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Teaching | Learning is Emotional: Interpretive and Impressionistic Approaches to Exploring Emotions in Science and Science Teacher Education

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The Graduate Center, City University of New York

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TEACHING | LEARNING IS EMOTIONAL: INTERPRETIVE AND IMPRESSIONISTIC APPROACHES TO EXPLORING EMOTIONS IN SCIENCE AND SCIENCE TEACHER EDUCATION

by

KATELIN CORBETT

A dissertation submitted to the Graduate Faculty in Urban Education in partial fulfillment of the

requirements for the degree of Doctor of Philosophy,

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ABSTRACT

Teaching | Learning is Emotional: Interpretive and Impressionistic Approaches to Exploring

Emotions in Science and Science Teacher Education

by

KATELIN CORBETT

Doctoral Advisor: Konstantinos Alexakos

This dissertation is a compilation of studies, on emotions in teaching and learning. My experiences as a teacher and student of physics have informed my perspective. These experiences as well as my role as a science teacher educator have contributed to my transformations. My work is interpretative and impressionistic. I attempt to address what is happening and why it is happening through my own interpretation, participant reflections, heuristic responses and dialogue with participants. My research community has also informed this work, as well as the preservice and inservice teachers that have participated in each of the studies. I consider this work to be emergent due to the consistent thinking and rethinking of each exploration.

This dissertation is presented through four studies and consistent personal reflection. Each chapter highlights events and experiences in teaching and learning. My axiology (values), epistemology

(theory of knowledge) and ontology (how I view the world) have informed my research and have shifted through the process. Chapter 2 is a forum response to an article discussion about culture and didactic transposition. In this chapter, I draw on my own experiences as a female physics student and female physics teacher in male dominated spaces in. In the 3rd chapter, I examine emotions, such as fear and anxiety, and the role they play in the perception of learning physics. In addition, I consider axiology and epistemology as contributing factors in what is taught, how it is taught and who is taught in a physics classroom. In Chapter 4 focuses on the development and use of a heuristic as a mindfulness intervention, method and methodology for exploring student-teacher interactions with preservice and inservice science teachers. In Chapter 5, I use impressionistic tales as a research method | methodology for exploring emotional conversations about race and religion in a physics class and illuminate the significance of axiology and awareness of axiology in teaching. each of these chapters I identify the significance of emotions as well as the sociocultural aspects associated with teaching and learning.

I hope that by sharing my stories, readers can make connections to their own experiences. Like a heuristic, readers are encouraged to consider these experiences reflexively, become aware of their own emotional experiences and provide an opportunity for personal transformation. I have come to understand and value the significance of exploring emotions in teaching and learning. My hope is that readers consider how emotions are significant in their own interactions.

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Chapter 1

"WHERE AM I NOW?

Katelin: Since a very young age, I have had a love of learning. I spent long emotionally grueling hours in the university library metaphorically stuck between my desire to understand and my desire to succeed. I had a positivistic and deterministic view of learning and living.

If I … then…

If I study for two more hours then I will do better on the exam

If I go to the gym every day then I will lose weight

If I do summer research then I will get into graduate school

Objectivity was imperative and bias was a naughty word.

As I reflect on where I am now I know that I have learned so much from those who I have worked with, my family, my students, my advisors and my peers. I am more aware of who I am, what I value and what I don't understand. I am also aware of how these things mediate my teaching, learning and being in the world.

Emotional: Free Write

Teaching and learning have been part of my life for as long as I can remember and even before that. I have been a high school physics teacher for nine years. In that time, I have strengthened in my passion for teaching and my desires to share this passion with my students. I came to this doctoral program because I felt that I needed to explore the structures that inform what happens in the classroom as well as those who do and do not study physics.

As I walked out of Konstantinos Alexakos' (my advisor, or KA's) office after sharing with him one of the final chapters of this dissertation, I felt vulnerable and hopeful at the same time. The work that I do and the way I have approached research is emotional. I have always viewed myself as a teacher but have struggled with finding strength in my voice as a researcher. By viewing teaching as research, I have started to understand myself better as a researcher. I

would have never been able to predict how emotionally difficult this work would be, this is in large part due to the fact that I never before viewed research as connected to my emotions and my life in the way I now understand them to be. Emotions are a significant part of interpersonal interactions, the decisions that we make, what we value and the way we view the world. My understanding of emotions and the role they play in interactions are largely informed by Randall Collins (2004) and Johnathan Turner (2007) and mediated by my own experiences as a teacher | researcher. Recognizing my emotions during moment-to-moment interactions and being transparent (sharing these emotions) in the work that I do is part of my frameworks for teaching and research. Because of this I think it is essential to share here who I am and where I come from.

My Roots: Being Emotionally Grounded

I consider myself to be emotionally grounded. Although I am not exactly sure what that means, I think that being grounded has to do with the support I have received from my family. During my childhood, my mother taught me that if I studied hard enough I could do anything and be anything I wanted. I often think that I took that sentiment on as a challenge. I wanted to do things that were difficult and be things that were unexpected. This is the way I approach life. "Girls don't study physics," so I studied physics. "Teaching in New York City must be difficult," so I looked for a job within the five boroughs.

I think about the concept of being grounded metaphorically. It is like being a tree rooted into the ground, deep into the surrounding soil. The soil is what nurtures the tree but also keeps it from tipping over. When I was young, my parents always valued school, hard work and happiness. These are the things that have helped me to grow as a learner, as a teacher and now as a researcher. Ken Tobin (2012) often talks about this concept of resonance and "learning by

being with." I have learned compassion and dedication because they were consistently molded for me as a child, by being with those who show unconditional compassion and support, my family.

Not only do I feel grounded by my family, I think of them as my foundation. They have always encouraged me to put everything I have into everything I do. My dad speaks proudly of an experience where he worked the entire summer. "Yup I worked the whole summer" he says, waiting for a response. Eventually answering the question he thought you would ask, "Yup 100 days straight." I think that this sentiment is important to my axiology and epistemology when it comes to teaching, learning, research and life. I believe that I put my whole self into the work that I do and it is an asset, not a bias that needs to be explained away.

As a science major I viewed research as a quest for truth and generalizability. I would talk about outliers and sources of error as if they were unavoidable and put a great deal of effort into explaining them away. Part of my transformations as a researcher is the way in which I now view contradictions. I value, the outliers as a means for increasing understanding. This axiology mediates my research.

I value all of my interpersonal interactions especially with my family. I don't believe that anyone values family more than my mother. You would never have to question this because she lives this transparent value system. Learning by being-in-with is how we "pass on" our values and our traditions (2012). We don't need to write them down, or question them, they are part of us. My mom has taught me how to tie my shoes, how to drive a car and how to value family. Like a teacher in formal schooling, my mother has taught me and continues to teach me explicitly and implicitly, agentically and passively through dialogic interactions and shared experiences.

When I came to the CUNY Graduate Center I came to learn, I didn't realize how much I would learn about myself. I am emotional, I am empathetic and I am anxious. I have become more aware of my heartrate, my breathing and my emotional energy. Although I try to be more sympathetic to myself, I find it hard to be. Awareness is the first step and having agency means that I can act and make decisions, but passivity means that I don't always make these choices consciously (Tobin, 2012). KA always tells me to take care of myself. I'm not sure what that means exactly. I want to do things that make me happy but also make me proud. Challenging myself makes me happy but also stressed and I have found that sometimes that doesn't result in "taking care of myself."

Transparent Axiology

My greatest personal transformations are in my awareness with respect to my own axiology and epistemology. I have come to understand transparency to be part of my theoretical framework and part of my framework for teaching. What I value as an educator, researcher and as a person in the world is not only important to who I am but is important to the way I interact in the world. Because these values are embedded in my passive and agentic decision making, it is important to be aware and honest with others about what is valued and understood. Being transparent and open, also makes me vulnerable, and that is why it is a risk.

What I value and how much it is valued is my axiology (Alexakos, 2015). In this chapter, I share the things that are important to me because they are important to the work that I do and how I make meaning. My axiology informs and is informed by my epistemology and is part of my frameworks for research and social life. In three of the chapters in this dissertation (ch. 3, 4 & 5), I discuss the significance of a teacher's awareness and transparency around their values and theory of knowledge. In doing my doctoral research, I have thought a lot about my own

axiology and epistemology and how they have transformed. What I value has been informed by my experiences and those I have encountered in my life from my childhood to now, as a teacher and researcher.

Where am I now: Becoming a Teacher | Researcher

Teaching at Brooklyn College has also informed my perspective about research. When I started teaching graduate level courses to preservice and inservice science teachers I was extremely nervous. I did not know if I had anything to share with them. In my work at the CUNY Graduate Center I have learned about the things that are most important to me. These things have transformed my perspectives and inform the way in which I teach, research and live.

It seems strange to begin my dissertation with where I am now but it is aligned with the dynamic nature of hermeneutic meaning making. Where I am now, where I was and where I am going are all part of the transformations associated with authentic research. Authentic inquiry is part of my research framework. There are four criteria for authentic research developed by Egon Guba and Yvonna Lincoln (1989) and adapted by Tobin (2006). Ontological authenticity relates to the transformations of the participants, researchers, teachers and students. Catalytic authenticity implies that these changes are catalyzed beyond the individual, to the larger community, and result in improvements. Educative authenticity means that the research values learning from difference. The fourth criterion is tactical authenticity which suggests that all participants benefit from the research, encouraging researchers to consider power dynamics and inclusion of those who may be marginalized and victimized. In an effort to adhere to these criteria, I include student perspective, use mindfulness interventions and encourage emotional awareness as means for positive change. In addition, doing research in teacher education, with current and future teachers is a way to catalyze change.

Over the past five years as a doctoral student I have learned a lot about myself. I came to graduate school because I wanted to explore the issues that I felt existed in education, the over standardization of schools, the emphasis on test scores and accountability and the inequitable representation of women and students of color in rigorous science, math and technology courses. I certainly expected to learn, but I just didn't realize how reflexive the process would be.

My Students: Epistemology

Professionally, I identify as a student, a teacher and a researcher. Although I believe that they are dialectically intertwined and I understand teaching, research and learning to be all aspects of knowledge production, when asked what I do or what I am, I say I am a teacher. That is because of the importance of my students. As both a high school teacher and college instructor, I have learned a lot from them. I value their voice and perspectives and appreciate what they have to contribute to my own understanding. One of the studies in my dissertation (chap. 4) took place in a class that I taught at Brooklyn College. Two other studies in my dissertation (chap. 3 & 5) took place in KA's classes at Brooklyn College. In those instances, I was not the official instructor of the course, but took on the roles of teaching in different ways, including working with students on lab activities and asking and answering questions. Through these experiences I better understood knowledge as socially constructed and experienced a shift in my own epistemology. I believe that each of us brings our own interpretations and experiences to making meaning in moment-to-moment interactions. This is why it is valuable to include multiple perspectives and multiple voices.

Appreciating my Emotions

My emotional awareness has increased as a result of my doctorial research experiences. I was not aware of the intensity of my passion, nor did I appreciate its intensity before I began researching emotion at the Graduate Center. Sitting in a research squad meeting one day, I clearly recall asking KA if being aware of our emotions and consistently attempting to make sense of the emotions of others was overwhelming. His response was, that's an interesting idea (chuckles). Even now, writing this chapter, tears are populating in the corner of my eye. I can feel my heart beat faster. Becoming aware is dangerous, becoming aware is a risk. However, being aware and reflexive afford agency (and passivity) and that is powerful. I have learned many mindfulness strategies in my doctoral coursework and have studied heuristics as a tool for ameliorating negative emotions. I think that without interventions, becoming aware of our emotions is a risk.

Framing My Dissertation

I began my work at the CUNY Graduate center with the intention to study physics education. I hoped gain a deeper understanding and address inequities in who takes physics at the level of policy and generalizability. Although this is still of interest to me, my understanding of knowledge, culture and teaching have transformed.

Chapter 2 of my dissertation, *Gender, Identity and Culture in Learning Physics,* is the first chapter in this dissertation that I completed. I have changed a lot since writing this, and reading this chapter is important to understanding my transformations. The chapter is a reflective response paper to a forum article about culture and didactic transposition, published in the journal, Cultural Studies of Science Education. I draw on my experiences as a female physics student and a female physics teacher in male-dominated spaces.

This 3rd chapter of my dissertation, *An emotional relationship with physics content,* identifies the significance of emotions and sociocultural aspects associated with teaching and learning. It also identifies axiology and epistemology as contributing factors in what we teach, how we teach and who we are in a physics classroom. These themes have developed and been carried through each chapter in my dissertation.

Chapter 4, *Developing Heuristics with Students* focuses on heuristics, reflexivity, and doing research with students. Heuristics have played a major role in my understanding of values, power, and the meaning of hermeneutic phenomenology. In developing heuristics with students, I learned a lot from them about valuable student-teacher interactions.

Chapter 5 of my dissertation, *Emotional Conversations about Race,* is an impressionistic tale of an emotional conversation in a physics class about race, following the shootings of Alton Sterling and Philando Castile. I still cry every time I read through it. Teaching is a personal experience, writing this tale has helped me to see how, in teaching, we share ourselves with our students.

