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The Quantum Nature of the Student

The Double Slit Metaphor

There is an experiment. It's quite simple really: There are 2 walls, one in front of another. The first is solid, but with a rectangular slit in it. The second, behind the slit wall, is made up of some sort of lighter, malleable material. Some distance away from these walls, again in front of them, is a cannon. This cannon shoots marbles randomly at the slit wall, and those that make it through the slit, record their impact on the further wall by denting it. The denting is important here as the marbles are meant to represent particles of matter. What happens is then expected: a rectangular like shape similar to that of the slit is recorded on the far wall.

Now we replace the slit wall with a wall with 2 slits and fire the cannon again, randomly shooting the marbles at the wall. Again, the result on the far wall is a record of the double slit wall. We have 2 impact points the shape and size of the slits. QED.

Now we try the same thing, but with water, or more appropriately, the ripples of the water. The waves. We place the walls in a tube of water, starting first with our single slit wall. Where the cannon was we simply strike the water, and a ripple is formed. This ripple reaches the slit wall and is stopped except where the slit allows it to pass. The ripple is smaller, but we still get a footprint of the size of the ripple on the farther wall.

Again, we replace the single slit wall with our double slit wall, but what happens is what is known as an interference pattern. That is, when the ripple hits the 2 slits, it produces 2 ripples on the opposite side of the wall. As these ripples move outward from the slits, they begin to collide with each other creating ever smaller intersections. What appears on the far wall is actually comparable to a gradient, where the strongest tone is set dead center, and weaker tones are recorded on either side of it. Where the colliding ripples hit the wall, we see the strong tones and where the non affected ripples strike the wall we see weaker tones. The pattern is spread across the rear wall, the 'signal' getting weaker as the ripples move towards the edge of the wall. This is how a wave behaves as opposed to the particle of the marble.

In the quantum world, however, this is a bunch of hooley.

At the quantum level of matter, what we thought were particles behave like waves and what we thought were waves behave like particles, but it's still more complex than that. In the quantum realm, a single slit wall provides the same results. Replace the slit wall with a



Quantum Nature of the Student

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double slit wall, and that's where things go a little strange. It all happens when we observe the experiment, or at the same time don't. As can be seen, even grammar and conjugation in talking about the following event becomes complicated.

What happens when we observe the double slit experiment at the quantum level is the rear wall gets indentations like that of our marble cannon.

However, what happens when we don't observe the experiment is the rear wall being left with an interference pattern like that of a wave.

We change the outcome by observing it. How? No one knows just yet. It might have to do with something called 'superposition' where a bit of matter is more or less in more than one type of thing or in more than one place at a time.

Confused? Good. That should happen. Even high level scientists and mathematicians are baffled. Don't feel bad. Do remember, however, this is going to be the operational metaphor for students, learning and student learning.

The Student is not a Particle

Students, unlike matter--supposedly--are sentient and thus capable of chaotic and unpredictable behavior. They are however, things but as I would argue, and Albert Einstein has observed about the quantum state, capable of 'spooky behavior at a distance'.

I'm not suggesting we through students at walls to try and test this metaphor, but

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I am saying that we as instructors change the student by mere observation. This may be apparent to any quality instructor, but let's look at in a quantum light.

The student is a thing, not a particle or wave, but the slit wall itself. Given a single slit, we can predict the outcome.

Given a single perspective, the student will repeat said perspective, verbatim.

This is predictable. This is expected.

This is boring.

A student is a double slit wall, or perhaps contains multiple slits, or channels, through which knowledge can pass and the result on the student's rear wall is the end result, or applied knowledge, of learning.

Knowledge as Wave/ Particle

We as instructors spew forth knowledge like the cannon shooting marbles, but what some of us may not realize is that we are actually creating ripples.

Poetically speaking, we have knowledge, and by imparting it to a student we only give forth an echo of what we know.

That echo is the ripple.

Something strange happens when it hits a student, however. If we watch the information hit the student, we're prone to seeing what we expect: the indentation of knowledge in exactly the form with which we applied it. But when we don't watch this knowledge, or watch the student receive it, we see an interference pattern at the end.

