Quantum Drama as *Theatrum Mundi*

Key principles of quantum physics that can influence performance are uncertainty, entanglement and retrocausality. In the microscopic world, uncertainty exists since scientists cannot determine the speed and the location of an electron at the same time. Uncertainty manifests in theatre when we refrain from judgment. Quantum physics has shown that two electrons that are entangled can communicate despite long distances between them. In quantum theatre, characters that are entangled similarly can communicate with one another when they do not share the same time and space. In quantum physics, the theory of retrocausality suggests that effects can precede their causes, and a later event can affect an earlier one. Using a two-factor analysis, historical theatre genres are compared to identify the scientific paradigms that underpin them. A quantum theatre analysis (Johnson 2012) of the play Incendies by Wajdi Mouawad reveals key aspects of quantum theatre. Quantum theatre principles have widespread implications for arts education in schools and communities. Improvised dance, music and ritual have often been employed in theatre to help create experiences that may seem inexplicable to actors and audiences in a classical physics-based view of reality. Quantum theatre principles have been adapted to educational drama settings (Martin-Smith 1995).

Keywords: *quantum theatre; quantum physics; uncertainty; entanglement; theatrum mundi*

Introduction

"All the world's a stage, And all the men and women, merely players;" So begins Shakespeare's Jaques in *As You Like It,* (II, vii). Yet what does this imply about the Elizabethan conception of humanity and of reality? The metaphor that theatre is life dates back at least to Plato's disparaging comments about theatre in *Republic* (Books III, X), yet it has meant different things to different people across the centuries. For contemporary theatre director Peter Brook:

> … theatre and life are the same thing and aren't the same thing. They are made up of the same ingredients, yet the theatre wouldn't exist as a form if something different didn't take place (Peter Brook quoted in Harwood 1984, 13).

What is the "something different" to which Brook is referring? According to Harwood it is "extraordinary explosions of new vitality, changes of every kind around the nucleus of actors and audience." Harwood goes on to clarify: "To do that, [theatre] has to possess the audience, and be possessed by it. That is the essential requirement: both actors and playgoers are obliged to lose a sense of themselves, or, if you like, to gain a broader sense of identity, if the drama is to do its work (Harwood 1984, 15). In quantum theatre the actors and audience similarly must "lose a sense of themselves", as the electron does

when it makes a leap from one quantum energy level to another, or as it disappears as a wave and reappears as a particle. Our understanding of the application of quantum theatre principles to educational settings is addressed in the author's paper "Quantum Drama: Transforming Consciousness through Narrative and Roleplay." This article, "Quantum Drama as *Theatrum Mundi,"* asks the questions: "What would theatre look and feel like if we could expand our sensory perception to perceive the macrocosmic universe as both waves and particles?"; and "How do we encourage this quantum perception of theatre in actors and in audiences?" I use quantum theatre as a methodology to analyze the play *Incendies* by Wajdi Mouawad to reveal key principles of quantum theatre. The paper concludes with recommendations regarding the relationship between quantum theatre and the current educational system.

Literature Review

Key principles of quantum physics that can influence performance are uncertainty, entanglement and the time-space continuum. In the microscopic world, uncertainty exists since scientists cannot determine the speed and the location of an electron at the same time. Uncertainty manifests in theatre when we refrain from judgment. Coleridge's "suspension of disbelief" speaks to our ability to suspend judgment to appreciate the supernatural character of poetry. Similarly, we are encouraged to suspend judgment in Keats' notion of negative capability, which occurs "when a man is capable of being in uncertainties, mysteries and doubts without any irritable reaching after fact and reason" (Rollins 1958).

