What is Quantum?

James Jones

Context

Sinagua Middle School or SMS, one of the two middle schools, part of the Flagstaff Unified School District. Sinagua was part of three high schools within FUSD from 1989 to 2009, when it closed due to low enrollment. Then it reopened as one of the two middle schools. The school has grades from 6th, 7th, and 8th grade. Currently, the school has enrollment about 1200 + diverse students (Anglo, Hispanics, African Americans, Native Americans, and other nationalities). The school has both certified and classified staff employed, that also includes administration, teachers, para professional, admin, cooks, and janitors.

Students who attend SMS, come from communities within or on the outskirts of the Flagstaff area like Kachina Village, Mountainaire, Doney Park, Munds Park, Parks, Lake Mary area, Mormon Lake, Belmont, some students even come from small Navajo communities from the Navajo reservation like Leupp, Birdsprings, Dilkon, Cameron, Tolani Lakes, etc. The students that go to school at SMS live within their school boundaries or come to school within a 90-mile radius either by bus or other means of transportation.

According to the information provided by the district, the classes for each of the grades (6th, 7th, and 8th) has a student-teacher ratio of 25-1. That is because there are multiple classes of the same subjects to balance out the high student enrollment and participation. The students take core classes (Math, Science, Social Studies, English, etc.) with some elective classes (Music, Woods, PE, Language, Cooking, etc.). The school have the core and elective programs were created, so during the end of the year or during the summer registration, students can select their elective programs, but, their core classes have already been selected for them by their selected counselor. One of the elective classes that is being offered is the Navajo Language. Students sign up with one of the three phases: Phase 1- beginner, Phase 2 - intermediate, and Phase 3 - advance. The other language class that is being offered is Spanish.

Students whom are new to the Navajo language classes struggled because students have faced the following: they had little or no exposer to the Navajo language when they were in elementary school, they do not have immediate family members who speak the Navajo language, and they did not learn Navajo in a way the teacher did the lessons or activities. Some students that took this year's Navajo classes knew some of the very basic vocabulary meanings and or two-word simple conversations. Another factor to their struggles was that they came from other elementary schools within the school district, where Navajo language and lessons is being taught by focusing only on basic animals, numbers, and basic questions and answers, and with little or no writing or reading in the language activities. Some Navajo culture or traditions are taught, but in the English language (because those are the only resources that one can find), but to teach Navajo is difficult and challenging simply because the teacher has to be fluent in reading, writing, and speaking.

The students that will be coming into the Navajo class, will be placed in one of the three classes. 6th and 7th graders were in Phase 1 or Phase 2 Navajo (beginner and/or intermediate) while the 8th graders will be in Phase 3 (intermediate to advance). For some students this will a new experience and for some they will be expecting the expectations of the class. All the Navajo classes will have the same lessons and themes but the level of difficulties will be different and challenging.

There is a Navajo assessment that is given to all the students at the beginning of the school year and another during winter and at the end of the school year. This assessment is called DOPLA (Diné Oral Language Proficiency Assessment). This assessment has four parts of that the student must complete without any help from the teacher, friends, or others. The four parts are reading a short story and answer 10 questions, personal identification questions, recognizing Navajo vocabulary words and use the words into Navajo sentences, describe picture story in the Navajo language, and retelling a selected video into the Navajo language. However, the story could be read to them aloud or they could read the story on their own. But all responses are done in the Navajo language. But if the assessment becomes very difficult then the test ends. This assessment will also indicate how much a student knows about the language and where the teacher will focus in terms of instructions and activities. This test indicates where students were at the beginning of the school year and see if they progress or not throughout the school year and each time this will let the teacher focuses on which of the 4 parts of the assessment the students did not perform well.

I am Chiricahua Apache, born for the Tangle People, my maternal grandfather is Bitter water People, and my paternal grandfather is of the Salt People. My name is James Jones. I have obtained my Associates of Arts degree in Social Science and Psychology from Navajo Community College (now known as Diné College), BS degree in Elementary Ed, and M. Ed in Bi-Culture and Bi-literacy degree from Northern Arizona University. I am from a small community called Rock Point, AZ. I was born and raise there. I went to school there from kindergarten to 12th grade. I was raised in a traditional setting and Navajo language was my primary language at home. I was not exposed to the English language until I went to school. Throughout my education at Rock Point Community School, I was learning all subjects in Navajo and English languages.