I conclude this dissertation with chapter 6. Titled, *Transformations*, I reflexively consider changes in my understanding of teaching, learning and research. Beginning my doctoral work as a member of a research community (squad) has informed my research, my interpretations and myself.

I hope my experiences and what I have learned provide some insights for you and your own teaching and learning. Thank you.

GENDER, IDENTITY AND CULTURE IN LEARNING PHYSICS

Gender, Identity and Culture in Learning Physics

Abstract Student engagement in science, as defined by Iva Gurgel, Mauricio Pietrocola, and Graciella Watanabe, is of great importance because a student's perceived compatibility with science learning is highly influenced by personal identities, or how students see themselves in relation to the world. This can greatly impact their learning experiences. In this forum, I build on the work of Gurgel, Pietrocola, and Watanabe by exploring the relationships between engagement in physics and gender, and by looking at the expansive nature of the concept of culture. I expand the conversation by investigating ways in which learning science has impacted my own identity/worldview, particularly how it affects my personal teaching and learning experiences. I focus the conversation around the relationship between gender and the experience of learning science to further the dialogue concerning identity and how it impacts engagement in science. I also look at the role of didactic transposition in the perceived dis- connect with science. I reveal my experiences and analysis through a personal narrative.

Gender and the cultural collide

In the work done by Gurgel, Pietrocola, and Watanabe the aspect of cultural identity focused on is a student's national cultural identity, Brazilian. As was discussed in their work, national identity is just one of the many aspects of an individual. Other aspects, including race and gender, are also essential when thinking about a person's identity with respect to learning science. Historically, in my own experience as a female student of physics, gender was an important part of who I was within every classroom experience and how I viewed myself within the context of learning science.

As a woman studying Physics at the college level I had my own experience with cultural disconnect as it related to my gender. My decision to study physics in college was the result of positive experience I had as a high school math and science student, the enjoyment I experienced when problem solving and the success I had in STEM related courses. One of very few women in my formal science classes, I studied physics surrounded by male teachers and male students who had very concrete goals. They wished to be engineers, work in a lab or hoped to continue studying science in graduate school. I was uncertain of my own path upon entering college, but soon realized the reality of the gender disparity in my classes. Though not treated differently, my own perception of self was influenced by the very visible lack of female representation in the faculty and student body. In considering what it means to be a college student studying physics, a common trait shared by many of the constituents was gender. Though not a requirement for entry into the physics major, being male seemed to be an aspect shared by many members of the group and therefore appeared to define it. As a woman I often felt that I had overcome the requirement and was able to assimilate into the culture to become ''one of the guys''. This idea of the individual informing the collective was very much part of my own reality and because being male appeared to be a trait that defined physics majors I felt that I had overcome the label.

As suggested by Anthony Giddens (1991) and discussed by Gurgel, Pietrocola, and Watanabe, the group exists because of the individuals that make up the collective. The individuals that comprise a certain subgroup define the characteristics of what it means to be a participant. The group itself becomes defined by such traits that are then assumed for all other constituents. These traits would not exist, nor would the group, if the individual did not experience uniqueness. Gurgel, Pietrocola, and Watanabe refer to this notion of assuming traits about an individual based on a group that he or she may or may not identify with as labeling. I

experienced the impact of such labels by acquiring the stigmas associated with a male dominated field. Labeling is also prevalent when considering the public view of science and the notion of what it means to enjoy or appreciate it. When I tell people that I teach physics the response is normally some variation on ''Oh wow, physics is difficult'' or ''I am not good at science''. The individual is looking at science defined by a particular label and then distances himself or herself from it.

As Gurgel, Pietrocola, and Watanabe discussed in their study, the conflict of belonging impacts the identity constructed with respect to one's own uniqueness amongst a group defined by a character trait that you do not possess. The authors reference the work done by Nancy Brickhouse (1994) who makes an important point that we must stop considering that there is something wrong with a girl's ability to learn science and should instead examine what is wrong with how science is being taught. Almost as important as how science is taught, is what science is being taught and with what purpose. Brickhouse (1994) notes that the achievement differences that appear in boys and girls in the physical sciences as early as 9 years old increase in other sciences, as they get older. Conceptualizing science as a reductive body of knowledge and practices and learning as transmission of such knowledge and practices in a bounded classroom may only perpetuate the cycle of marginalizing women from the field of science. By expanding the notion of science as culture we can attend to identity development through implicit and explicit structures that are produced and enacted inside and outside the physical boundaries of the classroom walls.

Transformations

In my first 2 years as a science teacher I found it fascinating to see which students elected to take physics classes and which students abstained. My first physics class had only two female

members out of a roster of 25. The noticeably disproportionate gender representation was striking to me. Looking back on this experience it is interesting that I was so astonished by this disparity. My experience in the college physics classes I attended as a student supported the stereotype, but my personal perspective rejected this notion.

My experiences as a college physics major proved to be transformative. Spending long hours in the science building with my fellow physics majors studying for exams and writing up detailed lab reports resulted in a strong sense of camaraderie. For me, learning physics and being part of the stresses, successes, and mutual foci of my peer group led to what Randall Collins (2004) would describe as emotional entrainment. By being a member in a social network organized around the learning of physics, my understanding of the structures that defined its membership transformed. Collins' (2004) Interaction Ritual Theory describes the connection between an individual's lived experiences and his/her understanding of the structures and rituals within the social group in which the experience was shared. This theory helps to explain the individual | collective as a dialectical relationship, where each could not exist without the other and where each is a constituent of the other. My understanding of what it meant to be a member of the group was refocused around the experiences I had within it and led to a transformation in what it meant to me to be a student of physics. I no longer viewed being male as a trait one needed in order to be successful in science. I had spent 4 years working toward a degree in physics and at some point along the way it became part of my identity. It was not until I reflected back on my experience that I was able to identify how my view had changed.

The transformation I experienced aligns with the work done by Gurgel, Pietrocola, and Watanabe where in the relationship between cultural identity (being Brazilian) and engagement in science is addressed. The views of participants within the study evolved and were further

informed through the implementation of three interventions. Looking at their study through a lens of ontological authenticity, as defined by Egon Guba and Yvonna Lincoln (1989), the participants as well as those who conducted the research went through a re-consideration of their own thinking as a result of the shared research experiences. Both the researchers and the participants benefited from these shared experiences and their work has the potential to further benefit the institution. The goal of the research was to examine the relationship between identity and learning science, which I have expanded upon using my own teaching and learning experiences both of which had resulted in transformations in understanding the relationship between identities and learning physics.

If we expand our view of science as culture we can better understand the ways in which our lived experiences contribute to our meaning making and discovery. It can also provide an opportunity to look at science as something that we all engage in through being in the world and not as an established community of elite that is narrowly defined.

Science as culture

In their research, Gurgel, Pietrocola, and Watanabe use culture to describe the students' shared national origin and the science culture of the school to be a set of information and formal language transposed from the science community. In this sense the cultural identities of the students are strictly bound by notions of what it means to be Brazilian, and the culture of science in school is strictly bound by a specific set of science principles and ideas. According to William Sewell's theory of culture (2005), being ''strictly bound'' means having thick coherence of meanings. For example, being a scientist is conceptualized by the majority as being white and male and therefore has, ''thick coherence'' of meanings. Being female or not white is often ignored or discarded as an anomaly because the overriding concept of culture does not allow for

multiple meanings, let alone contradictory ones. The authors push back on the collision of these two cultures and begin the conversation of the overlap between them. Looking at different ways in which culture can be viewed and theorized provides an additional perspective to their work. If we consider science to be culture, then we must not only look at the interactions between science and identity but also the way our lived experiences inform our identity within the culture of science.

Sewell's theory of culture (2005) looks at culture as knowledge production and discusses it as having thin coherence and ever-present contradictions. In the work done by Gurgel, Pietrocola, and Watanabe, the aspect of science production is first examined in the study through a survey that provided information about the students' views of nationality in relation to science. The survey also asked students to generate a list of famous scientists, which provided insights into who is seen as a scientist and what makes science part of their identity.

The idea of being defined as a scientist emphasizes the view that science is a subject that is studied by a specific sub-group of individuals. Based on general perspectives held and presented in society and the media, this sub-group is selective. Even the image of a scientist being a white male with a white lab coat, implies certain physical attributes that a scientist possesses. This idea can be conceptualized by considering the dialectical relationship between agency and structure, where in each of the constituents does not exist without the other. Enacting one's agency can often passively reinforce the structures by accepting well-defined boundaries of what it means to be a scientist and acting accordingly. This view also reinforces the existence of a strictly bound ''scientific community'' with schemas and practice that are not representative of all people. If we instead look at science as culture with structures, schemas and ever-present contradictions, we can bring to light a new understanding. The view that, culture is the

[re]production of knowledge, as defined in Sewell's theory of culture (2005), culture can only be produced from existing structures, so the reproduction of knowledge/culture will always have some resemblance to the prior structure. Viewing science as culture, one's identity within the context of a science classroom should overlap with other aspects of self in identity formation. In trying to link one's national culture with science, the disconnection is a result of a set of perceived criteria of what it means to be a scientist and who does science. The students who participated in the study, view the act of participating in science as being ''beyond the perceived norm of their own cultural abilities'' (Gurgel, Pietrocola, and Watanabe 2015). This does not have to be the case, science should not exist as an exclusive group of individuals and we must explore the perpetuation of this notion further.

Falling out of love with science: through didactic transposition

In discussing the conflict between the students' perceptions of Brazilian culture and science, I am reminded of my own experiences as a student in a large suburban public high school in New York. Although not true for everyone, learning science at a young age was both fun and natural for me. During science lessons my classmates and I were often asked to question, explore and experiment with things that were both new and familiar to us. We were asked to express our understanding of how and why things act the way that they do and received validation for attempting to explain the world around us. When we are children we perform science experiments on our own and observe what happens around us with wide eyes, touchy hands, and no fear of failure. Motivated by our own desires to understand the way the world works, we test gravity and the limits of the frictional force before even learning to walk. A young child can push something off the table and seeing it fall to the ground, try this act a second time. The confirmation that things drop to the ground can excite the child to continue in this process

knowing what the outcome will be based on previous experience. These acts of exploration are science.

As we grow older the structure of science classes becomes more rigid and the courses become abstract and decontextualized. Science is no longer an expression of an individual's own curiosity, but a set of pre-produced concepts didactically transposed into a core curriculum. The textbooks and the tests highlight information that was discovered, equations, diagrams and symbols that have been created to represent the ''beauty'' of the natural world. Students are expected to answer questions and apply understanding based on abstract principals that many times they have been asked to accept as truth. Even though a teacher might say they support multiple perspectives or ways of doing science, it would be more difficult to assess students in this way. This is an important aspect of the axiology of the teacher, the school and the school system where decontextualized canonical versions of science, as represented in standards, are privileged over contextually meaningful sciences experienced in people's everyday lives. This method of science consumption, as opposed to science production, creates opportunities for the kind of identity disassociation that was discussed by Gurgel, Pietrocola, and Watanabe with respect to one's cultural identity as it relates to learning physics.

In my own classroom a student's engagement in science comes in all varieties. It is easier to teach someone how to do something in a physics class than it is to teach them why they are doing it. Too often students are so concerned with answering a question correctly that they neglect completely why exactly the answer is even significant. This is not their fault. The process of asking questions and searching for a correct answer is consistently modeled for students throughout their learning careers. Students are more engaged in learning when they are motivated by a personal desire to learn. When my students perform a lab experiment we identify

the question that we are attempting to answer, the procedures and the analysis techniques. Once the lab is complete students will ask if their answer is correct. They seem to feel that a question is never asked that does not have a pre- determined answer, but this is simply not true. Due to rigid state curriculum and pre- established assessment tools, I am often forced to stick to formal labs that do not provide room for inquiry but are a reproduction of the idea that the lab has a set solution that the students are trying to figure out. We ask questions all the time we can't answer for certain and therein lies an opportunity for further exploration. A multiple-choice exam for example, does not give students an opportunity to express their own desires to question and explore. Teachers are very often bound to state exams but teaching with the ultimate goal of getting students to pass a required exam tells students the answer is more important than the path to discovery.

The perception of science as truth, and facts that are discovered by members of an elite group ultimately led to the view that scientists must have very specific traits and those who do not possess these traits are excluded. During the intervention in the study conducted by Gurgel, Pietrocola, and Watanabe when the students were brought to a lab with Brazilian scientists and interacted with a Brazilian researcher the students were exposed to the idea that science is not a set of laws and rules but instead the search for unanswered questions (Gurgel, Pietrocola, and Watanabe 2015). The experiences that researchers have are comprised of just that, asking questions and searching for answers. After their visit to the lab some students ''expressed astonishment'' that their own nation could produce such a lab and sparked curiosity as to where funding for the lab came from. Whatever difficulties they had in seeing themselves as ''scientists'' is a reproduction of the idea that to be a scientist one must work in a lab, which is

not the case. But then again, one should not have to fall into a classification to appreciate certain experiences of questing and discovery.

