Community School, which is southwest of the center community area. Currently there are 592 students enrolled in grades Pre-K–12, with a 13–to–1 student–teacher ratio. (Niche, 2024)
Through the school's Apache Language Program, all students acquire the skills necessary to read and write in their native Apache language in order to preserve it. Parents and children are also encouraged by the school to use the native language used mostly in their home. They declare with pride that almost 90% of the pupils speak Apache fluently, enhancing the school's pride as they concentrate on not just on scholastic success, but above all, in the preservation of the Apache language and tradition.

In addition, through initiatives like STEM (Science, Technology, Engineering and Math) and TAG (Talented and Gifted), Dishchii'bikoh Community School aims to give Apache students in the community of Cibecue and neighboring towns an excellent education and with the nearby community college, the Community School gives students access to programs for work.

With a Mission Statement “For Everyone, A Way to Learn, Grow, and Succeed”, The goal of Dishchii'bikoh Community School is to foster academic success through collaboration with families, students, and the community. Dishchii'bikoh Community School will have an environment that honors the language and culture of the Apache people. It will also use tribal characteristics to increase student awareness of and appreciation for their rich Apache heritage while giving them the chance to grow as individuals and as intellectual, emotional, social, and physical adults in order to succeed and make a positive impact on both tribe and the larger community.

The curriculum for this unit is, Measurement alters state: Qubits, undergo state changes when measured. The activities will cover the young learners to understand why the outcome of measuring a qubit change even though the system has not changed.

As a foreign educator from the Philippines, I am tasked of teaching the majority of subjects—reading, writing, math, science, and life skills K–12 students with special needs. I am using the Arizona Curriculum standards in my class. In line with that, I want to develop a curriculum to assist my students to comprehend the newest developments in the field of education and on how to apply this in real life situations.

The ongoing effort to create a sense of the school community is one of my favorite aspects of our school, and I have taken it into consideration when it is in view of the environment in which I work. Dishchii’bikoh Community School have worked on numerous projects where students from all classrooms and grades have contributed to a school-wide endeavor.

This community of instructors, parents, and students seems to be searching for fresh, demanding educational opportunities that will include the children in real-world activities outside of the classroom. I will also consider students whose families may not be as supportive or has a challenging situation.

Additionally, the school has given financial assistance, which is fortunate to have access to a variety of excellent instructional technologies.

Finally, I want to balance my curriculum to emphasize both local and global learning. My research issue concerns instructional methodologies and student engagement with respect to the newest development in education—quantum technology. In order to help students make personal connections to their learning so that it means more to them than just a grade and that they can take more ownership of their own learning and see it as meaningful to them, I hope to accomplish this through creative questioning and discourse, teacher modeling, and reflective activities. In order for the students to be at their best and reach their maximum potential, I will also be attempting to add various forms of assessments that can aid in self-evaluation.

Rationale

“I touch the future, I teach, I am making an impact” this is my mindset mantra. I strongly believe that as a teacher I have the ability to influence someone without using force or in a subtle but typically significant way. When an individual has a positive influence on someone, that person has a lasting impression to alter someone’s perspective in life and will help them to grow and learn more. In that sense, I believe that the foundation of our society will install curiosity and creativity, develop a skilled individual, and empower informed citizens. As an educator, I know that I can provide learning opportunities for my students, motivate them, and push them to reach their maximum potential.

I have been in a teaching position for more than a decade, and it's been an exciting journey. I have two strong mentors in life, my father retired Engr.Rolando B. Beramo who has been very supportive, understanding and developed a positive self-esteem in me. He had a huge impact on the development of my positive self-concept and life philosophy. And my mother Luz B. Beramo (deceased) for she assisted me to comprehend the reality of life.

When I was granted the opportunity to teach in the United States, I was excited and anxious at the same time of the position that was given to me. My first teaching position back at the East Coast was a Media Specialist, for students in grade school. My assigned task was merely to establish the use of technology and other learning materials and to enhance the use of these in collaboration with teachers to support students’ learning. In addition, I frequently collaborate with the teachers to locate resources that complement specific lesson plans, enhance their curriculum, make recommendations for extra materials, and provide assistance in constructing interesting and effective assignments.

As I continue my career in teaching in the United States, I moved into Arizona not just to experience the stunning landscape and wilderness of this state, but also to learn and to have the opportunity to connect more with indigenous culture. I want to discover the rich history and traditions of the Indigenous people in Arizona, where art and culture remain a key influence throughout the state.

I relocate from Eastern to Mountain as Special Education Teacher for K-12 at Dishchii’bikoh Community School, located in the White Mountain Apache Tribe of Cibecue. The school has a small population, the atmosphere is good, and I am free to teach at the pace at which I know my students will flourish.

While I’m learning and adopting the culture of the community, and in line with the Dishchii’bikoh Community School’s mission “For everyone, a way to learn, grow, and succeed,” I have these ultimate goals that I want to accomplish. These are to assist the students to feel more at home at school and understand how their home and school culture may complement one another to build their cultural and scholastic identity. And, to instill strength and resiliency, promote good identity development, and support tribal sovereignty.

I applied to Northern Arizona University's program to build an interesting curriculum that incorporates Apache history, culture, and traditions and to cope with the advancement of

Education. This is my opportunity to share my understanding of Apache culture, traditions, and stories. Wherein they are known in arts and crafts, making bows and arrows with stone tips, and the ability to adapt and incorporate new technologies such as metal arrowheads acquired through trade once European contact occurred, eventually transitioning to firearms when available; their nomadic lifestyle meant they were adept at building portable shelters such as wickiups and tipis, as well as tanning animal hides for clothing and shelter materials.