We're speaking here of interference in a objective way. It is a resulting term, some

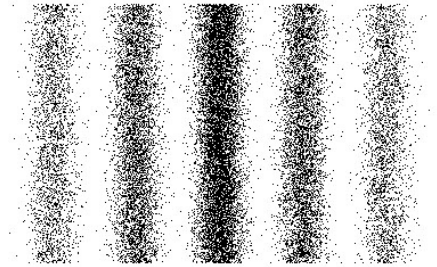
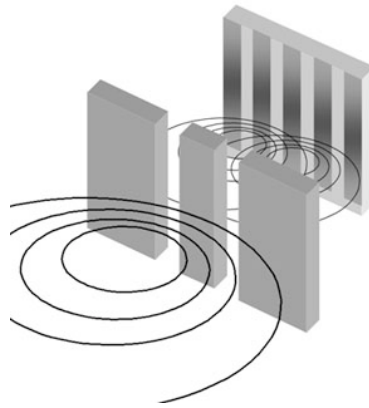
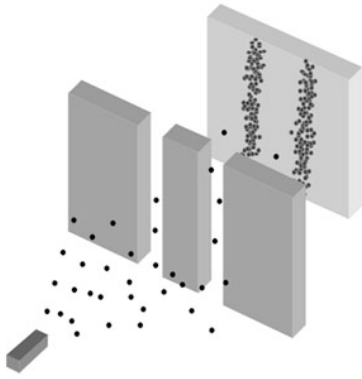
what opposite of the expected definite shape of our marble-shooting cannon of knowledge. It's not bad, nor is it good. It is a result.

That being said, what this is leading up to is the testing of knowledge from the student. Ask closed questions, and expected answers are received. Ask open-ended questions and receive variant responses, or an interference pattern.

But like genius mathematicians and physicists dealing with quantum weirdness, educators find themselves baffled and sometimes frustrated at the resulting interference pattern.

When we watch the knowledge pass to and through the student, we see a result that makes us happy, and we nod and consider it a job well done--because we expected it.

It is the interference pattern that occurs when we aren't looking that may be the important result. How and why it happens remains a mystery, but it happens because we see the result. The interference pattern is the spread of knowledge against the back wall of the student. The back wall is any experience or experiences the student may will have already been having. That's quantum language for saying will have or had already. At the time the knowledge passes through the student, I would argue that both the student and the knowledge are everywhere at once.



The Superposition of the Student

Knowledge can have a superposition, that much should be apparent. It can be multiple things to multiple people at multiple times. It's about perspective.

The superposition of knowledge is perspective, and it makes sense that we can only see one perspective at a time.

But what of the student? Suppose the student is our wave/particle and the double slit wall is the knowledge? As the student travels through the knowledge, for that is what learning is, we see two different results. When we observe the student, we get our expected double slit repetition on the rear wall of the world. Narrowly focused and isolated to echo the two perspectives or slits of knowledge we presented. Yet if unchecked, the student reaches a state of all states at once and produces the gradient variance of the interference pattern on the world. Whether the student is the wall or the wave/particle,

the outcome on the rear wall of the world or experience is the same. If observed, we get a measurable response. If unobserved, we get a broadly applicable response of varying degrees of the knowledge applied.

Just as the student has a superposition as a wave/particle, I would argue that a student also has a superposition as the wall. Just as the wave/particle, the wall has an infinitely variable position if not observed.

The Educator's Paradox

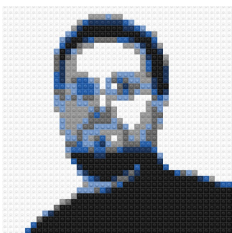
What do teachers do when confronted with the dancing, superposition of knowledge AND student? Measure the outcome and receive the inevitable expected grade, or 'unobserve' and see the interference pattern spread across experience to varying degrees? Sure, it is the latter that the teacher must be interested in, as the more broadly applicable the knowledge and learn, the

more successful a student can be. But an instructor can't OBSERVE that, and largely shouldn't if the correct and desired outcome is to come about.

In our science metaphor, this is the 'observer's paradox'. It states: the measurement itself affects the outcome so that the outcome as such doesn't exist unless the measurement is made...There is no single outcome unless it is observed.

I would say, with a few replaced words, the 'educator's paradox' is largely the same. As such: the measurement itself affects the grade, so that the grade doesn't exist unless the measurement is made...That is, there is no single grade unless it is measured.

This is the double slit metaphor for the quantum nature of the student. It captures knowledge AND student as having superpositions, and leads the educator to question: to grade or not to grade.



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