At school I was learning something interesting from my students as I watched them play video games or when they would digitally draw things on their Ipads / tablets, or phones, and their laptops. These were simple but complex games / digital activities in coping with life or mental issues and problem solving. Then we had the school handbook. At home, my parents and my grandparents were my teachers and at Thinking back when computers first came into educational existences, technology life back then was complicated and but at the same time made life simple. Some times to handle certain technology issues meant stating over from the beginning and reprogram the task. Technology in social and emotional learning was at its basic but with deep rooted (not knowing quantum and science) teachings. And it was easy to maintain a program but not easy to keep the programs because you would have to update everything just to make thing transferrable and compatible. Everyday something new was discovered and technology equipment were getting smaller in size and the pros and cons of the cost.
Now days, things are simple and not that complicated, but as long as you know “which is which” and “what is what”, and “what goes with who or where it goes” then you can earn your place in the next level of the technology world and you can do this globally without leaving your house. We are living in the technology world and our answers are not within the immediate circle anymore, because we have people in our lives in a global setting (since the introduction social media and social inter connections), and we don’t know these people but only through professional occupations, interest, and expertise. Also today, students are getting more dependent with social and emotional distractions than when I was growing up, but their solutions to their quantum world are much more-simple than back in the days. What I mean is that back in my time when you are dealing with issues, you had to seek out information by yourself and sometimes the answers you seek took time and lots of patience. But in today’s world, what you seek for answers are in the palm of your hands because

electronic devices or someone in the digital world will get the information you want. But still, you have to be more specific to get the right answer.

Rationale

What is quantum technology? How can you explain to students that they are living in a world where simple and complex quantum technology's input means either 1 or 0 for an answer? What is superposition and what is entanglement? Who are the brains behind quantum? Do natives have quantum (not meaning their percentage in bloodline)? To answer this in the most, simple way, will take time and patience (lots of them).
I watch my son play cga (computer generated animation) games on his phone or on his tablet or or his old PS4 station. He plays, and then, with excitement he tells me that he has defeated the enemy and going into the next level. So, I ask him what he did and how he was able to know that he is going into the next level. His response was simple, I just moved here and there and fought with these weapons and knew their weaknesses, and so on. I didn't get the answer I wanted but he knew how to play the games.
I remembered going to a science conference in Phoenix one year, and there I listened to a presenter who presented about the school that taught coding to students. He talked about students being introduce to basic coding to advance coding, and how the students who excel were offered jobs at major companies like "Google", universities / colleges, schools, software companies, gaming companies, and even with military intelligence, and major movie companies. I'm always fascinated about how some people know how technology works

Content Objectives

When I found out that I was picked for the Diné Institute and accepted into the Quantum group, I sent out a message to my Navajo teacher friends and to friends who are ITs or the ones that teach computer classes. The message was more of a question about their knowledge of quantum information, and how they use this information in their class or how they program their school websites. But to my surprise their responses were like, "What is quantum?" "What do you mean quantum education in a school setting?" "Bro, you are asking the wrong person." These were the kinds of answers I got when I asked my Navajo teacher friends. To be honest, they were either; 1- don't know the answer, 2- won't answer for free, 3- I'll check back with you later, and so on. I started my own quest to find our what quantum really means. And the answers were mind-blowing. I felt like I was in another place where scientific English language became hard to understand. The closest information where I could understand was watching some sci-fi movies like the The Matrix, Timecop, Windtalkers, Transformers, and some Star Wars movies. I have tried to read as much information about quantum to where I would understand it, but I seemed to get lost and I got more and more confused. I have also seen some videos about this topic on YouTube and even there I tried looking for videos that were simple to understand and in all they were too technical for me to try and distinguish what was said.

Until the Diné Institute residency happen I able to get more information, but yet I was still a bit confused. Our group got to work with some simple things like coin tossing, a simple device that changes the outcome a coin, window tint film, lasers, and games. I was able to understand the hands-on lessons we did. I get that. But, to try and explain what we did, into words was still a

challenge to me. My teammates and our instructor did their best to explain things to me. The more I tried to remember the things we in class the more a was getting lost. It's the explanation and writing the terms into sentences was and still a challenge. The hands-on activities, I can do those and explain the rules of the games or activities, to connect those activities or games with real world situation was and still a challenge.