However, Native American children according Casey (2017) face a number of challenges, including the legacy of forced assimilation through boarding schools, which has resulted in the loss of culture and language, high rates of poverty, exposure to violence, a lack of access to quality education, and a higher prevalence of adverse childhood experiences (ACEs) due to historical trauma from colonization, which has resulted in mental health issues and academic difficulties when compared to other demographics.

Also, Native American students in the United States confront a variety of obstacles, such as low educational performance, financial hardships, and lack of curricula that are culturally appropriate.

In Cibecue Arizona, which is operated by the White Mountain Apache tribe, the students in the community faces numerous daily hurdles. Cibecue students have a significant challenge due to their rural location and limited access to essential educational resources like fast internet access. Many residents of the tribe lack internet connection, and students often lack digital equipment like computers and laptops. The students from Apache do not have access to the same resources as the students from metropolitan regions.

With the opportunity given by the Northern Arizona University's Teacher Leadership Shiłgozhóó Institute I will develop a curriculum that will introduce Quantum Technology for the students of Dishchii'bikoh Community School and teach them how to use it not only in the classroom, but on how to incorporate this in their daily life. While preserving their cultural customs, I aim that my students in Special Education will be conscious of the quick advances in technology.

I believe that it is possible to foster critical thinking, imagination, and creativity in elementary and students with special needs by teaching them about quantum technologies. It can also introduce students to math, science, technology, and engineering—interdisciplinary courses. (Holincheck, N., 2024). For further reasons, elementary and students with special needs should be taught about quantum technologies for:

Opportunity And Accessibility

Students from underrepresented STEM fields can benefit from understanding quantum ideas as they prepare for a more varied career in the field.

Spark Excitement

Students that are exposed to quantum science early in life may become enthusiastic and decide to pursue STEM careers in the future.

Enhance Public Opinion

It is possible to raise public awareness of quantum information science (QIS) and enhance public perception of it by beginning early and using a conceptual approach.

Close The Gender Disparity

Given that STEM fields are now dominated by men, early exposure to quantum computing may inspire more girls to seek these occupations. (Dawton, 2023)

Improve The Educational Process

An immersive multimedia environment that incorporates text, pictures, videos, simulations, animations, and tutorials can be used to interest students in learning quantum physics.

Provide Fresh Opportunities

Encouraging students to learn the fundamentals of quantum computing can lead to new opportunities in the quantum technology industry.

In order to effectively introduce students to quantum technology, it is crucial to teach qubit measurement since it allows them to compare and comprehend different quantum technologies. The most basic type of quantum system is called “qubits” or “quantum bits”, and they serve as the cornerstone of quantum technology. They can represent any value in between their two states, |0> and |1>, a process known as ‘superposition’. Because of this feature, quantum computers are able to execute multiple tasks at once, potentially outperforming traditional computers by millions of times. (Doherty, 2020). Although measuring qubits in a system can yield classical information from quantum states, it also has the potential to cause mistakes and upset the qubits. Since measurements are irreversible, it is impossible to restore the initial superposed states. On the other hand, sophisticated methods such as partial and mid-circuit measurements can aid with quantum information preservation, dynamic algorithms, and error correction.

What a qubit is, how it differs from bits, and how it is comparable to bits should all be taught to students in the classroom. Students would be better able to appreciate both the potential and constraints of quantum information and computation if they had a deeper understanding of the unique characteristics of qubits.

Qubits are described by a wave function and exist in a superposition of 0 and 1. The wavefunction compresses during measurement, pushing the qubit into one of two states: either 0 or 1. A measurement's outcome is always probabilistic since it is based on the wave function.
A qubit collapses from a superposition of states into a definite state of either 0 or 1 when measured in quantum information. This is an irreversible process that turns the qubit into a classical bit by removing its quantum characteristics. The measurement's outcome is probabilistic and is reliant on the qubit's superposition amplitudes. (EITCA, 2023)

However, when a qubit is measured in the world of quantum information, various fascinating events emerge. The superposition collapses into either 0 or 1. The likelihood of measuring a specific outcome depends on the amplitudes α and β. For example, if $\alpha = 1$ and $\beta = 0$, the qubit is always measured as 0. This collapse impacts not only the measured qubit, but potentially the entire system. This is due to "entanglement," a quantum feature that permits several particles in different regions to simultaneously be in superposition. (EITCA, 2023).
When a qubit is measured in the sphere of quantum information, it transforms from a superposition of states to a determinate state. The measurement outcome is probabilistic and determined by the amplitudes of the qubit superposition. Following measurement, the qubit loses its quantum features and operates like a conventional bit.

Also, the measurement outcome is probabilistic in nature. Even if the qubit is produced in a certain state, the measurement outcome will be random, dictated by the probabilities of the amplitudes. Once the measurement is completed, the knowledge about the initial superposition state is gone. This is known as the collapse of the wavefunction and is a basic notion in quantum mechanics. In addition, the process of measurement can be viewed as collapsing the wave function of the qubit, which characterizes its superposition of 0 and 1. The result and the amount of information that may be gleaned from the qubit depend on the measuring foundation that is used. Measuring the projection of a qubit's state vector along a specific axis, like the z-axis, is one method of determining a qubit's state.