During the Renaissance, the "theatre of the world" or *theatrum mundi* offered a persuasive view of man's place in the world, fixed somewhere between the angels and the devils. As Shakespeare's Jaques says about people in his time and place, "They have their exits and their entrances, And one man in his time plays many parts..." Of course, language does not only help us to communicate ideas, but actively creates the world in which we live. Not only does the metaphor of *theatrum mundi* describe actions on the theatre stage, but it has come to be used today to describe our behaviour and social roles beyond the theatre (George 1986, 353). If we are actors in life, then the suspicion is that perhaps we are being inauthentic. If our exits and our entrances are our fates, do we really have free choice? This extension of the theatre metaphor from the stage to our social roles distorts reality, as Erving Goffman pointed out in *The Presentation of Self in Everyday Life:*

> To Goffman, the actor is symbol of 'our ,entrapment in predetermined roles written for us (by society). Though constantly checking up on the successful projection of our own 'fronts ,and the sincerity of everyone else's, we are, on his stage, doomed to mutual deception and hence permanently insecure, on the defensive, in retreat.
>
> In contradistinction, in the Quantum Theatrum Mundi, the actor is symbol of a permanent negotiation and re-negotiation between the determinism of roles and

> the existential freedom of each player, whose perhaps most significant result is that the concept of 'self' — which to Goffman is mere abstraction, construct, and ultimate fiction — is reinstated, at least in its role as source of individuality, unpredictability, difference, and spontaneity (George 1989, 175).

If applying the theatre metaphor to life is a distortion, what is to be gained by considering theatre as *theatrum mundi* in the quantum age? I will argue that our understanding of the revolution brought about by quantum physics is reflected in quantum theatre, a new genre of experimental theatre that may have wide implications for how we perceive reality and how we educate young people in the 21st Century.

One of the most significant differences between Newtonian worldview and the quantum worldview is the uncertainty principle. Heisenberg's uncertainty principle demonstrates that you cannot determine both the position and the momentum of an electron at the same time. The very act of measurement changes the state of the object observed. Quantum physics suggests that matter behaves both as particles and as waves, and that by observing reality we collapse the waveform and reality behaves as particles. If you have ever seen a murmuration of starlings in the air, or a tornado of barracuda schooling in the water, or giant waves breaking on the shore, you have observed wave motion in nature. However, most of the time, this wave motion is invisible. Theatre, by using quantum approaches such as uncertainty of plot, entanglement of characters, and distortion of space/time in the setting, can make these invisible waves visible. One implication of the uncertainty principle in quantum physics is that the characters are not fixed, but are fluid, and co-created by the audience:

> … there needs to be a move towards a kind of identity in theatre dependent on 'equal empowerment of performer and spectator, both understanding that they are jointly engaged in the creation of identities.' This would require a move away from the modern illusionistic theatre, where identity has been 'fixed into the performance of a fictional dramatic character [and] is no longer identity as processual, changing social interaction. … There is, therefore, little opportunity for performer and spectator to collaborate directly in creating immediate and physical performance identities.' A theatre practice reflecting a quantum identity paradigm might provide the opportunity for this mutual creation of identity (Johnson 2012, 76).

In quantum theatre we reconceptualize the audience in the theatre as conscious co-creators. New York director Richard Schechner in his book *Environmental Theater* (1973), sees a vital connection between the actors and the spaces in which they work. He also encouraged audience participation,

> There is an actual, living relationship between the spaces of the body and the spaces the body moves through; human living tissue does not abruptly stop at the skin, exercises with space are built on the assumption that human beings and space are both alive.

Schechner also encouraged audience participation in performances such as *Dionysus in 69*, framing the audience as co-creators in the theatre experience. Like the observer in quantum physics the audience fundamentally changes the experience. In a similar vein, Professor E.R. George in his paper on quantum theatre, has also emphasized the roles of time, space and observer:

> . . . We are not just spectators but players. It will be shown that these entities (space and time) are not merely the stage on which the cosmic drama is acted out, but belong to the cast (George 1989, 172).