Yves Chavallard's Theory of Didactic Transposition (1991) has implications on culture production and identity formation. The relationship between the teacher, the student and the taught knowledge is of great importance within all teaching and learning environments especially considering knowledge taught in schools. Didactic transposition is how knowledge/culture is produced in the life of a scientist and how it becomes represented in textbooks and ultimately how the teacher enacts the culture/knowledge in her classroom Often culture of science is comprised of sets of truths transposed into the classroom in ways that contribute to disconnected feelings of students toward science in schools. Knowledge presented in schools can be considered a series of ideas generated outside of the classroom that are transposed and evolved into scholarly knowledge, which has been informed by outside sources. As a High School physics teacher in New York City, I see the impacts of this transposition. Although I try to engage students in problem solving that is relevant to their own lives, I have seen the impacts of mandated science standards and assessment which prove to be key contributors to feelings of disconnection between students and science. Through my experience as a NYC physics teacher it is evident that curriculum is considered to be what is taught, which individuals outside of the specific learning experience inform. The courses taught in schools are based on a set of State standards that the students are expected to meet. In physics much of this is algebraic problem solving, laws, accepted theories of how the world works and application of these theories. Although it is not the only lessons learned in a particular class period it is the basis for what goes on within a classroom.

Learning should be purposefully meaningful, contextual, and enacted in ways that transform the real world for social and nature's benefits (Vianna & Stetsenko, 2011). Inquiry based learning is one example of a way to counteract the view of science as transposed truths. Learning through inquiry provides students with opportunities to participate in discovery and inform their own meaning making. As discussed by Heather Banchi and Randy Bell (2008), there are many levels of inquiry but what is most essential is providing students with opportunities to explore their own questions, design their own experiments, and pursue their own ideas. Being in the world provides a great opportunity for learning to happen and through inquiry, the teacher, student and what is taught switch roles throughout the learning process. When students can relate to the ideas being explored, and contribute to all aspects of understanding, they are more engaged and more inclined to ask questions and participate in further discussions. This is an act of pushing back on the knowledge [re]production.

This transposition of knowledge from teacher to student with no opportunity for students to repurpose the knowledge structures contributes to cultural disconnection or distancing. A culture that seemingly belongs to the teacher is often expressed as ''too hard'' or ''pointless'' within the classroom. Developing lessons in order to appeal to student interests and engaging students through real world examples is a way to share the schemas and practices within the culture of science. These practices and schemas may not transcend boundaries in the students' eyes and in turn appear to be incompatible with their own identity. I often ask my students to share how physics relates to their own lived experiences and although I receive valuable responses I am still tied to a set of information that must be taught. Students can easily generate a long list of physical forces they experience throughout their day and expand the conversation into a deeper understanding of the abstract concept of actions and reactions. Students eagerly

respond to the idea of decision-making based on anticipated outcomes but then become overwhelmed with equations, which they view as structures of science and not as representations of the same relationships they so eagerly discussed. The formalities of the equations are constructions of the scientific community and can be viewed by students as incompatible with their own identities. Since, according to Sewell's (2005) concept of structure, new structures can only be reproduced from existing ones, students find it difficult to further develop ideas without the structural foundation needed to do so. Equations and laws are part of the strictly bound science community. Without the ability to permeate this boundary, develop a structural foundation, or see oneself as part of a science culture, a disconnection is an inevitable result.

In order to begin to move beyond the disconnection, we must help students, teachers, and society re-define their strict (i.e., narrow) views of science and what it means to be a scientist. Conceptualizing science as culture can illuminate ways for us to begin to permeate the walls that confine an elite science community and help teachers to not reinforce the strict idea of who does science. This view of science as culture could help to realign the axiology of a system that promotes didactically transposed curricula that alienate so many of our students.

Chapter 3

AN EMOTIONAL RELATIONSHIP WITH PHYSICS CONTENT

Towards Critical Classrooms

Relationships in Teaching | Learning Physics

When entering a physics classroom there are many relationships to consider. Some of them are interpersonal, between student and teacher, teacher and coteacher, and even individuals and themselves. Others include the relationship between the students and the content, and the content and the context. All of these interactions mediate the emotional experience of teaching and learning. Categorizing affiliations does leave out other relationships and creating categories reduces the fluidity of and interaction between each. But exploring the ways in which each component of a learning experience is significant, brings about awareness of these essential elements. I believe that all learning experiences have some element of teaching present. Because each presupposes the existence of the other, teaching and learning are a dialectic and cannot exist in isolation (Tobin, 2012). As I examine the experiences of preservice and inservice teachers in a college general science class with a physics theme, I challenge the awareness of who learns physics, what content is taught in a physics class and how it is taught, through the use of personal narrative. I note the emotional perspectives of participants, my own personal epistemological shifts about the formal and informal structures that exist in a physics classroom and the implications for teaching. Using an interpretive lens of what is happening and why it is

happening, I explore two events that emerged. The first event focuses on the decision to teach the concept of time in a physics classroom. The decision to incorporate mindfulness practices in the physics classroom is the second event I explored. Both of the events identified relate to the values of the instructor and are examples of the way in which axiology and epistemology inform what is taught and how it is taught in a physics class.

Before We Begin

> Katelin: I am a high school physics teacher, a doctoral student, and a researcher. I am an explorer, a lover of learning and a scientist. I believe that these labels do not define me or give a full description of exactly who I am but provide context and points of reference for what I do and how I observe the world.

When I began my doctoral studies in science education, I knew I wanted to research teaching and learning in the physics classroom. Though my view of research has shifted over time, I have not wavered in my passion for learning about physics education. I viewed my potential research projects as a set of methods for finding general solutions to clearly defined problems or an attempt to discover problems that have not yet been identified. While I see the merit in this type of organized research, due to the emotional nature of teaching and learning I believe that I cannot remove myself from my work. In addition, questions and subsequent findings emerge and transform throughout the research process. Bourdieu and Wacquant (1992) refer to this process of making meaning as hermeneutic phenomenology and is a key component of my theoretical framework for research, teaching and learning. The hermeneutic process is a method of making sense of lived experience through multiple interpretation, consistent questioning and consideration of context. Transformations are the changes, large and small, that result.

In the summer of 2017, I worked with Professor Alexakos (KA) and his students (preservice and inservice teachers) at Brooklyn College as they explored general physics topics such as motion, forces and electricity. As a high school physics teacher and a doctoral student of KA, I took on the roles of teacher, learner, observer and researcher. We engaged in the work as coparticipants in the classroom, providing each of our own interpretations and perspectives. Many of the students in KA's class were members of a teaching methods course that I taught the previous semester. I engaged in all aspects of teaching and learning, supporting students when questions arose and inquiring about their experience as the course progressed. I approached this research through descriptive and interpretive inquiry, as proposed by Kenneth Tobin and Steve Ritchie (2012) and developed from the work of Fred Erickson (1986). Interpretive inquiry embraces thick descriptions and is strengthened by polyphonia (many voices) and polysemia (many meaning-making frameworks). The concepts of polyphonia and polysemia, developed by Mikhail Baktin (1994), suggest that multiple voices and multiple frameworks for making meaning add to the reader's understanding because of the potential that multiple perspectives have to inform or transform. This type of research is in direct conflict with more mainstream positivistic forms of research in which methods and methodologies are categorized, classified and dichotomized (Tobin & Kincheloe, 2009). Positivistic research is rooted in data driven and empirical approaches that support the quest for generalizability. Taking an interpretive approach aligns with my own theory of knowledge and reduces the restrictive nature of positivistic approaches that are often in pursuit of a single truth or answer.

Using multiple methods of observation, including video analysis, personal narrative and coparticipant reflections, provides depth to this research study. In my work I wish to identify specific events that emerge as contradictions. As presented by William Sewell (2005) and

theorized in the context of education research by Tobin (2009), these events are of interest due to the ways in which they challenge what is expected. Tobin (2009) describes a contradiction as a "spike in the curve" or an occurrence that falls outside of the patterns being produced. Through the use of thick description, I attempt to make meaning of these events. One event I identified was the unexpected discussion of time that emerged on the first day of the class. The other event is a conversation that the instructor initiated on the second day of class about breathing and the potential benefits associated with particular breathing exercises. Both events helped me to understand the role of axiology and epistemology in teaching physics.

My Experience the First Day of Class

On the first day of class, Sherry, a first-year biology teacher, expresses anxiety and excitement as she enters the room. Having taken a teaching methods course that I taught during the previous semester, her enormous smile indicated that she was excited to see me. She began to walk toward me as soon as she entered the classroom.

"Hey Katelin, don't worry, I have been studying. I had the physics teacher at my school go over some of the material with me" Sherry exclaimed.

I could sense her nervous energy which was evident to me from the fast pace of her voice and the persistent curling of her hair. My first thought was *why would she feel the need to prepare prior to entering the class*? I quickly realized I might do the same if I were registered for microbiology or organic chemistry, courses that seemed far out of the scope of what I had studied previously. Courses that have a reputation of being so challenging that students find minimal success as measured by exams and final course grades.

I examine the classroom and note the number of male students present; Two.

Thinking back on my own college experience as a physics major, I was often the only female in the room. I am both intrigued and excited for what is to come.

First impressions

I include my own inner dialogue regarding my experiences in KA's general science class at Brooklyn College as part of my description (Tobin & Erickson, 2012), representing my own narrative and interpretations of what was happening with a grey background. The process of retelling what was happening directly aligns with the hermeneutic phenomenological approach (Gadamer, 2004) of meaning making and is akin to Van Mannen's (1988) approach of impressionistic tales. As I attempt to recreate the events that transpired, I try to capture the emotions and atmosphere. Video recordings of the course provide an overview of what can be observed, while my reflections, memories and conversations with students provide further analysis. Much like an impressionistic painting, the accounts of what happened are not exact renderings of what transpired but depict elements of what was felt, observed and experienced.

Conversations with students

I have shared my interpretation of Sherry's emotional experience on the first day of class from my perspective. I asked Sherry to share her own interpretation of the emotions she experienced with respect to taking physics, in order to better understand what was happening on the first day of class.

> Sherry: Before taking the class, I definitely felt nervous as I had never taken a physics
> class before.

Sherry was not the only student to express apprehensions about taking a physics focused science course. In a discussion with Patty, an elementary school teacher, after class one day I asked her what her expectations were before the class began:

> Patty: I thought it would be hard.

I asked her to explain further what aspects she thought would be challenging:

> Patty: So many details and terms, memorizing formulas, things like that. I didn't want to look like an idiot.

Focusing on the challenges associated with the course, Patty expressed concern for the anticipated difficulty of the class as well as the potential emotional experience of her peers viewing her negatively.

Emotions and Physics

The emotion shared by Sherry and Patty provide an insight into an experience often associated with learning physics; anxiety (Mallow, 1987). Teaching and learning are emotional experiences because they are human experiences. The relationship between students and emotions they experience due to the perceived level of difficulty of the course is one relationship to consider when teaching physics. Some find the prospect of taking a course that is historically considered challenging by mainstream society, an exciting opportunity. Others shy away from the course completely, never to take a physics course their entire life. Still others enter a physics classroom with the notion that they will likely be unsuccessful and have prepared themselves for what they

perceive to be their imminent and almost certain failure. Sherry and Patty each expressed some form of concern about the difficulty of the course even though they had never taken a physics course before. These emotions that students (and teachers) feel as they enter the classroom are part of what Collins (2004) refers to as the emotional energy. Resulting from patterns of social encounters, emotional energy comes from successful and failed chains of interaction rituals and range in intensity. Collins' interaction rituals theory (2004) suggests that the emotions of an individual are mediated through their interactions and carried from one interaction to the next. I believe that these interactions are not only interpersonal interactions but relationships between the individual and the content. The anticipation of entering a physics class contributes to how someone approaches the course. According to Turner (2002), emotions mediate every interaction and all previously experienced emotions are therefore part of subsequent interactions. Any and all prior experiences, positive or negative, with learning physics (or science) could contribute to the anticipation of success or failure in a subsequent course. In addition, all prior conversations around the difficulty and challenges of a physics course could contribute to developing anxiety.

Although merely suggestive in nature, social stigma around learning physics plays a major role in the emotions that students, anxious of what is to come, bring with them into the physics classroom (Bryant et.al., 2013). Jerry Mallow (1987), researching the negative role that anxiety plays in the science classroom, points out that these feelings can carry into adulthood, making those with science anxiety less likely to pursue careers in science related fields. This is problematic considering that these perceptions of difficulty have proven to be barriers for young girls over their male counterparts (Murphy & Whitelegg, 2006). In studying factors contributing to attrition in physical science majors, Elaine Seymour and Nancy Hewitt (1997) found that women and underrepresented minorities were among those most often discouraged from

pursuing these fields, one such factor being the widespread images of the white male scientist. Although there have been increases in the number of women and underrepresented minority students who major in science and engineering fields, according to the National Science Foundation (2017), still half of those working in science and engineering are white men. The macro level structures mediate who enrolls in physics courses as well as how students approach these courses emotionally.

The emotional interaction between students and the content are realized on the individual level. These experiences are also part of the classroom climate and the way in which students engage in learning. Turner (2002) points out that these emotions are not just present during interpersonal interactions but mediate our actions and responses in all social situations. Emotions that deal with core values or related to an individual's identity are heightened and failure would produce intense negative emotions. Individuals who identify as teachers and more specifically, science teachers, may experience high levels of anxiety around enrolling in a physics course because the potential for failure is directly connected to their personal identity. The anxiety experienced around learning physics would be exacerbated by any prior experiences of failure. Collin's (2004) theory of interactions ritual (IR) suggests that interactions produce and reproduce emotions that are carried with us from one experience to the next so any negative emotional experience in a math or science class contributes to the way in which a student approaches their next experience with these subjects.