Content Objective

One of the best ways to introduce students to transdisciplinary science, technology, engineering, and math is through quantum computing. Scientists and educators agree that early exposure to quantum information science is essential for preparing K–12 kids for advanced science and math courses in college as well as for professions in related sectors. (Brown, 2023).

Quantum education in grades K-12 is still in its early stages. The Q-12 community is now working to offer both informal and formal learning opportunities for teachers, students, and families. This includes new lessons, events, access to quantum technology, and job information.
Starting quantum education in K-12 allows a bigger, more diversified pool of students to learn about this interesting topic, preparing them to be future leaders in this quickly increasing sector.

Quantum computing has a wide range of possible uses, and it will be crucial in determining how technology develops in the future. But for quantum computing to reach its full potential, we must make sure that students are ready for a world of quantum computing.

Early exposure to quantum science can contain information on applications and societal relevance, which should stimulate curiosity and encourage more kids into later coursework and professions in Science**,** Technology, Engineering, and Math (STEM). Starting early with a conceptual, intuitive approach that does not rely on sophisticated mathematics will most likely improve quantum awareness with more students at different levels.

Because existing Quantum Information Science (QIS) materials are intended for more advanced students, they must be updated to be age-appropriate and built on prior knowledge of target students.
Therefore, classes should focus on the following considerations:

1. Maintain a friendly environment that promotes inquiry and exploration.
2. Offer collaborative, experimental activities.
3. Provide a low stakes teaching environment (e.g., less time pressure without aggressive assessment)
4. When relevant to the STEM subject, use a learning cycle approach to construct models of quantum systems and phenomena.

The topic of quantum computing is expanding quickly and has the potential to completely transform many different academic disciplines. For the students to understand Quantum technology, the learning materials should be familiar, interesting and can easily be used by the students at any level.

Quantum object known as ‘qubit’ is needed to develop quantum computers and other quantum information technologies. In quantum computing, a qubit (or quantum bit) is the fundamental unit of information, just as a binary bit is in classical computing.
To define a qubit, it requires an unlimited number of bits because it is "continuous" as expressed by complex numbers.

Moreover, Qubits are represented by a superposition of multiple possible states. A qubit uses the quantum mechanical phenomena of superposition to achieve a linear combination of two states.
A classical binary bit can only represent a single binary value, such as 0 or 1, meaning that it can only be in one of two possible states.

In the classroom, students should learn what a qubit is and what makes it similar to bits and what makes it different. Also, what will happen to a qubit if it is being measured. By this, the young learners will have a deeper understanding of the special properties of qubits that would allow them to grasp the possibilities as well as the limitations of quantum information and computation.

In quantum computing, qubit measurement is crucial because it makes it possible to retrieve classical information from quantum states. EITCA (2023) enumerated some reasons why measuring a qubit is important:

Retrieving traditional data

It is possible to obtain classical information from a quantum system by measurement.

Quantum algorithms for computing

A key component of quantum computing techniques is the measurement property where the qubit collapses into a base state and stays in that state after measurement.

Intertwining

When qubits are entangled, no matter how far apart they are, measuring one qubit instantly changes the state of its entangled partners. This has the potential to improve the efficiency of complex calculations in quantum computing.

Correction Of Errors

Quantum error correction algorithms rely heavily on partial measurements, which involve measuring only a portion of the qubit population. Errors can be found without collapsing the quantum states of the computational qubits by monitoring specific qubits, known as Ancilla qubits. Qubit measurements are made in order to retrieve classical information from quantum states. For tasks like error correction and dynamic algorithms, advanced methods like mid-circuit measurements are crucial.

In the realm of quantum information, a number of fascinating events can be observed when measuring a qubit. A thorough understanding of qubits and their characteristics is essential in comprehending what takes place during the measuring process. A qubit collapses from a superposition of states into a single, distinct state when measured. The result of the measurement is probabilistic and is dependent on the superposition amplitudes of the qubit.
Now, the superposition collapses into one of the two possible measurement outcomes, 0 or 1, when a qubit is measured. The likelihood of observing a specific result is contingent upon the values of α and β. For instance, the qubit will always be measured as 0 if $\alpha = 1$ and $\beta = 0$. Conversely, in the event that $\beta = 1$ and $\alpha = 0$, the qubit's measurement will consistently be 1. Generally, the squared magnitude of the associated amplitude indicates the likelihood of measuring a 0 or 1. (EITCA, 2023)

Nevertheless, the observer effect makes the measurement procedure flawed since it can cause errors and perturb the qubits throughout the measurement process. Because measurement modifies the quantum state irrevocably, it is also essentially destructive.

The qubit loses its quantum characteristics and starts to behave like a conventional bit after it is measured and collapses into a defined state. One way to conceptualize the measurement result is as a classical bit that may be handled and modified through the use of classical logic operations. It is crucial to remember that the results of the measurements are probabilistic. According to the probabilities established by the amplitudes, the measurement result will be random even if the qubit is prepared in a certain state.

The qubit's superposition state is irreversibly disrupted, and its coherence is destroyed during the measuring procedure. It is impossible to measure a qubit and keep it in its initial state since the qubit's state always transforms into one of the basis vectors.

Since a quantum bit, or qubit, undergoes state changes upon measurement, the learning goal of this curriculum unit is to recognize that the object being measured may alter as a result of the measurement technique.