DI group met again in Kayenta to discuss our successes and challenges about our chosen topics. I shared my challenges about my lessons with my students. It was there when our instructor introduced Onri Jay Benally. *Benally is building technology with the potential to improve space exploration. As a research associate in the lab of Jian-Ping Wang, a professor in the U of M College of Science and Engineering, he works in spintronics (short for "spin transport electronics"), a technology based on how electrons spin. It has a bright future in many fields, such as designing more efficient computer storage chips, devices that can withstand the bombardment of radiation in space, and tomorrow's medical sensing and treatment technologies. (Morrison, 2021)* He is also a PhD candidate at the University Of Minnesota in Physics dealing with quantum. In a short article I read by Deane Morrison, he said this that made me reexamine my topic. He stated "It's very important to be able to relay all this complex information about quantum science and make it easier for people to understand," he says. "It's also required when you're talking with professionals—they want you to be able to explain these things, from the complex level down to the very simple level." He shared with our group the many things he worked on, he's working on, and the videos he created. This young man has so many things to share, and I am still listening or watching his videos.

Still I'm trying to understand the simplicity of quantum.

I thought reading more and rereading was about quantum would help. I'm still reading some of the articles I downloaded, but it became some else. A lot of the words I was reading were familiar but the research information was getting more technical and advance for me and the information I was getting were hard to understand and that became my frustration. I was overwhelmed with the amount information I was reading and my thought of my students, "how am I to explain this information to my students?" How can I do this? The other question was which class to pick to do these lessons to?

"Quantum entanglement is a bizarre, counterintuitive phenomenon that explains how two subatomic particles can be intimately linked to each other even if separated by billions of light-years of space. Despite their vast separation, a change induced in one will affect the other. "(https://www.space.com/31933-quantum-entanglement-action-at-a-distance.html)

"What is superposition?

Superposition is the ability of a quantum system to be in multiple states at the same time until it is measured. Because the concept is difficult to understand, this essential principle of quantum mechanics is often illustrated by an experiment carried out in 1801 by the English physicist, Thomas Young. "(https://www.techtarget.com/whatis/definition/superposition)

Since I have struggled this topic, I will approach my lessons from the basic science project approach. By doing this the students and the teacher as well, will learn about the complexity of quantum in the simplest form and with some basic scientific experiments. Also due to limit supply for certain projects that would go with the lessons, the research projects will be simple.

Charts:
Charts in many different forms will be used multiple times during the duration of the unit lesson. The charts created will be made for students (for individual use), and one will be made in a large poster form so that students will be able to see and follow the instruction; 1) lesson / activity on quantum history. This chart will help the student learn more about their activities online research and hands on activities. Teachers know what KWL is K-What do I KNOW?, W-What do I WANT to know?, L-What did I LEARN? And this chart has been used for many activities or lessons.
But for this particular lesson and activities, I will be using the KWHL chart. KWHL is K-What do I, KNOW?, W-What do I WANT to know?, H- HOW will I learn? L-What did I LEARN? There will be an extra column for H (HOW will I learn?). The student will indicate how they are going to learn about their quantum unit. For example, the student will indicate that they will learn how to make patterns using technology software by using formulas or diagrams of input and outputs of 1 or 0, or making diagrams using paper grid paper. They will make notes about what they did with each lesson or activity and indicate what their plans are. There will be two activities where we will be using the KWHL chart. The students will report their progress as they input their information

ACSII code
Introduce the lesson on coding using ASCII and binary numbers. Teacher will do a lesson about binary numbers and what two numbers the computer reads 0 or 1 or in any combination. Teacher will also give handouts about the binary codes and also the ASCII codes in the English alphabets and a tweaked ASCII code for Navajo alphabets. Teacher will make some examples about how the binary coding works using simple words in English and then another in the Navajo language. After the binary code lesson then the teacher will introduce the next lesson on the importance of using the ASCII code. Again, using the ASCII code, teacher will use simple words in English and Navajo and have students decode words. Along with the ASCII lesson teacher will also introduce how the Navajo Code Talkers played an important role during WW2. Teacher will do a lesson on how the codes were developed by the 32 Marines and how each letter was used, using simple Navajo words. Another handout will be given to the students about the words that were used by the code talkers. This time the teacher will use the ASCII code to send a message and see how long it takes for the students to decode the message and respond back to the teacher using the ASCII code. The students will be challenged to use the Navajo ASCII code system by translating their response in English message.
The students' assessment will be about understanding the code system and the time it takes for them to decode a message. To see how familiar they get with the three coding system.