More Conversations

Turner (2002) describes fear as one of our base emotions, usually resulting from an imminent threat. It is pointed, protective and critical for survival. Taylor, another student in the class, used

the term fear in expressing the concerns she experienced before taking the physics themed general science course.

> Taylor: The first day I had fear because I never took physics. I was freaking out to be honest. I had no experience with the language. My high school didn't even offer physics.

As Darwin (1920) describes, fear is a perception of danger and can produce physiological responses such as changes in heart rate and breathing. Often conflated, fear and anxiety are discussed by Frazzeto (2004) as distinct emotions. He identifies anxiety as the manifestation of the awareness that something is wrong or that an individual's values are under threat. Worrying does not solve the problem or provide safety, it keeps us pre-occupied, taking our attention away from productively ameliorating the emotion (Frazzetto, 2014). This is not always easy to do and often, in an effort to rid ourselves of anxiety, we reproduce it.

Theorizing Fear of Physics

The individual experiences the emotion of fear on the micro level. The fear of physics is produced and reproduced as a result of past social experiences (Collins, 2004). Factors such as race and gender play a key role in the level at which these emotions are experienced. In addition, our epistemology, theory of knowledge, can contribute to our emotions with respect to studying physics. In viewing knowledge as a product, this commodification of education legitimizes the fear of physics. Commodification can be defined as the view of knowledge as a commodity, resulting from consumerism and competition around schooling (Karpov, 2013). Although we can attribute negative emotions around learning physics to anxiety, I believe that we can also

theorize the emotional experience one has before taking a physics course for the first time, as being afraid of physics.

Accountability in education has gained increasing importance since the advent of the No Child Left Behind Act of 2001 and with the increase of standardized testing, all stakeholders in education are awarded numerical grades or merits for achievement (Kress, Zechmann, & Schmitten, 2011). Teachers and students alike, have expectations of giving and receiving grades for assessments in a way that resembles payment for goods and services. Success in a course, as measured by final grades, is the desired outcome. If this outcome is viewed as the goal of learning, anxiety can become fear. Heidegger (1996) states that anxiety does not know its cause, because one is not anxious of a particular thing. If knowledge is viewed as fixed or grades in a course viewed as a product of learning, then physics (learning) can be something to be feared. From a framework where science and learning science is considered to be culture, it would not make sense to be afraid. I view culture as knowledge production and reproduction (Tobin, 2012). I consider physics to be culture because of the meaning constructed within classroom activities and experiences (Sewell, 2005), not as a way to compare physics to other fields of study.

Viewing knowledge as a commodity has been argued against by many constructivist educators and researchers including Dewey (1929), who suggests that learning should focus on the process of knowledge construction through authentic tasks and draw on prior experience. Paulo Freire (1972) discusses this idea from the perspective of power and social justice by describing the banking approach to education, where the knowledgeable gives knowledge to the unknowing. The "banking approach" to education discourages critical questioning and is telling of the values of the educator (Friere, 1972). The pervasiveness of the standards-based transmission forms of education is a reality that cannot be ignored and is in direct conflict with

an inquiry approach and critical meaning making. These structures inform classroom practices and the culture of the classroom.

Physics lessons and classroom activities can be designed within a constructivist paradigm by supporting the active construction of a student's subjective understanding of reality (Keser & Akdeniz, 2010). However, the often-unavoidable structures of testing and standards are reproduced in a classroom each time an assessment is administered or even discussed. This contradiction between the epistemology of the educator and the way in which standards and assessments are enforced and discussed nationally has implications for teaching and learning. Due to the conflict in values that emerge when teaching within a system with an opposing epistemology, it is essential that teachers are aware of the structures that exist and are transparent with their students about their views and values with respect to teaching and learning. In teaching, the ever-present emotions that exist within every interaction are often overlooked or ignored but it is important to note the widespread ripples that structures of accountability generate.

What is Taught First

In addition to the emotions associated with learning physics, another relationship to consider in the physics classroom is the relationship between the student and the content with respect to what is taught. I have often considered what is taught in a physics class to be a fixed entity. By participating in KA's general science class I have a better understanding of the ways in which deciding what we teach students reveals our view of knowledge. This decision of what is taught in our classroom is mediated by factors such as learning standards, assessments and teacher accountability. The following event emerged as significant because it was unexpected and sparked a discussion around what content is taught in a physics class. The decision appeared as

an event to me because it was surprising and perplexing. In my nine years as a physics teacher, I have never begun the curriculum with a discussion of time, or even considered teaching it.

An Event: Why are there 24 hours in a day?

Returning to the classroom after tracing our shadows in the Brooklyn College courtyard the professor (KA) addresses the class.

"Ok! Our shadow. Sometimes its long, sometimes its short. Why?"

Laurie answers confidently. "It depends on where the sun is in the sky, if its higher or lower. It determines the length of your shadow."

"Ok, ok. What do we call that point when the sun is as high up in the sky, as high as its going to go?"

Noticing no hands were raised. smiling and pointing to his wrist as if to tell someone that they have arrived late for class, KA asks, "what do we call that?"

I attempt to make sense of what KA is trying to do. Is he trying to teach us astronomy right now? We haven't even discussed motion.

Michelle quietly mutters. "Noon."

Wagging his finger in her direction and nodding with approval KA confirms her response.

The class, myself included, follow him through a series of additional questions leading us to what I perceived to be the intended focus of this exercise.

"So, we can divide the time between one sunrise and another sunrise into 10 parts, 20 parts… How many parts do we divide the repetition between sunrises?"

Mike responds "24!"

KA asks: "Why do we choose 24?"

I start to construct my own answer. I think about my physics training. I reflect on the astronomy lessons I created related to the length of the day on each planet and which planet's year is longer than a day. I have no idea how to answer this question, I'm perplexed. Do I know the answer to this? Why have I never questioned this before?

Why Teach Time

Most introductory physics classes and physics textbooks begin the curriculum with motion. Starting with the nuanced difference between the terms distance, displacement and position, physics teachers introduce vectors. From there, the discussion flows quite nicely into the rate at which these quantities change per unit time. We take for granted this very concept of time for a variety of reasons. To me, time is a concept that all students have been introduced to and have experienced and have lost track of. Time is part of our colloquial vernacular and its definition would not be questioned, mainly because its definition would not be discussed.

I asked Sherry to watch a video I had recorded of the class. I did not tell her why I viewed the 12 minutes and 20 seconds that I shared with her as an event or even that I thought it was one. I asked her to describe what she thought was happening in order to gain insight from her perspective. She responded:

> Sherry: KA's attempting to make connections between the sun's position and the concept of time. He's eliciting responses about the sun being high in the sky and the effect on shadows e.g. noon - small shadow or no shadow. He's discussing the day as being broken into arbitrary hours, 24, using the amount of sunlight and darkness that we experience throughout one day cycle. KA gives some background on other culture's measurement of time. Emily brings a point from the readings: that scientists don't discover things, they create abstractions about natural phenomena.

Sherry identifies an important point of focus, that was brought up by Emily and emphasized by KA, which was the arbitrary nature of the 24-hour time increment. In Arnold B. Arons' (1997) text book, Teaching Introductory Physics, he describes the idea of an operational definition. Arons urges educators to consider the ways in which words acquire meaning through shared experiences. Arons (1997) also argues that the process of defining a word should be made explicit to students. This description of generating a definition is aligned with the hermeneutic process of constructing meaning and is an indication of KA's transparent epistemology. Kuhn (1996) also argues that science is constructed within the social and cultural world and is not simply a set of objective truths. Time is one example of this, however most physics textbooks make no effort to support development of the definition of time, text books label time, describe how to measure it and move on to how it is applied.

The Danger of Labels

Labels are often used as a way to make assumptions and reproduce a set of collective ideas while not questioning what the term means. In addition, labels contribute further to what Marcus and Fisher (1986) refer to as the crisis of representation or the inability to address the vast variety and diversity of meanings that can be constructed from a single event or term. On the macro level this crisis highlights the difficulty in finding an adequate means to describe a social reality. On the most micro scale it refers to our inability to represent our own thoughts within a single conversation through the limits of descriptive language.

In physics, the crisis of representation is relevant due to the robust amount of esoteric jargon. It would be easy to hide misunderstanding behind a smokescreen of terms and just as easy to assume someone does not understand due to their inability to use a term correctly. Arons (1997) defines words as metaphors and points out the failure of many students to be aware when they do not fully understand the meaning of a word or phrase. This emphasizes the significance of teaching that aligns with a transparent theory of knowledge.

For me, time is a difficult topic to discuss, that is what makes it so interesting. In my personal reflection from the first day of class, this event stood out to me due to my own feelings of confusion. Time is a term that I am often thrilled to discuss with my high school students. The first thing that I tell them is that time is not real. Time is the way in which we explain its very passing. I sensationalize the notion that it is an abstraction, but fail to develop time as a construct with students. The way in which we introduce content is another aspect of the relationship between our students the content: how physics is taught.

How do we teach: Encouraging Students to be Critical

> Katelin: I can remember being taught how to read a clock so that I could answer a simple question: "What time is it?" Not always knowing what the implications of my response were, I answered because I knew how and not because I knew why. "What time is it?" is now part of my every day experience, asking myself and asking others often. My next understanding of time was a bit deeper. I began to understand the passage of time. "How long until we get there?" In reference to a road trip, I understood that a response of *a few minutes* was significantly quicker than a response of *about an hour*. I am not exactly sure when I became critical of this concept. As a high school physics teacher, I am shocked that I didn't push myself to question it sooner.

There are many strategies and methods to help teachers figure out the best ways to explain concepts to students. Books have been published about teaching that share insights into appropriate classroom management, rigorous curriculum development and effective lesson planning. But what is often neglected in teacher education discussions is that the way we teach mediates what is learned. The question KA asked students *"why are there 24 hours in day?"* is telling of his axiology and epistemology, which is therefore part of the culture produced in the interaction. When I asked Sherry why she believed that KA began the course as he did she responded:

Sherry: It seemed like KA was trying to erode the myth that science is a de facto explanation or understanding of the world; that it can be fallible and that culture plays a role in our explanations/abstractions. He's attempting to uncouple what's been learned during science classes: that experiences and observations can exist independently of a scientific explanation that is "right" because it's been taught to us since we were little kids. I think in doing this, he's asking us to consider our own observations and experiences and begin to ask questions about the scientific paradigms and schemas that we've held to be true, such as that we have 24 hours in a day. This theme has resurfaced in many of the classes that I've taken with KA beyond the physics class, so I think it's a concept that he feels strongly about having students consider. I think that he wants students to do their own thinking rather than simply take a concept and accept it as truth without considering how a scientist arrived at that conclusion.

Through this experience not only is KA teaching his students how to be critical, he is also teaching them that it is important to him. Sherry interprets what she thinks KA was trying to do, stating that *"he wants students do their own thinking."* She is articulating what KA thinks is important (his values) and how he believes knowledge is constructed.

Transparent Teaching: Promoting Critical Classrooms

Katelin: My first perception of teaching was that teaching is an art. It is creative and instinctual. Every teacher has their own technique and those who are successful achieve success for completely different reasons. Although there are some standard practices and activities that can be transferred from classroom to classroom, every room has a unique set of experiences because of the individuals that help to construct these experiences. Teaching is culture.

Alexakos (2015) describes critical research as the process of challenging what is accepted as the norm and pursuing alternative ways of conceptualizing cultural assumptions. Being critical as a researcher, teacher and person in the world mediates social interactions. Because of this, it is important for teachers to be aware of the way in which their values mediate classroom experiences and critical teachers challenge what is accepted with respect to content. The necessary elements for critical research as summarized by Alexakos (2015) adapted from the work of Joe Kincheloe (2003) are:

1. Rejecting positivism and reduction of questions to technicalities by ignoring political and ethical aspects of schooling.
2. Awareness of the role personal values have on practices and the need for researchers to be cognizant of their own values
3. Awareness of personal values in research interpretations
4. Awareness of the role dominant forces play in the researcher's decisions and practices
5. Awareness of obstacles posed by social structures and how to overcome them.

Applying these principals to teaching helps to organize the elements of critical teaching.

1. Rejecting reductionist views of knowledge.
2. Awareness of the role personal values role play in the classroom and being cognizant of their own values.
3. Awareness of personal values in teaching practices and content decisions.
4. Awareness of the role dominant forces play in content decisions and teaching methods.
5. Awareness of obstacles posed by social structures in education and how to overcome them.