Teaching Strategies

In the classroom, students are given a daily routine at the beginning of the school year that they are expected to follow. The subjects, their schedule, the resources they would be using, and even their seats in the classroom were all explained to them.

To accomplish this curriculum, the following classroom strategies will be implemented:

Visual, Aural, and Kinesthetic (VAK) senses

Teachers can use a variety of techniques from Quantum Learning to engage students' visual, aural, and kinesthetic (VAK) senses. It is important to make an effort to better address the needs and learning strengths of our students, especially the young learners and students with special needs in order to help them become greater academics by implementing these tactics and adding more VAK strategies into the classroom.

As mentioned, students learn in different ways, some are visual learners wherein they prefer to get knowledge in the form of visual aids and kinesthetic materials, pictures, videos or illustrations. These students prefer to see examples or demonstrations. They enjoy schematics and images. With this, I can also utilize some movies or video clips in teaching. While listening to the information for auditory learners. This teaching strategy is effective for these students which includes lectures and speaking exercises wherein they can share and converse with one another. For those who are kinesthetic learners, information is best received through motion. This could involve any activity that requires a student to be physically active, such as standing and moving around. These are the students who enjoy participating and like to get their hands dirty. It is the students who wish to carry out the experiments.

Collaborative Learning

This involves students working in groups to learn from one another, solve issues, and answer questions. It can be done in pairs, small groups, or huge teams.

Differentiated Instruction

Differentiation refers to adapting training to match individual requirements and learning needs of the students. The materials, processes, and products will pair the needs of the students to reach out to an individual or small group to alter the teacher’s style of teaching to produce the best learning experience of the student if possible.

Cultural Integration

This can help the students develop empathy, critical thinking, and problem-solving abilities while also improving their academic achievement. Also, learning about one's own culture allows the students to comprehend their own identity.

Inquiry-Based Instruction

It is a variety of instructional strategies that support students' learning by guiding and, more and more, allowing them to independently investigate difficult issues and questions, many of which lack a definitive solution.
Students receive assistance in sharpening their skills by asking insightful questions, identifying what needs to be learnt and the resources needed to answer those questions, and sharing what they have learned with others.

Growth Mindset

It is the conviction that learners may improve their intelligence and skills over time by working hard, learning new things, and being persistent. Based from Hogarty (2022), the idea that one's skills are not innate but may be enhanced with work, education, and perseverance is known as a growth mindset. Having a growth mindset is all about how someone approaches obstacles, how they deal with setbacks, and how they change and grow as a result.

Literary Work

Together with the other classroom strategies, Literary Work will also be implemented in the class. Participation in class in pre-reading, reading, and/or post-reading, as well as vocabulary building will be a part of the class activities.

This curriculum unit will use three books of Native American Stories for the younger learners in general and special education. I will offer the following activities to help them comprehend why measuring a qubit change even though the system has not changed.

The books that will be used are :

1. Fry Bread: A Native American Family Story
   Author : Kevin Noble Maillard
   Illustrated : Juana Martinez-Neal

2. Look Grandma, Ni Elisi!
   Author : Madelyn Goodnight

3. Inch by Inch
   Author : Leo Lionni

Vocabulary Building

Before reading the materials, the students are prepared via vocabulary building. Its objective is to motivate students to actively think about word meanings, word connections, and word usage in diverse settings. This type of comprehensive, rich training to influence comprehension is the

most likely method to do so. One-on-one or small group reading, illustration, matching types, simple sentence writing, practicing context clues, sentence completion/gap fill sentences, and other activities can all help with vocabulary building.

Pre-Reading

Using visual organizers, illustrations, and sequences of events, pre-reading exercises include students in the various Key Ideas found in the book as a type of interactive reading. The graphic organizers are meant to be used for brainstorming ideas or topics by providing a comparable flow of ideas or relevant information. Students can easily transition to reading by activating their schema, or prior knowledge and experiences, through pre-reading practice, which also helps them to be prepared.

Reading

At this point, the students will read aloud or have a small group reading for those who need extra assistance. Literary Proficiency to help the students understand which reading and literary skills they will need to apply in order to completely comprehend the text, focus is discussed before reading. To ensure they understand the material, they must complete a series of reading comprehension tasks both during and after they read. The purpose of the simple comprehension questions is to help students grasp the stories' deeper meanings and relate the story to the curriculum unit. Effective questioning techniques help students make inferences. Asking the student, "What information is concealed and what might happen next and/or why the measurement changes" makes them think.

Post-Reading

After reading, readers engage with the material to expand their comprehension, knowledge, and thinking. Encourage the students to reflect on what they read to help them remember it.

Classroom Activities

When anything is measured, it usually remains the same both before and after the measurement. There are things that remain unchanged before and after the measurement. One example is measuring a table, the table remains in the same before and after measurement. However, there are things that measuring might alter what we are calculating.

In quantum mechanics, a qubit's state changes when it is measured because the measurement process "collapses" the wavefunction, causing the qubit to change from a superposition of several possible states into a single, distinct state, either 0 or 1 (MacCormick, 2023). In other words, the interaction with the measurement device actively affects the qubit's state, in contrast to classical measurements that passively read information without changing the system.

The following activities will help the young learners and students with special needs to understand why the outcome of measuring a qubit change even though the system has not changed.