"Quantum Mechanics for Dummies" (YouTube video)
Lesson activity: Hitting your mark

This video is not kid friendly. The video is about 20 minutes long and has lots of information. There are many topics explained with diagrams and fun graphics but the vocabulary used are advanced for students for middle school. But students will watch the video and teacher will stop the video when a topic is introduced and teacher will try to explain the topic to the student so that they will understand what the information is about.
There is a section in the video where it talks about quantum and protons about going through openings and how protons that go through the openings are decoded for information. The protons are faced with barriers that are either rejected or recoded so that it can pass through the openings.

Activity:
Materials needed- Chain linked fence, white butcher paper, golf balls or small pebbles the size of a quarter, and tape to hold the paper up.
Paper will be taped up to the chain linked fence and students are to stand at least 20 ft away. Students are the proton shooter and the pebbles or golf balls are the protons. Students will take turns throwing the objects and see if they can hit the paper and see if the chain link fence blocks their protons. Then after when done taking turns, students will analyze the protons that went through and rewatch the video and in their words talk about what they have noticed and come up with their own conclusion.

Vocabulary:
Students will be learning new technology quantum terms.
For example: Math- diagrams, input, output, probability, statistics(s), etc.
Quantum- superposition, entanglement, 1 or 0, control, NOT, CNOT, SWAP, etc.
Technology- plot, , , ,etc.

Analyzing diagrams

Think-pair-share:
Students will make plans and begin to start how they will research their quantum project. They will plan a step-by-step information on all of their project. They will share their ideas with the teacher and the class. The students will be encouraged to use their KWHL chart and the student will fill in the first two sections of the KWHL, the K and W. After they have revised their plan then they will work on the H part of the KWHL. The H will give the student a more focus about their research. Students will gather feedbacks about their project and they will need to make any changes.
The students will be using various resources when they do think pair share. For example: When students watch any media videos from (You-Tube, tik-tok (if allowed), etc) they will share with the class or group and have discussions about the videos. When they take notes during a presentation and share their insights about the presenter(s).

Interviews and Guest speakers:
Hopefully there will be guest speaker(s) scheduled, who will be sharing how they use math to create their understanding of quantum. The guest speaker will talk about their preferred specialty in understanding quantum styles and they will also talk about their history about how they learned and what they learned about the program. This is so the students can get comfortable

with the guest speaker. These guest speakers will be either in-person or by ZOOM depending on the speaker's choice of communication. Students will be interacting with the guest speaker about how to start on their projects. All students will be starting their projects at the beginner's level. However, students can also do an individual interview on their own. They do need to share their information with the teacher and students whenever they are done and are ready to share. This will give some students in the class, ideas about their assignment, if they had trouble getting starting or had a hard time gathering information.

Videos:
Student will view videos (from approved sites) about quantum and share with the class about their thoughts on the video. The student will then do a brief presentation about the video and also if like they can do some examples with the class. There will be some videos will help with the step-by-step process to help students at their own pace and also it can be watched individually at anytime and anywhere as long as they get more in-depth knowledge about what quantum means.

Structuring task the allow for student collaboration and communication:
Every class time, students will have time to collaborate with one another for feedbacks and or instructing each other about how to start their research or project.

Teaching Strategies – A unified, coherent teaching plan for the content objectives.

Teaching Strategies –

The teaching strategies that will be used, will be used for all three lessons and activities. The students learn in many different ways because some are either; kinesthetic learners, visual learners, and or auditory learners. Some Native American learners learn by hands on lessons and by doing so they will remember the process of how to do things.

This unit will consist of many teaching strategies that will help both the teacher and the students. There will be teacher modeling and modifications will be made as the instruction is being made.