Efforts to engage students in critical discussions that question norms of knowing, can be a conscious or unconscious decision. Directly following the class, I asked KA why he began the course curriculum with time, he responded "*I didn't plan it that way.*" This is what Tobin (2012) refers to as the dialectic relationship between agency and passivity. An educator's axiology and

epistemology informs the decisions that are made within a classroom regardless of the level of awareness. Tobin describes the connection between the intentional production (agency) and unintentional recreation of knowledge (passivity) as happening simultaneously and closely linked to values. The relationship between teachers and students are mediated by the axiology, epistemologies and assumptions made by every person in the room. Decisions are made, information is discussed and ideas are validated based on the collective values of the classroom. This collective axiology is comprised of the contributions of the individuals who make up the class. Collins (2004) points out that entrainment is a considerable contribution to the collective. The values of the teacher or other individuals with a large amount of social or other forms of capital play a larger role in the emotional entrainment, or heightened emotions associated with mutual focus. In the case of a physics class, the professor may be viewed as the individual with the most capital and therefore their own views on what is important to discuss in the class become paramount. Therefore, each of the elements of critical teaching prompt some form of awareness.

Another example of axiology informing agency and passivity in KA's classroom is the way in which he values mindfulness practices. Mindfulness is a framework that can be used to address intense emotions such as anxiety. Ken Tobin, Malgorzata Powietrzynska and Konstantinos Alexakos (2015) suggest that mindfulness is linked to positive mental and physical health benefits and is useful in addressing issues around wellness. Considering the emotions in a science classroom experience such as the fear of engaging in physics or the anxiety associated with teaching and learning, mindfulness interventions can be helpful for students *and* teachers. Breathing and becoming aware of your breathing is one technique for promoting awareness and

engaging in mindfulness that promotes wellness. Breathing exercises are part of KA's axiology, epistemology and way of being in the world, which are evident in his teaching.

Mindfulness: Becoming aware

"If you feel angry and you think you are about to start yelling…" Professor KA's voice trails off as he addresses the class.

He stops speaking to release a long outbreath.

With his palm still flat on his belly, KA continues "You can change your emotion."

Accompanied by a short burst of laughter, one student from the back of the room says "I feel like I just learned a trick."

The professor responded with genuine support of the student's suggestion, "it will change your heart rate."

"I feel like I just learned a trick"

During the second meeting of the class, KA began a discussion with his students about breathing. Having done a significant amount of his own research into the positive effects of different breathing exercises, KA revealed his values once again to his students by taking the time to discuss with them the possible benefits. KA continued on to discuss the emotional impacts of positive social interaction as well as the vagus nerve, the nerve responsible for tasks such as heart rate, sweating and gastrointestinal peristalsis.

The heading of this section, "*I feel like I just learned a trick*" was a comment made by a student after KA introduced the class to a few quick breathing techniques. The awareness that this student experienced revealed a high level of reflexivity and is another example of the professor's values being part of what was learned in the classroom. The new level of consciousness (and unconsciousness) about breathing as an emotional intervention has increased student agency (and passivity) with respect to the emotions they experience in teaching and learning. The members of the class were students of physics, teachers and future teachers. As students taking physics, the anxiety experienced can be mitigated through deep breathing. The transformations with respect to how this intervention was valued has even greater implications in their role as teachers. These shifts in axiology and epistemology toward awareness and value of breathing as a "trick" or as an emotional intervention will inform their future interactions.

In addition to sharing his values and theory of knowledge, KA's teaching is entrenched in a framework of mindfulness. Powietrzynska (2015) suggests that mindfulness practices afford agency and promote reflexivity. Through reflexivity a teacher takes a critical look at their own emotions, values and ideas of knowledge as they are framed by the social world (Bourdieu & Wacquant, 1992). Being self-aware in many facets of our existence affords agency. Tobin (2002), Powietrzynska (2015) and Alexakos (2015) introduce mindfulness interventions into their classes as a way of potentially ameliorating negative emotions. Heuristics are one example of a mindfulness intervention that provides a means for promoting personal awareness and enhances conscious decision making. Valuing wellness in teacher education can carry into k-12 education and beyond by bringing about awareness in others. The concept of becoming aware connects to the emotions of anxiety in that anxiety promotes awareness of that which we are anxious of and often results in the reevaluation of what is more important (Frazetto, 2014).

To me, the prospect of being able to alter my emotional state can be freeing and empowering. As educators we have both the opportunity to support our students in seeking such positive emotional experiences as well as the potential to reproduce anxiety. Frazzeto (2014) suggests that we can avoid anxiety by actively seeking positive experiences in lieu of focusing on the negative thoughts. This does not mean our problems or struggles should be avoided, just that by being of a positive mindset you may be able to face your problems with greater awareness.

So What?

Tobin (2012) describes the subtle transformations associated with consistent face-to-face social interactions as "learning by being in-with." This sentiment is important for educators because of the frequency with which we engage with students. Our values and views on knowledge, how it is constructed and whose knowledge is valued are present in every lesson taught and every activity designed. In physics, the cannon of knowledge and emotions associated with the perceived difficulty, coupled with the structures of assessment and accountability contribute to who enrolls in physics and how they approach the course.

After the summer semester had ended and all course requirements were complete, I asked Sherry to recall what her expectations were.

> Sherry: I imagined a lot of requirements like calculus would be necessary before taking the class. I thought we would talk about gravity, motion. I was hoping to talk about particle physics because I've read articles and see documentaries about particle accelerators and I wanted to know more. I didn't expect to do hands-on activities. I thought we'd mostly take notes on lectures. After the class, I feel like I'd like to take another physics class. I feel more excited, if the opportunity arises again, than nervous about being unprepared.

This research experience has highlighted the prominence of the emotions of anxiety and fear associated with the anticipation of taking a physics course as well as the role that the values of the instructor play in the experience of teaching and learning. In her reflection, Sherry expresses a transformation in her emotions with respect to learning physics. Originally, Sherry was nervous about taking physics. After this experience Sherry is now eager and excited to take another physics course. The way in which content is taught and knowledge is assumed within a classroom, can be transformative and is telling of the educator's view of what knowledge is and how it is constructed. Teaching students to question knowledge that is traditionally considered to be fact, such as time, brings awareness to the concept that knowledge can be constructed hermeneutically, through consistent questioning, valuing multiple view points and giving consideration to context. When educators are unaware of their own values and views with respect to knowledge and how it is produced, they passively reproduce structures of teaching and learning without being aware of it. Shelley was able to articulate, not only how she felt about taking a physics class but also what she believed to be KA's view of knowledge, all while learning physics. I have learned a great deal about the significance of being aware of all of the decisions that are make in teaching and how they are rooted in the perspectives of those who decide.

I encourage educators, teacher educators and future educators to consider their own value systems and the ways in which these values inform their teaching. I know that there are many things to consider when entering a classroom, but who we are and who we teach are important factors in the culture we produce.

Chapter 4

DEVELOPING HEURISTICS WITH STUDENTS

A Heuristic for Student Teacher Interaction

Starting Out: Becoming a Teacher and a Researcher

I began teaching graduate level teacher education courses at Brooklyn College in the fall of

2014. Before I started, I knew that I was interested in doing research with my own students and

began doing so almost immediately. The research I participated in did not begin with research

questions or a formal hypothesis in a positivistic sense (Kincheloe & Tobin, 2009). Instead, my

research interests aligned with my teaching interests of exploring emotions, valuing student input

and embracing an inquiry approach. I wanted to learn with my students and from my students.

Although I was nervous to begin this work, asking students to learn with me felt like a natural

place to begin. I believe that it was my initial experience with heuristics as a graduate student

that prompted me to incorporate heuristics into the first course that I taught at Brooklyn College.

As I embarked on teaching at the college level for the very first time so began my journey into

research. In this chapter, I share my experience engaging students in the process of designing a

heuristic, the associated struggles and what I have learned because of this experience.

The term *heuristic*, most generally, can be defined as enabling a person to discover or

learn something for themselves (Merriam-Webster, 2018). In my research, a heuristic, although

considered to be both the research method, and methodology, is a tool used to draw participants'

attention to collaboratively defined aspects of classroom interactions. The thoughts and ideas that

participants presented as members of a Brooklyn College teacher education course played a key

role in the development of the heuristic and mediated the way in which the research emerged.

First Impressions

I was first introduced to a heuristic as a doctoral student of education. At that time heuristics

appeared to me to be a simple quantitative survey consisting of, what I interpreted as, questions

(Tobin & Alexakos, 2013). Although they were not phrased as questions, I treated them as such.

A heuristic, as codeveloped by Wolff-Michael Roth and Kenneth Tobin (2002), and further

researched by Konstantinos Alexakos (2015) and Malgorzata Powietrzynska (2015), consists of

statements called characteristics. Each characteristic is followed by numeric responses that

allows the reader to place themselves along a scale from 1 to 5 based on how often the reader

engages in the activities described from rarely or never (1) to very often or always (5). A space is

then provided below each statement for the reader to comment, which can be seen in figure 1.

Figure 1: Characteristic from: Mindfully listening heuristic, developed by Tobin, Alexakos & Powietrzynska (2015)

Please rate each of the characteristics below by circling the appropriate numeral on the 1-5 scale that best reflects your perceptions of occurrence and/or quality. As necessary, provide contextual information that applies to your rating.

When others are speaking in a dialogic conversation:

1. I monitor the eyes of the speaker

   5*: Always/Very often;* **4***: Often;* **3***: Sometimes;* **2***: Seldom;* **1***: Never/rarely*

   _____

   _____

My first experience reading through the characteristics of a heuristic resembled the

experience one would have taking a survey. The first heuristic I read was titled *Mindfully*

listening and was developed through the research efforts of Tobin, Alexakos and Powietrzynska (2015). Some of the characteristics of the mindfully listening heuristic can be seen in figure 2. In reading through it for the first time, I refrained from participation in the comments section and answered based on what I thought was the correct response, not letting myself engage in any actively reflective experience. Looking back, I was the unaware survey taker; I was disengaged and I was not present. It was not until I took the time to be reflexive that I began to see the power of this mindfulness intervention. To be reflexive, as Pierre Bourdieu describes (2003), is to become aware of that which we were once unware. The level of engagement with a heuristic and the frequency with which it is used, mediate the resulting shifts in the reader's level of awareness (Alexakos, 2015).

Figure 2: Mindfully listening heuristic characteristics developed by Tobin, Alexakos and Powietrzynska (2015)

When others are speaking in a dialogic conversation:

- I monitor the eyes of the speaker
- I show my respect for the speaker
- I express my opposition verbally and nonverbally to unethical speech
- While listening to others my nonverbal actions project compassion and empathy to the speaker
- When a speaker says something with which I disagree I try to learn from the difference
- I make sense of the speaker's facial expressions of emotion
- I make sense of the speaker's gestures
- I nod my head as a sign of attentiveness

Although I was not using the heuristic to the fullest extent of its potential, I believe that the act of reading through the characteristics of the speaking and listening heuristic was still transformative. Transformations can be a shift in awareness resulting from the reflexive nature of reading a heuristic or a change or action that results from being conscious of our values

(axiology) and the way we construct meaning (epistemology). The conscious and intentional decisions we make as a result of becoming aware are part of our agency. Tobin (2012) theorizes the interconnectedness of agency and passivity, arguing that both intentional and unintentional actions happen simultaneously and contribute to the creation of culture (Tobin, 2012). Through this reflexive intervention, we become aware of what was emphasized.

I can vividly recall my reaction to the characteristic "*I make sense of the speaker's gestures.*" Perplexed at the possibility that it might matter if I did in fact pay attention to the movements of my co-conversant was, at the very least, intriguing to me. I thought first about the very idea of gestures and their role when interacting with students as a teacher. Within a single classroom experience a teacher is immersed in numerous personal interactions. Paying close attention to the body language, gestures and facial expression of emotions of the students in the classroom can provide a teacher with vital information, not only about how students are responding to the day's lessons but also about the student's state of mind when entering the classroom. I cannot help but think that teachers, myself included, are doing this already but to what extent and with what level of awareness? In my experience, sometimes a teacher is aware that a student entering the classroom has had a particularly bad day or conversely that a student is highly engaged in a lesson. However, regularly making a conscious effort to interpret the meaning of these gestures and facial expressions increases the level of agency within an interaction, resulting in transformations. This single characteristic brought a new level of awareness of something I was already conscious of in the most extreme cases, but now take note of regularly. The placement of a student's hand, or the way a student's posture changes during a conversation can indicate changes in emotions and gives me the opportunity to make meaning of these gestures by asking the student to share how they are feeling. As a teacher, I am constantly

bombarded with non-verbal forms of communications and attempt to explore their significance. I believe it is important to consider what is being communicated to us through the gestures someone is making while keeping in mind that they can be misinterpreted and misunderstood in the same way that verbal forms of communication can.

Heuristics: Method | Methodology | Intervention

When I first began graduate school at the CUNY Graduate Center I thought research methods and research methodology were completely distinct concepts. My perspective has shifted in many ways and heuristics have played a significant role. I am more aware of my epistemology and axiology and how they inform my research with respect to participant voice, perspective and the relationship between methods, methodology and authentic research. Alexakos (2014) asserts that it is essential for teachers and researchers to be aware of their values and make them transparent because these values frame their work. Our value systems are equally as important in teaching as they are in research. Axiology is not just what is valued, but how much it is valued and in what ways. Our value systems change over time as we encounter new experiences, learn from and with others and become more aware. Part of my own value system is engaging in research that embraces participant voice (polyphonia) and meaning making through multiple interpretations (polysemia).