Videos

How Does a Quantum Computer Work?
https://www.youtube.com/watch?v=g_IaVepNDT4

Little Qubit Goes to the Kindergarten, The.
https://www.youtube.com/shorts/ixjWBUkx1e4

Quantum Computing For Babies - Read Aloud Kid's Book
https://www.youtube.com/watch?v=nhi-AudcSkE

Quantum Computing In 5 Minutes | Quantum Computing Explained | Quantum Computer | Simplilearn.
https://www.youtube.com/watch?v=X8MZWCGgIb8

Quantum Computers Explained – Limits of Human Technology
https://www.youtube.com/watch?v=JhHMJCUmq28&t=112s

What is a Qubit? - A Beginner's Guide to Quantum Computing
https://www.youtube.com/watch?v=90za6mazNps&t=134s

Read-Aloud Activity

1.Fry Bread: A Native American Family Story
Author: Kevin Noble Maillard
Illustrated: Juana Martinez-Neal

The book is about a contemporary Native American family and their friends baking fry bread together. The sizes of the fry bread comes in different measurement and sizes.

2.Look Grandma, Ni Elisi!
Author: Madelyn Goodnight

About a child named Bo who is looking for the appropriate container to display his traditional Cherokee marbles on the Cherokee National Holiday. Bo experiments with many containers until he finds the appropriate one, with the assistance of his grandmother.

3. Inch by Inch
Author: Leo Lionni
This tiny inchworm can measure everything, even a robin's tail and a toucan's beak. When a hungry nightingale threatens to devour him for breakfast unless he measures her song, the inchworm must carefully solve the conundrum.

Throughout these tales, people measure a variety of objects (such as the size of the fry bread before and after it is being cooked, looking for an appropriate size of contained and the length of a bird's tail in Inch by Inch). Then ask the following questions to the participants to get them to consider the various ways that we measure things: What precisely were they measuring? In what way was it measured? Why was that the way they measured it? When they took a measurement, did anything change?

Small Group Activity

Materials:

- Measuring form
- Writing Materials
- Stick and Feather Lollipops
- Augmentative and Alternative
  Communication (AAC) device – for Non-Verbal learners
  Feather lollipops are used to represent the *Feather* which is a significant symbol to the Native American Culture. The symbol is highly respected and represents great honor, strength, power, intelligence, trust, freedom and a connection to the Creator

During the Activity:

1. Present a sample of the feather lollipops and candy sticks to the participants and inform them that while they can't eat them yet, they will eventually be able to.
   Encourage conversation about the following query: How would you gauge a feather lollipop or candy stick flavor if you were given one?
   a. Encourage the students to think of different methods for determining a feather lollipop or candy stick flavor.
   b. Assign participants to distribute throughout the broader group. A little possibility Among the answers are to : open the package, examine the color, taste, smell.
   c. Make a chart of the concepts for further reference.

2. Inform participants that they will be using four different techniques of measurement for the rest of the activity: (1) looking, (2) smelling, (3) tearing something open and sniffing, and (4) tasting. Encourage a conversation on destructive and non-destructive techniques.

3. Give the feather lollipop and candy stick and a measuring worksheet to each participant.

4. Follow these steps for measuring: (1) examining, (2) smelling, (3) cracking open and smelling, and (4) tasting.

**Weekly Lesson Plan will be prepared for the activities.*
(See Annex B)

Student Assessment Plan

Informal Observation

This will be used to evaluate students' abilities and growth in the classroom without depending on grades or other reports. To get qualitative information about the students' performance, the teacher can watch them while they play or work on assignments. Students may act more spontaneously and offer a more objective perspective because they are typically not aware that they are being watched.

Measuring Form

Since it enables teachers to better understand their students' learning and enhance their instruction, measurement form is an important component in the classroom assignment to write down the understanding of the students.

Question and Answer

The question-and-answer format is essential for student learning in the classroom because it actively involves students in the content, fosters critical thinking, helps pinpoint areas of comprehension and misunderstanding, stimulates discussion, and enables teachers to assess students' understanding, all of which contribute to deeper learning and knowledge retention.
During the activity, participants will employ four means of measurement. These are looking, smelling, touching and tasting.

To find out how many licks it takes, for instance, to reach the center of the feather lollipops or candy stick, the students may lick the candy until it reaches the center, which implies that the candy will change its color and size while the student is measuring it. It is frequently crucial in science that the measurement technique "intrudes" on the object of the measurement.
Simple values are stored in memory by classical computers, and when you read from memory, the storage devices can measure and hold the value. Molecularly speaking, however, quantum computers are in an extremely delicate and complicated stage. There isn't a measurement tool available that can take reading without drastically altering the data being recorded.

- After each measurement (looking, smelling, touching and tasting), the teacher will ask participants or assist them to record their views on the measurement form. Record their perception of the flavor, which may differ from previous thoughts based on new information they gathered information from the present measurement.

- Following their initial attempt at using each measuring method on the feather lollipop or candy stick, participants may ought to try them again with a lollipop of a different color.

- Depending on the time, each participant should try each approach with at least two lollipops or candy and note the outcomes. With moderate to minimal assistance, participants should answer the worksheet question, "Which method do you think is best for figuring out the

flavor of the lollipop or candy?". After trying two or more lollipops. Why do you believe that?