Another revealing aspect of quantum physics is entanglement. When particles become entangled, any measurement of spin in one particle results in an opposite spin in the other, even when the particles are separated by great distances. Have you ever been thinking about a friend, when you suddenly receive an unexpected call from them on the telephone? If you are wondering how we can make comparisons between the microscopic world and the macroscopic world, a mathematician named Hugh Everett formulated the "many worlds" interpretation of quantum physics:

> An atomic particle can move through space and time in a multiplicity of directions at once – as if it is an expanding spherical *wave* passing through all possible trajectories. But when we interact with the particle when we measure it – we always find it in one place, not many … Everett showed that it is mathematically consistent to say that when a scientist measures the position of an atomic particle, he *splits* into numerous copies of himself. Each copy resides in a different Universe. And each copy sees the particle in a different position. The set of all possible particle positions inside a *multiverse*. According to Everett, each Universe inside the multiverse is constantly branching, like a tree, into separate but parallel universes… (Byrne 2013)

Why can't we perceive parallel universes? As Einstein pointed out, time and space are relative to the observer. Under normal conditions, we experience time and space similarly. But in the theatre, and in film, we can experiment with time and space, making time go backwards, as in flashbacks, or jump forward to illustrate the future:

> … these entities (space and time) are not merely the stage on which the cosmic drama is acted out, but belong to the cast. … In Einstein's conception, space is no longer the stage on which the drama of physics is performed: it is itself one of the performers.
> (Sir Edmund Whittaker, quoted in George, 1989, 172)

Method

Paul Johnson, in his book *Quantum Theatre* (2012), has suggested that the revolution in quantum physics can provide us with the language for identifying transformations in theatre, as well as in education:

> If quantum mechanics results in a profound process of reconceptualism within classical science, can it have a similar effect within the humanities, and, more specifically, within the analysis of theatre and performance?" (Johnson 2012, 16).

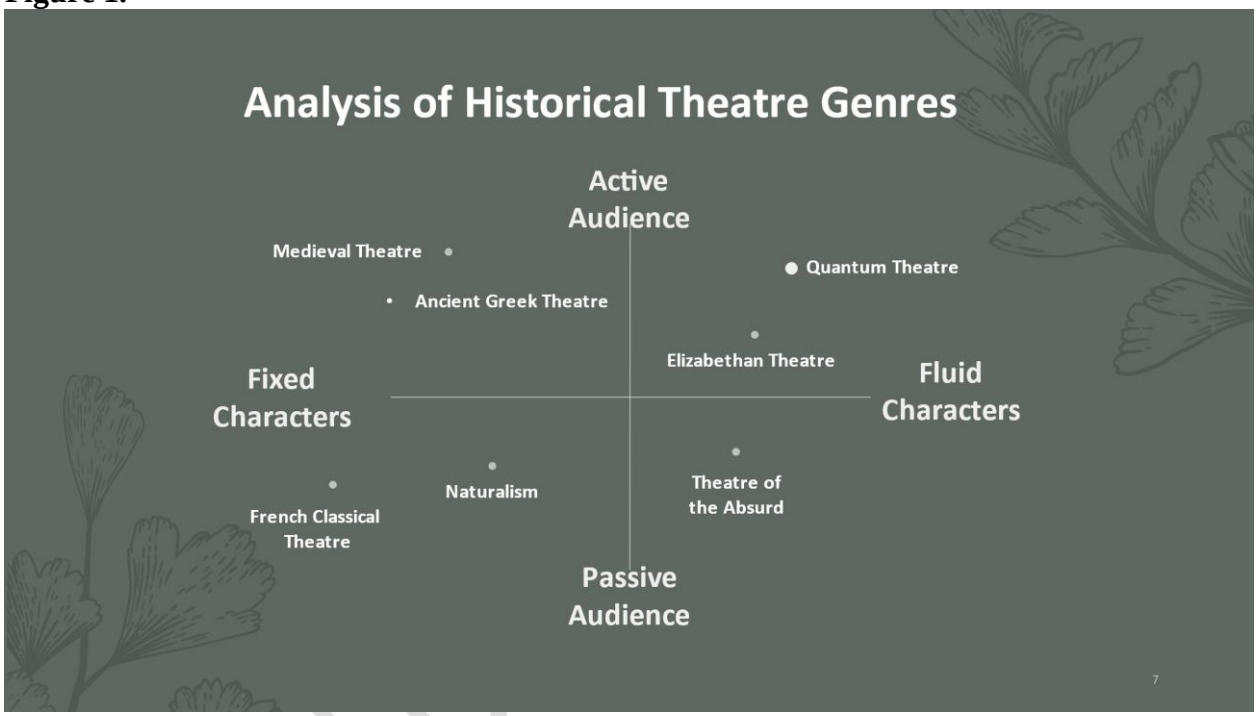
Today, the world hovers tenuously between optimism for a new quantum age in which we take responsibility for our planet, and pessimism that tomorrow we could be destroyed by nuclear war. Quantum physics has unleashed the power of the nuclear bomb, yet the current positivist paradigm assigns us the role of spectator in our own annihilation. If we can see quantum theatre as *theatrum mundi*, not only do we have a methodology for understanding the macrocosmic world in which we live, but we have a better chance of becoming co-creators of this new quantum world. For that social revolution to occur, we need to understand that non-experimental theatre reflects the scientific paradigm in which it was created; it is a theatre which is rational, positivist and linear. As Thomas Kuhn observes, "normal-scientific research is directed to the articulation of those phenomena and theories that the paradigm already supplies." In theatre, as in the Elizabethan *theatrum mundi*, there is always an underlying scientific paradigm that underpins its creation. It is beyond the scope of this paper to discuss the relationship between theatre genres and their underlying scientific paradigm, however it is hoped that this research, illuminatingly carried out for Elizabethan theatre by Frances Yates in *Theatre of the World* (1969), will continue. The naturalist theatre of the 19th century was characterized by mechanistic rationalism, as William Demastes points out (Johnson 2012, 23). We can say the same about education today. Its theories and practices reflect the rational, positivist, and linear scientific paradigm under which it was developed. In order to develop a system of education that is appropriate for the quantum world in which we live we need to examine the theories underpinning our research. As James Andris argues:

> Social scientists, and in particular, educational theorists should stop using a mechanistic matrix as a backdrop for their theories, and open their minds to models of education that share some or all of the properties of subatomic particles. That is, it should be an empirical question, rather than a point in a metaphysical position, whether or not qualities such as nonlocality, superposition, and unmeasurability are manifested by macro level educational and other social phenomena (Andris 2001).

The possibilities inherent in an approach to theatre and drama performance are provided by new developments in our understanding of quantum physics. Paul Johnson has demonstrated that "quantum mechanics can be used to develop an analytical framework for writing about live performance (Johnson 2012, 185). In order better to understand the relationship between scientific paradigms and the genres of theatre that reflect them, a two-dimensional analysis can assist us in comparing them according to three axes: 1) character as it reflects identity along a continuum between fixed and fluid

identity; 2) audience as co-creators, passively participating as spectators at one end, or actively co-creating at the other. Using this analysis we can plot the relative positions of ancient Greek theatre, medieval theatre, Elizabethan theatre, French classical theatre, naturalistic theatre, theatre of the absurd and quantum theatre.

Figure 1.



Discussion

This brief analysis necessarily generalizes about theatre genres. While different playwrights might slightly change the positions of each genre, the genre's placement in a quadrant is dependent on their relative position to the other theatre genres considered. The purpose of this analysis is not to make absolute judgments; it is employed for the purpose of comparison. Ancient Greek theatre is plotted in the active audience/fixed character quadrant, since though the audience is not physically active, they are actively participating by suspending their disbelief. Since they believe in the gods portrayed by the actors, they are more concerned with how a character is portrayed than understanding the plot. While the depiction of the characters in ancient Greek theatre is dependent upon the individual playwright, for the most part they play fixed roles. Aristotle identified the characteristics of tragedy in the unities of thought, place and action. Medieval theatre is plotted in the active audience/ fixed character quadrant as well; the audience's belief in God helped them to actively participate in the action, often by moving to follow the action as it unfolded. The characters were relatively fixed, since if they varied too greatly