I use the Sheffer stroke (|) between the terms method, methodology and intervention, as a way to emphasize their interconnectedness. As I learn more about research through my experiences as a researcher I have come to understand these terms to have a dialectical relationship, as theorized by Tobin (2006) and discussed by Alexakos (2015), where each presupposes the existence of the others. Methods (the means by which data is collected), methodology (theory of methods) and interventions (an opportunity for transformation) are each

assumed when engaging in authentic research. Heuristics are an excellent example of this dialectical relationship and I would consider heuristics to be part of my research methods, methodology and in service of the authenticity criteria.

The authenticity criteria as developed by Tobin (2006) from the work of Egon Guba and Yvonna Lincoln (1989) emphasizes the beneficence of those involved in the work and has helped me to understand the connection between research methods and the concept of an intervention. Authentic research adheres to four key criteria. Ontological authenticity (all participants embrace transformation), educative authenticity (participants learn from each other and from difference), catalytic authenticity (improvements and positive change are realized through ontological and axiological shifts) and tactical authenticity (all participants benefit). Due to the multi-level transformative nature of authentic research and the learning that can result from participating, truly authentic research can be considered to be a positive intervention for all those involved and because of this, integral to the methodology and methods employed.

Malgorzata Powietrzynska (2015) refers to a heuristic as a powerful tool that both brings awareness and acts as an intervention to help ameliorate intense emotions. In considering any teaching and learning experience, this form of intervention can be extremely helpful when participants are engaged. Teachers and students experience a range of emotions within a classroom environment. Experiencing many negative emotions can be detrimental to an individual's health. Richard Davidson (2012) studies the neurological responses to emotions and emphasizes the potential negative impact to an individual's health and physical well-being. A heuristic is one tool that can be used, not only to draw attention to emotions brought about by interactions, but to provide possible alternative epistemological viewpoints. The characteristics are designed to make the readers reflexively aware of things that they may not have considered

(Bourdieu & Wacquant 1992). For example, consider the characteristic from the speaking and listening heuristic, developed by Powietrzynska, Alexakos, and Tobin (2015), "I make sense of the speaker's gestures." The statement not only draws our attention to the fact that the gestures made by a speaker could communicate more information than simply the words they are speaking, it also invites the reader to try to make sense of these gestures. Although the characteristic does not say exactly how one might go about making sense of the speaker's gestures, and I would argue it is impossible to tell someone exactly how to do so, the speaker is now aware that interpreting someone's gestures is a possibility and could be in service of a positive interaction.

By doing this research with students, I believe that their input was not just essential to developing an understanding from multiple perspectives, it was part of their personal transformation. One of the inevitable consequences of using heuristics is the dialogue the reader has with themselves. This inner-speak, as Bakhtin (1994) discusses, is transformative and significant, bringing about awareness through contemplation. In creating a heuristic with participants, they become more aware of their own emotions and in designing characteristics become aware of their values. This shared experience reproduces the culture of the classroom and is part of this powerful methods | methodology | intervention.

Although an individual cannot mediate the emotions of another, a heuristic encourages the reader to become attentive to the emotions of others, and changes in emotions, and as a result the reader can act or respond. Darwin (2009) discusses the physical response to emotions and expressions that result to be habits as evolutionary responses which, when one is aware, can be useful in interpreting the emotions of those we are interacting with. When a teacher has the ability to be aware of emotional responses of their students they can then choose to adjust,

address or to ignore the discontent or excitement that they see in their students. Students can do the same when interpreting the facial expression of emotions of their teacher.

Using a heuristic also provides a researcher information about those participating in research through the process of interpreting their responses to a set of characteristics. For example, a researcher can look for patterns that emerge or look for common themes amongst characteristic comments or numerical selections if the goal is to generalize or notice patterns that change over time. In reading through the comments, learning can also occur when the researcher focuses instead on the contradictions, the unique and unexpected responses, the responses that differ from what is generally stated. Choosing to focus on learning from difference (Tobin, 2006) is part of my research methodology and epistemology.

As a method and a methodology, heuristics provide valuable insights about those participating in the research. As an intervention, heuristics can provide someone with valuable insights into themselves. As I explore the use and development of heuristics with in-service and preservice teachers these insights emerge.

Whose Values are Represented?

A heuristic is intrinsically tied to the values of those who develop it. Each characteristic is designed to be an intervention. Written exclusively with a positive valence, as defined by the designer, each characteristic suggests what the reader might want to do, think, act or consider. Because the agency is initially given only to the writer, it reflects their own thoughts and values. For example, the characteristic from the mindfully listening heuristic (Tobin, Alexakos & Powietrzynska, 2015): *I nod my head as a sign of attentiveness*. This characteristic does not tell the reader they must nod their head when listening to a co-conversant but suggests that doing this is in support of good listening. Alternatively, if written with a negative valence, it might read: *I*

don't nod my head which is a sign of disinterest. The characteristic, as written in the mindfully listening heuristic, reflects the author's view that one should nod their head and is suggesting that the reader should consider if they nod their head as a sign of attentiveness and reflect on how doing so might mediate the conversation.

The inherent link between the heuristic characteristics and the values of those designing it is one of the many challenges of writing these characteristics. Being aware of your own values and the role that they play, is one way to mitigate the issue. I am not saying that it is a weakness of the intervention, on the contrary, it is a strength and being aware of this fact helps to bring about awareness of the agency associated with designing and sharing a heuristic. For example, the reader(s) and designer(s) can discuss the meaning of the characteristics based on each individual's personal values.

When I first considered designing a heuristic, I thought it would be important to include student perspectives throughout the design process. In order for the heuristic to reflect the values and voices of the participants, I believed it was important for students to participate in the creation of the characteristics of the heuristic from the beginning. The first step was introducing the concept of a heuristic and gauging student perception of the characteristics. Then the heuristic was developed based on shared values with transparent and consistent input. In this study, the exact wording of the heuristic characteristics were not developed collectively; the heuristic was developed based on a list generated by students of positive student teacher interactions within a classroom, which I will further detail.

Creating Heuristics with Students

The first course that I taught at Brooklyn college was a teaching methods course for graduate level students. Every student in the room was a certified teacher or aspired to be one. Thinking

about the structure of the course and my desire to prepare educators and future educators for the world of teaching and learning, I was acutely aware of the importance of my role and the role that my values played in the course structure activities and assignments.

Before the semester even began I planned to share a coteaching heuristic, developed by Tobin and Alexakos (2013), with students for a variety of reasons. One reason I wished to share the heuristic with students was because I found a great benefit from the awareness gained in my own personal experience. I also thought the heuristic would be useful because a major component of the course activities was giving members of the class an opportunity to develop lessons and coteach those lessons with their classmates. In addition, I thought it would be helpful to provide students with a possible intervention for future coteaching interactions in their professional life. Two of the characteristics from the coteaching heuristic are listed in figure 3.

Figure 3: Coteaching Heuristic characteristics developed by Tobin and Alexakos (2013)

1. I listen attentively to my coteaching partner.

    5: Always/Very often; **4:** Often; **3:** Sometimes; **2:** Seldom; **1:** Never/rarely

    _____
    _____

2. My coteaching partner listens attentively to me.

    5: Always/Very often; **4:** Often; **3:** Sometimes; **2:** Seldom; **1:** Never/rarely

    _____
    _____

After introducing the first assignment of the course, which was to design a lesson to teach the class, I shared the coteaching heuristic (Tobin & Alexakos, 2013) with my Brooklyn College class. Just as heuristics were introduced to me, I asked my students to read and respond to the characteristics. Many of the students in the class expressed great enthusiasm for addressing the

emotional aspects of their interactions in the classroom. Once everyone had completed the heuristic I asked student to share thoughts about what they had read. Jamie, an aspiring earth science teacher, commented that she thought teachers should also be aware of their tone and demeanor when working with students. She went on to discuss the experience her son had with a teacher and the "fear" he had when going to this class. Jamie was not the only one with a story about high pitched voices and aggressive stances. Many students expressed that they believed that a teacher's tone of voice and ability to show compassion could contribute to the classroom environment. The increase in awareness of the ways in which students can potentially interpret their teacher's tone of voice and posture could inform the ways in which they interact with their own students in the future. Randal Collins (2004) discusses how interactions are created and recreated within future interactions in his discussion of interaction rituals (IR). Maintaining a shared mutual focus around how we engage with students based on a shared set of values reinforces them. The immediate and enthusiastic interest expressed by my students indicated to me that they felt that this discussion was valuable to their development as teachers.

"We never talked about this in undergrad"

Our classroom discussion quickly shifted focus from the interactions between coteachers to the interactions between students and teachers. Directly following our discussion, I asked students to develop a list of aspects of student-teacher interaction that they thought were important parts of promoting a successful classroom environment. Again, focusing on positively valenced attributes that could bring about awareness and provide possible ways to ameliorate negative emotions or experiences. From the generated list, I developed the characteristics for our student-teacher interaction heuristic. Each component that students identified was developed into a characteristic. Many of the characteristics resemble those of the coteaching heuristic because

interactions that are valuable among (co)teachers are valuable between students and teachers. This fits within my own worldview, where-in students can be considered coteachers within a classroom and so it makes sense to strive for similar interactions.

The heading of this section, "*We never talked about this in undergrad,*" is a comment a student made at the end of class the day I introduced heuristics. Jennifer, a childhood education major concentrating in science, said to me "We never talked about this in undergrad." Although there could be many reasons why emotions in the classroom were not introduced in Jennifer's undergraduate teacher education courses, to me this is a critical element in preparing teachers for the classroom. The introduction of the use of heuristics and the subsequent collaborative development of heuristics were all part of the research, but more importantly part of their development and transformations as educators, future educators and people in the world. Although the course, Methods in Science Education, was intended to prepare students for the formal methods of teaching and learning as defined by standards, objectives and frameworks for teaching, I had the ability to focus our class on the interpersonal and emotional aspects of the classroom experience as well.

Compassion

One element of student teacher interaction that was of great value to my students in discussing classroom experiences was that of being compassionate. Compassion, like all words, can have a different meaning for different individuals. Although, we did not collaboratively define compassion, students in the class identified it as an important, if not essential, component of teaching. Richard Davidson (2012) describes six emotional styles, of which we lie on a continuum of each. According to Davidson, compassion is a combination of two distinct emotional styles, having a high level of social intuition and being extremely sensitive to context.

Based on this description of compassion, a teacher displaying compassion would understand how to respond based on the situation and the individuals participating in that situation and also be able to read the emotions of others based on how they act and how they express themselves. Therefore, sensitivity to context and social intuition are the dimensions of human emotion are important to compassionate teaching.

I believe that compassion is the way in which we care for another, their feelings, perspectives, values and beliefs. Because compassion was articulated as something that my students valued, compassion became a consistent element, both explicitly and implicitly, in the heuristic characteristics.

Explicitly*: I show compassion and provide support when students feel unsuccessful.*
Implicitly*: I value the perspectives of my students.*

Although not stated, a key element of compassion is valuing the perspective of others and being sensitive to their views and experiences. Considering a teaching and learning experience from the perspective of the student is one way in which we can become more conscious and more sensitive to context, which are in support of compassion.

The Significance of Creating Two Heuristics

The shift from a teacher centered focus to considering the student perspective in the classroom was an emergent aspect of the heuristic development. The decision to create two heuristics, one from the perspective of the teacher(s) (Appendix A) and one from the perspective of the students (Appendix B), was in support of the shifted focus. The creation of two heuristics not only reflected what my Brooklyn College students valued, but also provided them with an opportunity

to think about their students' perspectives when engaging in the lesson presentations. This illuminates the dialectical relationship between teacher and student, wherein one cannot exist without the other and each assumes the existence of the other. Although we label one individual the student and the other the teacher in any particular situation both roles are held by all participants. Students were asked to complete the teacher perspective heuristic after their lesson presentation and the student perspective heuristic when experiencing a lesson constructed by their peers. This experience required that all members of the class approach lessons from two different perspectives while at the same time teaching and learning from each other. By responding to two different heuristics throughout a presentation cycle, participants reflected on lessons as both students and teachers, reinforcing the significance of the interaction.

The emergent nature of this research and the fact that it was contingent on participant actions and interactions make this study what Tobin (2014) describes as, event-oriented inquiry. Adopted from the work of William Sewell Jr. (2005), Tobin (2014) theorizes events as moments or actions that bring about significant change or result in smaller transformations. Events do not have to be a large-scale disturbance but can be a simple unique response to a characteristic or a moment identified as salient due to shifts in participant understanding. A heuristic can be used to identify these events but also as a means for bringing about awareness and inciting discussion. Due to the transformative nature of an event there can be a sudden shift or intensification of emotions for all participants. For my research, I identified events based on student heuristic responses after lesson presentations, as well as class discussions of lesson presentations. An event can emerge as a contradiction to previously identified patterns or can be identified because it appears to be a direct conflict. In this work, events were identified based on both written responses and class discussions. The act of identifying events inherently highlights certain

aspects of the experience while leaving others unclear. This is certainly a limitation to event-oriented research but is a limitation to all interpretations and efforts to make meaning from experiences. Having multiple voices represented allows for a diversified understanding of what is happening and why it is happening.