During the informal observation,

1. questions may be asked to assess the students' understanding about the activity.

    a. What technique(s) would you employ to guarantee an accurate outcome? What are the advantages and disadvantages of this method?
    b. How much knowledge about the lollipop or candy did you gather by examining and smelling, nondestructive methods?
    c. How much knowledge about the lollipop did you get by opening them up and tasting and smelling them?
    d. Can you think of any additional instances when anything we measure causes the item we are measuring to change?
    e. Do you believe that knowing if the object is altered by the measurement is important?

2. Participants should be informed that qubits in quantum computers have complex states that include being both 0 and 1 at the same time. The measurement tools are destructive and can only determine a value of 0 or 1, hence there is not a non-destructive alternative. An attempt to measure an event or entity at the quantum level results in alterations to the original object of measurement.

3. Ask participants to complete the Measurement worksheet. Once they have finished, consider starting a discussion to give others a chance to voice their thoughts.

Alignment with Standards

This curriculum makes use of the Arizona Curriculum Standards for the following subjects:

Mathematics

Measurement and Data (MD)
1.MD.A. Measure lengths indirectly and by iterating length units.

1.MD.A.1. Order three objects by length. Compare the lengths of two objects indirectly by using a third object.

1.MD.A.2 Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. (Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps.)

2.MD.A Measure and estimate lengths in standard units.

2.MD.A.1. Measure the length of an object by selecting and using appropriate tools (e.g., ruler, meter stick, yardstick, measuring tape).

2.MD.A.2. Measure the length of an object twice, using different standard-length units for the two measurements; describe how the two measurements relate to the size of the unit chosen. Understand that depending on the size of the unit, the number of units for the same length varies.

2.MD.A.4. Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard-length unit.

Reading Standards for Literature

1.RL.1 / 2.RL.1. Ask and answer questions such as who, what, where, why, when, and how about key details in a text.

1.RL.2 / 2.RL.2. Retell stories, including key details, and demonstrate understanding of their main idea, central message, or lesson

Physical Science Standards

K.P2U2.2. Design and evaluate a tool that helps people extend their senses.
Background Information: People use their senses to learn about the world around them. Their eyes detect light, their ears detect sound, and they can feel vibrations by touch. People also use a variety of devices to communicate (send and receive information) over long distances. 4 (p. 137) Objects can have an effect on other objects even when they are not in contact with them.

Conclusion

Even though quantum technology may appear complicated at first, young learners and students with special needs can gain a lot from studying it. Introducing them in Quantum Technology where education is leading to has the advantages stem from the learning process's flexibility and accessibility as well as the potential of quantum technology to impact education, problem-solving, and future employment. Students could gain from learning quantum technology in the following ways:

1. *Improvement of Problem-Solving and Critical Thinking Capabilities*
   Abstract ideas like qubit, quantum computing, quantum physics, and entanglement are all part of quantum technology, can aid young learners and students with special needs in honing their critical thinking abilities. These subjects demand logical and creative thinking from students which might promote mental agility and cognitive development. Being exposed to

such topics might help the child to develop their problem-solving skills and broaden their perspective, even if they don't fully understand the sophisticated parts.

2. *Encouraging Participation in Developing Domains*
   Students will get the opportunity to learn about cutting-edge topics that are influencing the future by studying quantum technology. Because of this inclusiveness, they have equal access to education and the chance to eventually contribute to fields like materials science, cryptography, and quantum computing. Additionally, their participation can help close the gap between accessibility and current technology breakthroughs, resulting in more inclusive technologies.

3. *Enhanced STEM Proficiency and Upcoming Career Prospects*
   Important STEM (science, technology, engineering, and mathematics) abilities can be developed in students with special needs through exposure to cutting-edge sectors like quantum technology. A basic understanding of quantum technologies may pave the way for future employment in tech, programming, engineering, and even research. These abilities are crucial in today's environment. Students gain confidence in a competitive job market and expand their future employment options as a result, which empowers them.

4. Strengthening Cooperation and Interaction
   Projects involving quantum technology frequently call for cooperation and coordination, which can greatly benefit young learners and students with special needs. As students with varying learning styles cooperate to achieve a common objective, collaborative settings can aid in the development of social skills. In addition to encouraging conversation and idea sharing, this experience builds a sense of support and community.

5. *Advocating for Accessibility in Technology*
   Advocates for more accessible quantum technology might also be students with special education needs. They can join the expanding movement to make quantum technology more accessible and usable for everyone, including people with disabilities, as they gain knowledge about quantum systems. The creation of accessible quantum technology may be impacted in the long run by this kind of engagement.

In conclusion, by introducing Qubit and Quantum Technology, we give the young learners and students with exceptionalities the chance to acquire vital life skills, be exposed to significant future fields, and have access to individualized learning experiences by integrating quantum technology into the curriculum. These advantages can help these students succeed academically and socially, as well as set them up for success in a society that is becoming more and more reliant on technology.