There will be student engagements happening because the lesson will require students to interact with each other. Students will also be doing research for their personal project / presentation.

Some strategies:

I do, we do, You do (group or class), You do (duel: the teacher will explain the lesson into parts so that students will get enough information on how to do their assignments. Teacher will model each of the four parts which will be: 1) What the students know of quantum. 2) establishing what 1 and 0 means and why it matters, 3) understanding the codes, and 4) using the Navajo language to communicate in codes and how to maintain quantum mindset.

Teacher will also have the materials ready for the three lessons and activities. And with each lesson instructions and the activity the teacher will use all three strategies mentioned so that I make sure that all learners are accommodated.

I do: Teacher will model by introducing the topic of quantum at its simplest term.

We do: Teacher and the students will work on some simple problems together and, than make one up as a class to where the students test their capabilities of solving the problem(s). Also at this stage we will be sharing our work with one another. (I will also be learning with them about this topic.)

You do: At this next step, the students will be doing their assignment in pairs or work in a small group of 6.

You do:

While using the ASCII and the Navajo Binary sheets as visual aids and for media:

Students will be given their own handouts for their lesson and activities. These handouts will help them out when they are doing their assignment(s). They will also watch two videos from YouTube that pertains to the lessons / assignments on ASCII Codes and using binary codes. There will be handouts for students as mentioned and another where it will also be in a poster size so students can see the in-depth details. The oversize poster will also let students know where to look and also how they are going to use both codes when they are doing the activities of the lesson.

Use of technology:

Students will be using their I-pad or tablet, or phone, for the use of technology to create a profile using various apps and for their presentation.

1. Classroom Activities

   Students will be doing three activities
   Quantum Tic Tac Toe:

   Quantum Gates:

   Navajo Binary Code:

2. *Student Assessment Plan – A specific description of how you will assess student learning of the curriculum unit's content. This should include the method(s) you will use, along with any pertinent documents (i.e., test questions, activity instructions, etc.).*

Student will be assessed after the lesson and instructions have been taught. They will do some practices before they actually do the assignment(s) and take the assessment.

Student assessment 1: Using the arrows and the code of "0" (+,X) or "1" (+,X). Student will determine if the polarized filter works or not and give an explanation.

Student assessment 2: Using the binary code with alphabets.

Student assessment 3 (the main lesson): Gate

3. *Alignment with Standards – A clear statement of the particular state curriculum standards and Diné standards or CRAIS Tool principles your unit addresses. You must align your curriculum unit to both state standards and either Diné standards (DINÉ) or CRAIS Tool principles (TLSI).*

Standards
AZ Science: Physical science (Grades 6, 7, and 8)
$6^{th,}$ $7^{th,}$ 8^{th}: Physical Science
P1: All matter in the Universe is made of very small particles.
P2: Objects can affect other objects at a distance.
P3: Changing the movement of an object requires a net force to be acting on it.
P4: The total amount of energy in a closed system is always the same but can be transferred from one energy store to another during an event.

Navajo Nation:
Pre K- 3: Diné History Standards
I will understand historical/ factual events, people, and symbols that influence my family
C1: I will be able to understand cultural knowledge that has influence my family
PO4: I will name, recall events, and dates relevant to my current family culture and traditions.

C2: I will understand historical events, people, and symbols with significant ties to my family.
PO2: I will identify symbols of the Navajo Nation.

C4: I will understand time passage and chronology, specific to Diné culture and traditions.
PO4: I will identify historical events in different eras.

4-6:
C1: I will explore and explain how Diné people and historical events have influenced the development of my community.
PO2: I will recognize leaders that have impacted the Diné Nation.

7-8:
C1: I will present how Diné people and events have influence the development of Diné communities and culture to the present day.
PO2: I will identify an event relating to important people in Diné history.

Resources:

https://binged.it/3I5yfBX (Video)

https://binged.it/41uKCOZ (Video)

https://binged.it/42Q3QzM (Video)

https://bit.ly/42wRjRS (List of games dealing with quantum technology for upper elementary, middle school, and high school students)

https://youtu.be/JP9KP-fwFhk?si=7b6JqscaTmBy7EOz (video)
"Quantum Mechanics for Dummies"