When to Reflect

Allowing both the audience (students) and the presenter (teacher) time to reflect after the lesson/presentation was a key element of this research. Each class meeting was composed of three lesson presentations. Directly following each presentation every member of the class filled out either the student heuristic or the presenter heuristic. Eight characteristics in total made up the original design. Additional space was provided under each characteristic for comments. In addition, space was provided, in the form of a chart, for students to respond about the presentation, giving positive and constructive feedback on content, pedagogy and interaction (Table 1). This helped students to give feedback by focusing on what teachers should continue to do and providing possible changes that would make the lesson better. This combination of reflection methods, the heuristic and the feedback chart, provided a varied focus between the lesson structure component and the emotional components of the lesson interactions.

Table 1: "Plus-Delta" chart used for positive and constructive feedback.

Following a lesson presentation, Jennifer:

+ Plus	Δ Delta
Jennifer: * liked the coloring * very visual * great questioning * awesome classroom management * organization	*Jennifer:* *Instructions could be more clear so quick to understand *What was there background knowledge?

After the member of the class had participated in each lesson presentation and filled out the heuristic, a full class discussion took place. Some important elements of the full class discussion included ensuring that all participants were given the opportunity to be heard, all members felt comfortable speaking in a positive and constructive way and no individual possessed power over another. In this sense the discussion took on many elements of a what Gillian Bayne (2007) describes to be a cogenerative dialogue (cogen). The discussion began with the presenter's reflection of his or her own lesson and then moved to contributions from the rest of the class. A cogen provides an opportunity for teachers, students and researchers to come together in a dialogue around a shared goal and results in the production of knowledge. The post-presentation dialogue was constructed so that all participants were given the opportunity to contribute their ideas around improvements to teaching and teacher practice.

Salient Events: Student Comments

Although a numerical scale, used in the heuristic, can provide a landscape of responses for an individual presentation or a landscape for a particular individual, what was more interesting were the responses provided in the comment section for each characteristic. One thing that I found most salient was that participants commented most frequently on the first characteristic. The pattern of consistent blanks in the comments section for most of the characteristics was contradicted by the multitude of comments written in response to the first characteristic.

First Characteristic:

1. The teacher/presenter is aware of the impact of his or her tone of voice on my emotions and uses a tone that is respectful and encouraging.

The characteristics were listed in the heuristic in the same order that they surfaced during our original discussion about heuristics. Tone of voice was the first aspect of student teacher interaction that the students listed when generating a list of aspects of positive student teacher interactions. Students did not comment under every characteristic and often left the comment section blank. When participants did comment, they commented most frequently on the characteristic about the presenter's tone of voice. The presenters, taking on the role of teacher, also commented most frequently on this characteristic, taking time to reflect on the implications. Lisa responded to this characteristic following her genetics presentation (figure 4).

Figure 4: Lisa responds to the first characteristic:

1. I am aware that my tone of choice can impact my interactions with students and use a tone of voice that is respectful and encouraging.

   5: Always/Very often; **4:** Often; **3:** Sometimes; **2:** Seldom; **1:** Never/rarely
   Comments:
   Lisa Writes: The softer my tone and more engaging the better the students reacted.

The students may have been more frequently responding to this characteristic due to the fact that it was the first one on the list or perhaps this was the aspect that was most valued by the students. The heuristics were distributed to every member of the class after a lesson presentation. The additional feedback section was presented in the form of a two-column chart. One side of the chart was labeled Plus (+) intended for positive feedback and the other side labeled Delta (Δ) for areas of improvement. In addition to providing comments with respect to the first characteristic which addressed the presenter;s tone of voice, students revisited this comment again in the plus-

delta section of the heuristic in both the positive (Plus) section and the areas for improvement (Delta) section.

Table 2: Gabbie and Fran's responses to two different lesson presentations:

+ Plus	Δ Delta
Gabbie writes: Calm tone of voice	Fran writes: Improve the tone when getting attention

The two examples above, in Table 2, where taken from student heuristic responses to different presentations and indicate to me that this was an area of focus for some students as they were the only comments provided in the respective feedback sections.

Transformations: Shifting Focus

In the comment section of the post-lesson heuristic, student comments were often geared toward lesson structure improvements or positive aspects of their lesson design (Table 3). Most of the conversations after students presented, focused on aspects of the lesson that were planned, such as time management and questioning. This was true especially at the beginning of the semester.

Table 3: Katie's responses

+ Plus	Δ Delta
Katie: - Good job explaining verbally and visually what a K-W-L is -Great differentiation with leveled text	**Katie**: - When sharing group work, give groups time to prepare -Fill out the "W" in KWL right after the "K"

As the semester progressed, students started to discuss more elements associated with classroom interactions. The vocabulary from the heuristic began to make its way into the

discussion more often which is an outcome that can be attributed to how often the students read through the characteristics. When a student felt that they had a negative experience with respect to their interaction with the presenter, this was often written in the comments section and shared in full class discussion. Students rarely articulated moments of positive emotional interaction that were written on their heuristic, but seemed compelled to share with the presenter, moments of discontent. Bringing about awareness of their emotions during a particular experience was important. Verbalizing that they felt "cut off" or unnecessarily "shushed" provided them with the opportunity to make their feelings known and make the presenter aware. During one lesson about the life cycle of a pumpkin many students commented on the presenter's tone in the suggestions section of the heuristic reflection sheet (Table 4).

Table 4: Student responses to Anne's lesson presentation about the life cycle of a pumpkin

+ Plus	Δ Delta
Eden: - *Interesting topic* - *Fun lesson* - *Interactive*	**Eden:** - *Should be more knowledgeable on topic, do some research before* - *Kept telling the class to be quiet, productive noise is not bad!*
Nancy: - *Real materials* - *Clear instructions*	**Nancy:** - *A few times some answers were dismissed and we were told we were being too loud during group work*
Bo: - *Fun activity* - *Good materials*	**Bo:** - *Little poor class room management* - *Closed ended questions*
Gabbie: - *Hands on experiment* - *Nice worksheets*	**Gabbie:** - *Improve the tone when getting attention* - *Allow students to talk, its group work and they are learning unless you hear side convo*

Jay:	Jay:
- *Nice pumpkin activity* - *I enjoyed making the book*	- *Voice was a bit too strong at times* - *Need clearer directions* - *Lesson seemed a bit rush at times*

The responses after this presentation were dramatically different from the previous responses that students generated. Students focused on the presenter's tone of voice and the ways in which they were addressed by the presenter. The responses appeared to have a similar focus, centered around the presenter's interaction instead of the presenter's teaching strategies. The synchrony of responses not only highlight the awareness, but also the ability for students to articulate exactly what area needed to be improved. The agency of being aware coupled with the agency of being able to respond was empowering because of the audience's ability to act.

Tobin (2012) argues that agency and passivity are dialectically related constructs that presuppose the existence of each other. Both contribute to the production of culture within a classroom experience. The reflexive nature of heuristics affords the opportunity for change (Powiertrzynska, 2014) and as a result, the opportunity for agency *and* passivity. In reading through the student-teacher interaction heuristic multiple times each class session, over the course of a semester, students engaged in the production of knowledge both intentionally and unintentionally. What resulted was a culture of awareness around student voice and teacher tone in the classroom. This shift in awareness and focus is an indication of shifting axiologies with respect to what is valued in a classroom interaction. Becoming aware of the unaware (Bourdieu & Wacquant 1992) provides the opportunity to make goal-oriented conscious decisions about student voice and tone within a classroom, while at the same time passively contributing to the knowledge produced in an interaction (Tobin, 2012).

Classroom Culture: A Note about Power

There are many expectations that pre-service teachers have about what it means to be a teacher. Many of these expectations and assumptions stem from their own personal experiences with teaching and learning as a student. Entering the profession may signify some level of comfort with the norms and social constraints set forth by the systems of schooling in place. The symbols associated with school and the associated meaning and practices form what William Sewell refers to as culture (2005). Because these practices are not common, normalized or valued in the same way by all students, including how we learn and why we learn, there can be a direct conflict within a classroom. Because of the power relationship between students and teachers there can be a level of unawareness that can result in negative emotional interactions. The transparency as well as the resulting awareness create the opportunity for transformation and make heuristics a useful tool.

In studying emotional interactions between students and teachers, power and status play an inevitable role. The power dynamic within a classroom exists because of the nature of the predefined roles that each carryout. Turner (2002), describes emotions as variations on four base emotions, and the intense negative emotional experience that results due to the loss of expected prestige. Conversely, when someone is surprised by approval or praise, they have an intense feeling of joy and pride. In considering the way students and teachers interact on a daily basis, this is extremely relevant. The emotions of power and status are always present in classrooms and experiencing an inability to express oneself can sometimes lead to feelings of failure or other negative emotions. In addition, the feeling of inadequacy or the expectation of failure can become a default emotion when being disappointed by failure is so emotionally

intense, this is another reason why the emotions in a classroom are relevant and warrant our attention.

The challenges associated with presenting difficult content make it easy for a teacher to feel that failure is inevitable and can exacerbate a power dynamic already present in a classroom due to a perceived deficiency (Turner, 2002). The lesson presentation discussed in Table 4 appeared to be particularly challenging for the presenter based on her inability to answer student questions related to content during the lesson presentation. The shape shifting nature of heuristics, as discussed by Powietrzynska (2015), means that the characteristics of a heuristic are not fixed. Characteristics can be added, omitted or emphasized depending on the values and perspectives of the participants. Heuristics are expected to be amended so that they fit within the context of the research. The overwhelming number of responses associated with the volume of student voices in the classroom and the way in which it was addressed, warrants the addition of a characteristic to the student-teacher heuristic that encourages reflection around appropriate amounts of noise in a classroom.

Tobin and his Austrailian colleagues have studied the ways in which teacher emotions mediate tone of voice and body language. In a collaborative study with a high school teacher named Viki, Tobin et al (2013), used a heart rate monitor to show the connections between changing pulse rate and changes in the power of the teacher's voice. It was noted that high pitched vocal tones can negatively impact classroom experiences and productivity. When Gabbie suggests that Anne "*Improve the tone when getting attention"* (Table 4), she is noticing that this change could improve the classroom experience. Jay also notes that Anne's "*Voice was a bit too strong at times"* which indicates that a change in vocal tone could improve the student-teacher interaction. Gabbie and Jay's suggestions indicate that they are aware that tone of voice are

factors that contribute to positive classroom experiences and that tone is something that they value in an interaction.

Different classroom dynamics may result in different levels of shared trust and differing expectation. Because of this, when designing a heuristic with students there are many risks involved. Being transparent about your values not only makes a teacher vulnerable but necessitates being open to transformations in axiology and epistemology. This level of mutual trust is not easy, especially if the teacher is not aware of their relationship with power or the power dynamic that systemically exists within the social interaction of teacher and student.

Emotions around being silenced – Voice

Events also emerged through the process of reading student heuristic responses. During a lesson when students were not given the opportunity to share their own work with the class this appeared to be a major focus in the comments section. By approaching lessons from the perspective of a student, participants became aware of the feelings of ownership over their work. Seven students mentioned in the comments on the heuristic that they were not able to present their work and commented that allowing students to do this would be a positive change (Table 5). Not only was this important with respect to the shared experience but it was also pointed out to the presenter during the discussion. This feeling of disappointment in not being able to share out to the class is what Turner (2009) discusses with respect to extreme dissatisfaction or disappointment. Having an expectation not met can cause an incredible emotional response and turn a positive experience into a negative one. The way a teacher values student voice in a classroom is part of their axiology. I believe that polysemia and polyphonia are critical to reflexive and authentic research and can be applied to teaching and learning that values student voice and student perspectives. A teacher may be unaware of the way in which they value

student voice in the production of knowledge in a classroom and a heuristic can bring about awareness.

Table 5: Student responses to Sean's lesson presentation about fish

+ Plus	Δ Delta
Fran: - *Loved the KWL chart* - *Making observations in the beginning was fun* - *Loved live fish and seeing them up close, how they move* - *Very hands on* **Sarah:** - *Hands on* - *Provided real fish* - *Provided text* - *Had peers share* - *Gave us thinking questions*	**Fran:** - *Too much in one period* - *No safety instructions* - *Students should have presented posters* **Sarah:** - *Text was not developmentally appropriate* - *No safety instructions* - *Have students share instead of teacher presenting posters*

In Sean's reflection of his lesson, he expressed time management concerns. Although Sean's lesson plan reflected time allotted for students to present their posters, this part of the lesson was cut out during his presentations. Because of the emergent aspect of teaching and learning, it is difficult to plan out exactly what will happen during a forty-minute lesson session. When we attempt to respond to student questions and tangential wonderings we are valuing their perspective and their voice. In this particular lesson students expressed a desire to have shared their posters, which is another aspect of student voices. Participants taking on the role of student brought about awareness of this desire to be heard and resulted in these concerns being raised to

the presenter. In the semester reflection paper Sean comments on the ways in which he learned from his peers.

> Sean: I was particularly impressed with how some of my fellow-students used their voices, (not yelling, not coarse, not insulting), and the intermittent clapping of the hand to refocus students.