Sample Lesson Plans

Dishchii'bikoh Community School
Cibecue AZ
SpEd Self-Contained

Lesson Plan Week for October 21-25, 2024

SPED Teacher: Novie Luz B. Minguez_ Subject: Physical Science Gr Level_SpEd SC K-12

Book Title : *Measuring Feather Lollipops and Candy Stick*

Topic	M	T	W	TH	F
AZ State Standard	K.P2U2.2. Design and evaluate a tool that helps people extend their senses. Background Information: People use their senses to learn about the world around them. Their eyes detect light, their ears detect sound, and they can feel vibrations by touch.	K.P2U2.2. Design and evaluate a tool that helps people extend their senses. Background Information: People use their senses to learn about the world around them. Their eyes detect light, their ears detect sound, and they can feel vibrations by touch.	K.P2U2.2. Design and evaluate a tool that helps people extend their senses. Background Information: People use their senses to learn about the world around them. Their eyes detect light, their ears detect sound, and they can feel vibrations by touch.	K.P2U2.2. Design and evaluate a tool that helps people extend their senses. Background Information: People use their senses to learn about the world around them. Their eyes detect light, their ears detect sound, and they can feel vibrations by touch.	Reading : Title - Fry Bread: A Native American Family Story Life Skills : Making a Fry Bread
Learning Goal: **> student friendly** **> IEP (SpEd)**	For students to demonstrate an understanding of measurement using a ruler or natural senses (look, smell, touch, taste) Students will get familiar with the words : -Measurement -Non-Destructive Measurement -Destructive Measurement -Qubit -Quantum Technology	For students to demonstrate an understanding of measurement using a ruler or natural senses (look, smell, touch, taste) Students will get familiar with the words : -Measurement -Non-Destructive Measurement -Destructive Measurement -Qubit -Quantum Technology	For students to demonstrate an understanding of how basic tools can enhance their natural senses Students will get familiar with the words : -Measurement -Non-Destructive Measurement -Destructive Measurement -Qubit -Quantum Technology	For students to demonstrate an understanding of how basic tools can enhance their natural senses Students will get familiar with the words : -Measurement -Non-Destructive Measurement -Destructive Measurement -Qubit -Quantum Technology	
Teacher Input and Activities:	*Measuring form *Writing Materials *Stick and Feather Lollipops *Augmentative and Alternative Communication (AAC) device – for Non-Verbal learners	*Measuring form *Writing Materials *Stick and Feather Lollipops *Augmentative and Alternative Communication (AAC) device – for Non-Verbal learners	*Measuring form *Writing Materials *Stick and Feather Lollipops *Augmentative and Alternative Communication (AAC) device – for Non-Verbal learners	*Measuring form *Writing Materials *Stick and Feather Lollipops *Augmentative and Alternative Communication (AAC) device – for Non-Verbal learners	
Assessment of Learning Goal	With moderate to maximum assistance, students will measure the candy stick or feather stick using their senses. Students will be able to answer and state their opinion in at least 3 out of 5 questions	With moderate to maximum assistance, students will measure the candy stick or feather stick using their senses. Students will be able to answer and state their opinion in at least 3 out of 5 questions	With moderate to maximum assistance, students will measure the candy stick or feather stick using their senses. Students will be able to answer and state their opinion in at least 3 out of 5 questions	With moderate to maximum assistance, students will measure the candy stick or feather stick using their senses. Students will be able to answer and state their opinion in at least 3 out of 5 questions.	

REFLECTION for previous week: Choose (1) of the following:	
• Did I see evidence of student learning? What did it look like? • What were some of your successes? • How did I have an impact on student learning?	• What didn't work? • What would you modify in a lesson or assignment that didn't meet the learning goal?

Principal/Supervisor Feedback

Sample Rubric

SCIENCE	**4** **Exceeds expectations**	**3** **Meets Expectations**	**2** **Approaching expectations**	**1** **Below Expectations**
Focus / investigation Question	Answers the question completely using science vocabulary	Answers the question completely	Attempts to answer the question with limited details	Does not answer the question
Predication	Using prior knowledge makes a detailed prediction	Using prior knowledge makes a prediction	Attempts to make a prediction, but with incorrect details	Does not make a prediction
Work Period	Fully engaged in the investigation and working cooperatively	Engaged in the investigation and working cooperatively	Sometimes engaged in the investigation and working cooperatively	Not engaged in the investigation and not working cooperatively
Results / Data	Explains and records results and data from the investigation with science vocabulary	Explains and records results and data from the investigation	Attempts to explain and records results and data from the investigation	Does not explain or record results and data from the investigation

Lesson Plan #2

Subject: Reading

Gr Level: SpEd Self-Contained Grades 2, 4 & 8

Book Title: ***Look Grandma, Ni Elisi!***

Duration: 60 minutes

AZ State Standard

- 2.RL.1. Ask and answer questions such as who, what, where, why, when, and how about key details in a text.
- 2.RL.2. Retell stories, including key details, and demonstrate understanding of their main idea, central message, or lesson

Learning Goal: Student friendly, IEP (SpEd)

- Students will be able to ask and answer questions about key details in a text, using the "who, what, where, when, why, how" to demonstrate their understanding of a story.

- Sample Questions :
  - Which container is small / bigger ?
  - Can you tell me which container holds more?
  - Which container fits well for the marbles ?

- Students will get familiar with the words :

Atsutsa	(ah-joo-jah)	Boy or young man, often shortened to chooch
Elisi	(eh-LEE-see)	My grandmother
Gado usdi	(gah-do OOS-dee)	What? What is it?
Hawa	(ha-WAH)	Ok! All right!
Ni	(NEE)	Look!
Osdadv	(ohs-DAH-dunh)	Very good; excellent
Tla	(KLAH)	No; not

Teacher Input and Activities:

- Book
- Promethean Board
- Augmentative and Alternative Communication (AAC) device – for Non-Verbal learners

Assessment of Learning Goal

With moderate assistance and verbal cues, students will be able to answer and state their opinion in at least 3 out of 5 questions.