from Biblical tradition, they were likely to be censored by the Church. The medieval paradigm of belief was the great Chain of Being, on which all matter and life is descended from God. The characters of the French classical playwrights, Molière, Racine and Corneille are generally based on the Greek classics and on observations of social behaviour. Since the plays are written in Alexandrine verse, they are difficult to translate authentically. Hence the characters are fixed, and the audience, many of whom knew the original stories, were more passive than active in their reception, though an exception may be made for the furor that surrounded the opening of *Tartuffe* due to its criticism of the Church. The philosophy of Descartes had undermined the authority of the monarchy and the Church. The naturalist plays of Strindberg, Ibsen and Chekhov feature characters whose fates are determined by their environment. The audience is relatively passive in that they are expected to accept that their reality is determined. Heavily influenced by Darwin's theory of evolution, in naturalist theatre there is no place for gods or romance, only poverty, disease and death. The scientific paradigm which underpinned naturalism was logical positivism. In the absurdist theatre of Ionesco and Beckett, characters may be trapped, but they may also change during the play. Hence, they are more fluid than in naturalist theatre. Science and logic had been abandoned, so audiences must work harder to find meaning in the nonsensical language which questions received meaning. However, the audience remains relatively inactive. Perhaps the best example of an active audience with fluid characters is the Elizabethan theatre of Shakespeare. The characters in his plays often undergo a dramatic shift in understanding during the play, such as Macbeth's recognition that his "vaulting ambition" will be his undoing. The audience was actively participating in the action, shouting out their reactions, clapping for heroic characters and booing when the villain appeared. John Dee and Francis Bacon were having a strong influence of Renaissance thought, as were the transformations of alchemy on characters in Elizabethan theatre (Yates 1969). Quantum theatre, as we will see from the analysis below, is characterized by fluid characters and an active audience response, reflecting the quantum scientific principles of uncertainty, entanglement and the time/space continuum.

However, while comparing theatre genres and the scientific paradigms which gave rise to them may be a useful exercise, it will not usher in a new era of quantum theatre or our ability to see quantum theatre as *theatrum mundi*. As E.R. George has pointed out:

> The neglect of this alternative Theatrum Mundi derives doubtless as much from the complexity of quantum theory itself, and the massive revisions of our conception of reality which it entails, revisions as radical as those of Copernicus, Darwin, or Einstein … Although the word "quantum" has now entered popular vocabulary, few people are aware of the revolution that has taken place in science and philosophy since the inception of the quantum theory of matter" (George 1989, 172).

A brief analysis of a contemporary play, using quantum theatre as a method (Johnston 2012, 185), will reveal some key aspects of quantum theatre. The play *Incendies* (2011) by Lebanese Canadian playwright Wajdi Mouawad, deliberately plays with time, place and action. The play resists classification as a tragedy, since the main characters are both heroes and victims, who are caught up in and perpetuate the cycle of violence of the recent civil war in Lebanon. In such a play, Aristotelian catharsis is impossible, since the characters are neither "good" nor "bad". The play does not progress in a linear fashion, but jumps back and forth in time, without giving exact dates, alternating time periods, and presenting characters from different times in the same scene. What name should we give to this genre of contemporary theatre? Contemporary only describes the time period, rather than the way it manipulates time to shown that causes and effects are not linear. Since *Incendies* demonstrates aspects of quantum physics, such as uncertainty of time, entanglement of characters over generations, and retrocausality, where effects can precede causes, it is fitting to characterize the play as *quantum theatre.*

Incendies begins with the death of the main character, Narwal, mother of the twins, Jeanne and Simon. At the reading of her will, each receives a letter written by their deceased mother: Jeanne must deliver her letter to the father the twins have never met; Simon must deliver his to the brother they did not know they had. Jeanne decides to leave Canada and travel to Lebanon in search of their lost father. She learns that her mother had been imprisoned for assassinating a political leader, and while in prison was raped and tortured by Abou Tarak the head of the prison who was drawn to her singing. Investigating further, she discovers that Abu Tarak is the father of the twins. With this discovery, Simon is persuaded to leave Canada in search of their lost brother. He discovers that Nihad, the man he meets by chance in Montreal and suspects of being his lost brother, is actually Abu Tarek, their mother's torturer, their lost brother and their father. Having discovered the identity of their brother and father, Jeanne and Simon are able to deliver both letters from their mother Narwal to Nihad. In addition to the uncertainty of time, *Incendies* shows how the characters are also entangled. The quest to fulfill the terms of their mother's will lead to the complicated discovery that their lost brother, given up for adoption, is also their father. When, at the end of the play, Nihad visits his mother's grave, symbolizing that the characters will always be entangled, even after their mother's death.