Students will be able to get familiar with the measurement (big, small, long, short)

Sample Rubric

Key Element	4 points	2-3points	0-1 point
Comprehension	Written response demonstrates clear understanding of reading.	Written response demonstrates a general understanding of reading.	Written response is vague and unclear.
Application of Read-Aloud and instructions	Consistently applies concepts of read-aloud and instructions	Usually applies concepts of read-aloud and instruction	Unable to apply concepts of read-aloud and instructions
Completeness	Journal is consistently done and turned on time. Always includes date, book title and author	Journal is usually one and turned in time. Usually include date, book title and author.	Journal turned in on time. Rarely or never complete
Personal Response	Personally reacts to and responds to texts	Some personal response and reaction	Little or no personal response or reactions
Writing Conventions	Demonstrate proper conventions, neat and legible	Demonstrates some writing conventions; readable	Inconsistent use of writing conventions; illegible

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Videos:

How Does a Quantum Computer Work?
https://www.youtube.com/watch?v=g_IaVepNDT4

Little Qubit Goes to the Kindergarten, The.
https://www.youtube.com/shorts/ixjWBUkx1e4

Quantum Computing In 5 Minutes | Quantum Computing Explained | Quantum Computer | Simplilearn.
https://www.youtube.com/watch?v=X8MZWCGgIb8

Quantum Computers Explained – Limits of Human Technology
https://www.youtube.com/watch?v=JhHMJCUmq28&t=112s

Quantum Computing For Babies - Read Aloud Kid's Book
https://www.youtube.com/watch?v=nhi-AudcSkE

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https://www.youtube.com/watch?v=gsrEVqupTBI&t=453s

TED. (2011, January 3). Brene Brown: The power of vulnerability [Video]. YouTube.
https://youtu.be/iCvmsMzIF7o

What is a Qubit? - A Beginner's Guide to Quantum Computing
https://www.youtube.com/watch?v=90za6mazNps&t=134s

Annex

Annex A - Measurement Forms for Measuring Feather Lollipops and Candy Stick

DISHCHII'BIKOH COMMUNITY SCHOOL
Teacher Leadership Shiłgozhóó Institute 2024
Measurement Alters State : Qubits, Undergo State Changes When Measured

Activity : MEASURING A CANDY STICK

Student : _____ grade : _____

Candy Color/s : _____

Non-destructive Measurement Methods

Method	What flavor do you think it is?	Why do you think that?	How sure are you?
Look 			
Smell 			
Touch 			

Destructive Measurement Methods

Method	What flavor do you think it is?	Why do you think that?	How sure are you?
Break and smell 			
Eat 			

After all the measurements, I think the FLAVOR of the candy stick is _____

Which method do you think is best for figuring out the flavor of a candy stick?

   

Appendix

DISHCHII'BIKOH COMMUNITY SCHOOL
Special Education Self-Contained

PHOTOGRAPH CONSENT AND RELEASE FORM

Dear parents / guardians,

Greetings of peace!

I am currently a part of the Teacher Leadership Shiłgozhóó Institute (TLSI) professional development program at the Northern Arizona University (NAU) which focused on growing teachers' content knowledge, and to have the ability to write culturally responsive curriculum, and leadership skills.

For this year, I would like to come up with an instructional methodologies and student engagement for my students in SpEd Self-contained K – 10 with respect to the newest development in education which is Quantum Technology. The title of my study is *Measurement Alters State : Qubits, undergo changes when measured* .

With that, I would like to ask your permission to photograph and video your child while executing the curriculum and applying the learning materials in our classroom.
By signing this consent, you will allow me to conduct my research, photograph and record your child's image to be used for my presentation to the NAU.

In this form, you will also waive any claim for compensation of any kind for the use or publication of the images or depictions of your child, as well as any claim for damages of any kind including, but not limited to, invasion of privacy or misappropriation, arising out of the use or publication of such images or depictions of your child in this study. In addition, you will agree that any intellectual property rights associated with such images or depictions of your child are the sole property of the researcher.

I appreciate your support and cooperation to conduct this curriculum in the classroom and for the success of this study.

Chagashe'ba' ,

Novie Luz **B. M**inguez
SpEd Self-Contained / SpEd VEX Robotics
Research Fellow TLSI
Dishchii'bikoh Community School
Tel.# : 928.3322.444 Ext.1424
For Everyone, A way to learn, grow and succeed

Approved By :

Mr.David Nikolaus
SpEd Director

Dishchii'bikoh Community School

DISHCHII'BIKOH COMMUNITY SCHOOL
Special Education Self-Contained

PHOTOGRAPH CONSENT AND RELEASE FORM

Photo and Video Consent Form

Reaserach Title: ____Measurement Alters State : Qubit, undergo state changes when measured

Date: _____

Child's name : _____

Location: _Dishchii'bikoh Community School__& Northern Arizona University

Organizer / Research Fellow : __Novie Luz B. Minguez_____

Consent Statement:

I, the undersigned, hereby grant permission to take photographs and/or video recordings of my child during the research described in the letter. I understand that these images may be used for research and presentation purposes at Dishchii'bikoh and Northern Arizona University, Teacher Leadership Shiłgozhóó Institute (TLSI) .

Options:

- ☐ I consent to the use of my child's image and voice in this study.
- ☐ I do not consent to the use of my child's image and voice.

Name _____

Signature: _____