The play also demonstrates the collapse of space/time that occurs when reality is distorted in the theatre. Unlike a classical play which strives for the Aristotelian unities of time, place and action, quantum theatre can show effects before revealing causes. For the audience, this means taking the play out of the historical space/time of the Lebanese civil war, making non-specific reference to the events that occur. Actual places and times in the Lebanese civil war are referred to obliquely as "the birthplace of your mother," or "at the beginning of the hundred years' war". The audience apprehends not a historical story, but as an experience in which they discover the interconnectedness of families and

their ancestors across generations. In quantum physics, the distinction between cause and effect is not made at the subatomic level. Retrocuasality occurs when an effect precedes its cause in time, as when a later event effects an earlier one. This occurs in *Incendies* when in the scene at the end of the play, Nihad visits his mother's grave in Canada. When she gave him up for adoption as a baby, she left him with a clown's red nose. Nihad used the red nose in defence of his being a victim at his trial for torture and rape. Without the symbolism of the clown to signify that he was also a victim of the cycle of violence, it is improbable that he would have been able to emigrate to Canada to be reunited with his siblings/children. His life had come full-circle: in one sense, he had become the clown that his mother imagined when he was a baby, and an another he had fulfilled his mother's desire to reunite the family after her death. Thus, quantum theatre plays with time and space, collapsing the waveform of historicism so the audience can identify with the story. In witnessing this family's story, we recognize that we are all heroes and victims in our own family history, assisting our ancestors in our own lives to find the freedom they were denied. A performance of *Incendies* has the effect of causing us to place each of the characters under our own skin.

Conclusion

We hear of the revolutionary development of the quantum computer, that will allow us to make more complex calculations more quickly than classical computers, yet few of us realize that the revolution that has taken place in science and philosophy will have an enormous impact on the way we perceive the world. Quantum theatre is a powerful method that will help to transform our perceptions of one another, of time and of space. Hamlet advises the players "to hold as 'twere the mirror up to nature" (*Hamlet* III, ii). Quantum theatre has the potential to hold a more authentic mirror up to our natures, one which can reveal how our consciousness helps us to co-create our reality. Quantum physics proposes that our minds are holograms, collapsing the waveforms around us and projecting that consciousness outward to the world we experience. Recent experiments in quantum physics have demonstrated that our consciousness can effect changes in reality (Radin 2016). But what is consciousness? One of the most difficult problems of classical science is to explain the nature of consciousness. As we need language to help us think, so the language of quantum physics can serve as a method for seeing ourselves:

> One of the driving forces for this type of interdisciplinary work is that the development of a new language of analysis will enable previously hidden aspects of performance work or rehearsal practice to become visible, indeed come into existence, as a new language is developed to describe them (Johnson 2012, 13).

How, then, can quantum consciousness help us create theatrical worlds that can communicate the quantum world with audiences? Dance, music and ritual have often been employed in theatre to help create experiences that may

seem inexplicable to actors and audiences in a classical physics-based view of reality. In my thirty-year career as a drama teacher and theatre director, I have witnessed moments in the theatre and in the classroom that I can't explain. Children who used language so authentically in an improvised drama in Toronto about the ancient Egyptian myth of Isis and Osiris, that it reflected the actual rituals that have been handed down to us thousands of years ago. I witnessed a devised performance in Athens, based loosely on the ancient Greek tragedy of *Iphigenia in Taurus* in which the spirit of Apollo appeared to descend into the Iphigenia's body. Young teenagers performing Shakespeare have taken my breath away with ability to shift quickly between their contemporary characters in a theatre troop and their Shakespeare characters while performing *Pericles* in London. These are only a few examples, yet I am convinced that I was co-creating the experience with my consciousness of the plays and the performers. As John Cage observed, I am not alone in this belief:

> … 'consciousness is structuring the experience differently from everyone else's in the audience.' For Cage, there is a more fundamental distinction than various observers merely interpreting the identical observed object differently, instead what is observed varies from spectator to spectator. There is more than a variety of perspectives, there is in fact a variety of perceived objects" (Cage quoted in Johnson 2012, 105).

If our consciousness is created through a quantum hologram, then this type of non-traditional performance may hold up a mirror that reflects the structure of consciousness itself (Johnson 2012, 10). Quantum theatre functions as a *theatrum mundi* in which we can discover the possibilities of the quantum world. As E.R. George points out, it is the uncertainty of the theatre that allows us to witness a performance which is co-created by the consciousnesses of the actors and the audience:

> The similar fundamental indeterminacy of theatrical space—time … is precisely what the quantum physicists have discovered about reality: simultaneously objective and subjective — 'out there' but known and even created only by human interaction. 'Our senses writes Talbot, ' are not separate from what is 'out there', but are involved in a highly complex feedback process whose final result is to actually create what is out there" (George 1989, 173).

Quantum theatre principles have widespread implications for arts education in schools and communities, especially the reliance on the judgments of ability provided by standardized testing. When quantum theatre principles are adapted to educational settings, there will be an increase in mindfulness, creativity, and learner-directed education. Currently, the use of standardized tests can measure where a student is according to a predetermined benchmark. It tells us nothing about the student's rate of learning, or what the student is learning that is not measured by the test. It reminds me of the joke about Heisenberg being stopped for speeding:

> The policeman asks Heisenberg, "Sir, do you know how fast you were going?" and Heisenberg says, "No, but I know where I am!" Confused, the officer says, "Sir, you were doing 80 mph," and Heisenberg throws his hands in the air and huffs, "Great, now I don't know where I am anymore!"
> ("Heisenberg speeding", http://lessonidea.wordpress.com)

Many arts educators believe that standardized testing thwarts children's creativity and limits their learning to what the test-makers have decided is relevant. As Sir Ken Robinson observes:

> For generations, education has been biased toward narrow forms of academic ability, and as such it disregards the marvellous diversity of young people's talents and interests. On top of that, governments around the world have been spending fortunes on "reforming" education to "raise standards." These efforts have mostly been an appalling waste of energy, time and money. They are based on wrongheaded assumptions about children and learning and the world we are actually living in. They have marginalized the very capabilities our children need to create a more equitable, and sustainable world, including creativity, critical thinking, citizenship, collaboration, and compassion (Robinson 2022, xxvi-xxvii).

How, then do we reform education? I believe the arts have a critical role to play, since the arts, like the quantum world we live in, invite children to suspend judgment, to become entangled, and to take quantum leaps in time and space:

> Teachers and researchers can begin *to conceive of the active child as a wave motion rather than as a particle.* This means sharing the child's journey through fictional and virtual worlds, following as best we can while he or she is transported beyond linear time and local space. … When we engage in a mutual dialog with the child, we not only assist the child to meet developmental challenges, but also facilitate the child's developmental process by reflecting the child's changing self-image back to the child. If a child's self-image can be developed and externalized through roleplay, narrative, and other art forms, teachers may be in a unique position to do invaluable practical research by applying the metaphor of the quantum leap to the classroom (Martin-Smith 1995, 42).

I wrote those words more than twenty-five years ago, at a time when arts education was burgeoning in our schools. Though the classical pendulum has swung back since then, I continue to hold the belief that the future of education and the arts will be through a transformation brought about by the revolution we are witnessing in quantum physics. Yet it will not be advances in physics that brings it about. It may indeed be a quantum theatre performance by a small group of conscious actors and spectators that is broadcast around the world using holographic technology. As E.R. George pointed out, "no paradigm has ever been displaced simply by the accumulation of scientific evidence that it is wrong" (George 1989, 178). However, it is the poet and playwright T.S. Eliot who captures the spirit of quantum theatre best:

Time past and time future
Allow but a little consciousness.
To be conscious is not to be in time
But only in time can the moment in the rose-garden,
The moment in the arbour where the rain beat,
The moment in the draughty church at smokefall
Be remembered; involved with past and future.
Only through time time is conquered.
(Eliot 1944, 15)

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