> Sean later: Sharing (lessons) has given me the opportunity to make new discoveries (with) regards (to) content and to clarify previously-held misconceptions, aspects that have positively impacted my own personal development. With regards classroom management, I was also reminded that a good class isn't necessarily a quiet class, and that one of the most effective ways to manage a classroom is to produce and present lessons that are interesting to your students.

In his final class reflection paper, Sean connects what he has learned to what he observed from his peers. In a sense, their lesson presentations acted heuristically for him. Considering a heuristic to be a tool (or opportunity) used to bring about awareness and reflection in support of learning, I would argue that this kind of learning occurred when teachers were teaching each other. Sean concludes his reflection by addressing the way in which the professor's enthusiasm has informed his teaching

> Sean: The Professor appeared to be genuinely excited about her subject matter, almost bursting with enthusiasm. This in turn made me excited about what we were going to do and soon all the funny feelings (about presenting) vanished and I felt more comfortable. I imagine that(other) students share this same kind of apprehension, and that their success at overcoming (the discomfort) would depend heavily on the teacher and his/her ability to convey positive vibes to that student through their body language, tone of voice gestures, etc.

In the conclusion of his refection paper, Sean chose to focus on the emotional climate of the classroom and the aspects of student-teacher interactions that promoted a positive classroom experience for him. Sean mentions teacher tone, volume of student voice and the emotions he experienced when presenting to his peers. These terms and ideas were represented in the heuristic throughout the semester and were directly discussed in post-presentation class conversations. Examining this from a sociocultural perspective, as presented by Tobin (2012), we can consider this to be related to Sean's agency and passivity within the experience of the heuristic development and part the production and reproduction of the culture in the classroom.

Many of the students who participated in the creation of the student-teacher interaction heuristic reflected on these elements in their end of semester reflection. I have highlighted the reflections made by Lisa and Fran.

> Lisa: This course has taught me that teaching is about learning through failiure together with success. Through critique I learned what to do betther, with research how to strenghten my content, through modification, target different learning styles, and most of all recognition that I rely on my students to become a better teacher.

> Fran: This class surpassed my expectations and taught me more than just about important science topics. My main takeaway can best be attributed to Eleanor Duckworth, in that no idea is too small, if students take ownership over their thoughts and expression of these thoughts. This extends to myself as well. I need to trust myself and my students and teach them the tools to trust themselves and their own opinions.

Both Lisa and Fran address the idea that content, although important, is not the only lessons we teach in a classroom. Lisa expresses awareness that she is learning from her students, placing value on the dialectic relationship between teaching and learning. This relationship, wherein each

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connects to and presumes the other, emphasizes the interconnectedness of the roles of teacher and student, regardless of the formal title held by each individual (Alexakos, 2014). Fran also focuses on the perspectives of her students, making sure to value their opinions and supporting them in valuing their own ideas as well. In reading this reflection I reflected on my own awareness of this concept. Fran's comment made me aware that not only is it important for teachers to value student voice, but it is important to support students in valuing their own voice. Students can learn to value their voices as a passive result of teacher support but being aware of the potential impact increases a teacher's ability to be transparent with students. I appreciate Fran drawing my attention to this idea.

Shifting Focus: Toward Classroom Interactions

There are many structures that exist in a classroom setting. We associate some of these structures with our individual identities such as gender, race, religion and values, while others are part of the collective goal of schooling, the lessons and material that exist due to the standards and requirements for formal education. Adapted from the work of Sewell (2005), Tobin (2012) describes structures as resources that contribute to the production of culture. These structures are often produced and reproduced without acknowledgment or conscious effort. Tobin argues that there is a tendency to reproduce an experience as it has been done historically or in prior experiences. This is important when considering the idea of quiet classrooms, which are often emphasized in teacher education. Classroom management is taught as a set of strategies or techniques to organize students and maintain control of things such as the level of noise in the room. Teachers consciously and unconsciously strive to maintain order over what is happening in a learning experience and passively reproduce this power structure in the classroom. The reflexive process of designing and using the student-teacher interaction heuristic brought about

awareness for many students with regards to the concepts of student voice and productive noise.

Using the heuristic from the perspective of a student, helped participants to identify the ways in

which they value student conversation and presentation in teaching and learning. This shift in

axiology coupled with the awareness of values brought about agency resulting in many students

speaking up when they felt their voice was not heard or valued during a lesson presentation.

Alexakos (2014) describes how it is important for teachers to be aware of their axiology because

these values have implications for classroom interactions. If students are aware that they value

their students' perspectives in the production of knowledge, they can make decisions that reflect

this axiology when working with their own students.

The shifting focus during post-presentation discussions from lesson structure and time

management to tone of voice also indicates a shift in axiology and epistemology as well.

Conversations toward the end of the semester and student final reflections showed a greater

emphasis on emotional aspects of classroom interactions. Typically, the main focus of methods

courses are the structures of lesson development and teaching strategies emphasizing their

importance over that of the interaction. The use of heuristics proved to be transformative,

bringing about a shift in what students found to be most important. Many students articulated this

in their final reflections. For example, Lisa states "*most of all recognition that I rely on my

students to become a better teacher.*" Lisa references content she learned in the course but

focouses on the significance of her epistomological shift, indicating it as *most* important. Her

comment also indicates her awareness that knowledge can be constructed from and with her

students.

Becoming Aware: My Own Tone of Voice

As a high school physics teacher, I pride myself on the energy and enthusiasm that I bring to the classroom. Prior to the research experience discussed in this chapter, I never considered how this energy manifests itself in my tone of voice or volume, or the way tone and volume could play a role in the experience of my students. When I first discussed heuristics with my students at Brooklyn College they pointed out that an encouraging tone of voice was in service of a positive classroom environment and I completely agreed. In that moment I became aware of the role that my voice plays in interacting with students. By developing the heuristic with students and asking them to identify what they valued in positive interactions I was learning from and with my students. As the semester progressed I better understood the challenges of interpretation. Reading through student comments about tone and the way it is perceived differently by different people I began to develop a better understanding of one of the many important aspects of heuristics, that each person has a different interpretation of an interaction. As a class we designed two heuristics, one from the perspective of a student and one from the perspective of the teacher. The benefit of this was not to search for synchronized responses but was a way to be reflexive from multiple perspectives. The more we used the heuristics, and the more I read through the student response the better I understood that simply being aware and believing that my voice was supportive and encouraging was not enough, I consider how my voice was perceived by students, and not assume they shared my perceptive. Reading through a heuristic can bring about awareness and transformation but as Alexakos (2014) agues, the frequency and level of engagement with the heuristics mediates the level and rate of these transformations. The consistent exposure and level of analysis with which I engaged with the characteristics of the student-teacher interaction heuristic we created made this a high-level intervention for me.

What I Have Learned About Heuristics

My understanding of heuristics has deepened, expanded and changed. Central to this transformation is my own axiology and epistemology. When I was first introduced to heuristics I questioned the power dynamic of such a potentially high-level intervention. The suggestive nature of the characteristics and the agency and passivity with which the reader experienced their own transformations seemed to be at the designer's discretion. Designing heuristics with student input has helped changed my perspectives about awareness axiology and agency. When I introduced the coteaching heuristic to my class at Brooklyn College, it was suggestive of my own personal values. We did not use this exact heuristic throughout the semester, but in seeing this heuristic first, students were exposed to a set of characteristics that I identified as important. The students immediately connected the relationship between coteachers to the relationship between students and teachers which positions teaching and learning as dialectically related.

I view students as coteachers in a classroom experience because knowledge is produced within the interaction between students and teachers. Because I believe that students take on the role as teacher in classroom experience, they can be considered coteachers. If we position students as coteachers in the classroom, this multi-perspective heuristic development would no longer be needed. I believe that this is a large leap for many teachers and consider a heuristic from the student perspective brings about awareness and is a step in the right direction.

So What? : The Agency of Being Aware

A powerful aspect of heuristics is that they bring about awareness, which allows the reader to reflect and act. Not every person who reads through a set of characteristics will change their actions dramatically, but if it aligns with the values and perspectives of the reader, perhaps some aspects will be adopted. The reader can engage with the characteristics to the extent that they

wish. When we engage in conversations with students each day we are sometimes unaware of the role of our values and perspectives as well as the values and perspectives of our students. As teachers we ask questions, respond to answer and manage classroom behavior but beyond these interactions we are also sharing with our students our own values, our own experiences and our own emotions. Although they are not articulated in the same way that content is, our emotions and the emotions of our students are present in every interaction and play a role in the way we teach and learn. Because of the significance of the interpersonal aspects of teaching, addressing the emotional aspects of teaching and learning in teacher education courses can at the very least, bring about awareness. Designing heuristics with students is one way to bring about awareness of the values and perspectives of teachers and students, making them transparent and providing the opportunity for reflexivity and transformation.

Chapter 5

EMOTIONAL CONVERSATIONS ABOUT RACE

TALES FROM THE CLASSROOM

> *Katelin*: The relationship between teaching and learning is evident in every interaction. Within a formal classroom space, the teacher is often viewed as the holder of knowledge, the transmitter of information, the "sage on the stage," while students are viewed as inactive observers or consumers. Because we are constantly learning within any social interaction, we are also always sharing in the experience of teaching those around us. This inevitable dialectic is an essential aspect of formal education but is often overlooked because it is difficult to simply imagine and interpret. The content that is taught and learned is only a small part of the knowledge produced within a classroom experience.

Welcome to College Physics for Teachers

The professor stands at the front of the room as his students fill in the empty seats. He leans against the front table as if to support the weight of himself and his words. Shoulders high in the air almost touching his ears. He interrupts their chatter.

"We should have a discussion about the recent events that have transpired, before we get into the physics today."

From the last desk in the back left of the room I observe sympathetic eyes and nodding heads of emotional support. Though most heads begin to shake as if to express disappointment to a small child, some sit motionless attached to curious fingers, that attack keyboards, searching for answers. There is a synchronized sadness amongst those who felt the magnitude of the professor's words. It took me a second to realize I was shaking along with them, with heavy sadness weighing down my heart.

Dan's head turns to me. My seat is directly behind his, and although unassigned, the same seat in which I sat each and every day. At this point in the course we all have assumed our seats as part of our classroom identity. Rachael, always sitting next to Peter and Zara, next to Ittra. Dan's eyes ask me for reassurance and I hold myself back from reaching out to him.

The tone of the room matches it's bleak décor. Off white walls reflecting incandescent light and varying shades of cheap grey and black furniture. Large lab tables sit on sloped, poorly installed tiles. These tiles thinly cover the cement below, only exposed in some areas that have been chipped away, as a result of shifting large metal cabinets filled with heavy dust.

Silence

Hand raised

"I'm in the dark, I'm sorry, what happened?" Dan's voice asks for forgiveness. I want to speak for everyone. "*We forgive you for not knowing*" I say to Dan, but only in my head.

My heartbeat starts to pick up the pace. I wonder if my heart rate matches Professor

Konstantinos Alexakos' (KA) or Dan's or if their heart rates have increased steadily since

walking into the classroom.

BumBum….   BumBum….   BumBum …BumBum…BumBum

 "My son shared a video with me last night. Does everyone know what I'm talking about?" KA

asks as he digs his arm out from behind his back and stretches it straight out to the twenty-four

adults sitting in front of him.

Of course some of them don't know. Dan just said he didn't know what happened. Why are you

asking them? It's not fair to ask who knows, who pays attention to the news, who has to care

about social injustices and who gets to be ignorant to it.

BumBum….BumBum….BumBum …BumBum…BumBum… BumBum…BumBum

I take in a deep breath trying to fill my belly with all of the oxygen in the room.

Exhale… 1…2…3.

No hands. Every pair of eyes diverges from contact with the lonely professor standing at the

front of the room.

Does he want me to answer? The gate that holds back my tears is not strong enough for me to speak. There is no way that I could communicate what had happened clearly. There is no way that I could express myself, express the truths of what had happened in a way that was comprehensible, at least not through my own sympathetic barriers. With every emotion I beg him not to call on me, not to ask me to speak.

"You mean the Alton video?" Kevin breaks the silence.

Thank you, Kevin. I am relieved. I am off the hook.

KA smiles but only with his mouth. I can feel how forced the smile is but appreciate it all the same. I count exactly zero other smiles.

"My son showed me a video of a man viscously tackled to the ground…
Shot.
And *Killed* by police.
A black man."

Kevin, still sitting directly in front of KA, legs spread wide apart, is bent over such that each elbow meets each knee.

He lifts himself up. Or maybe KA did it with his earlier request.
And puts his hand in the air.

KA, refusing to *call on* him, gestures for him to contribute.

"I just feel for my students. You know, what they go through. What did they feel like when they found out? How do they deal with it? But also, the way they have to be careful and take care of themselves and their friends….I mean we go to sleep thinking about Alton and wake up to Phil, it's tough."

July 5ᵗʰ, 2016 12.35 a.m. Alton Sterling is shot and killed in Baton Rouge, Louisiana.
July 6ᵗʰ 2016 9:37 p.m. Philando Castile is shot and killed in Falcon Heights, Minnesota.
The New York Times reports:

> *The Justice Department opened a civil rights investigation on Wednesday into the fatal shooting of a black man by the Baton Rouge, LA.,police after a searing video of the encounter aired on television and social media, reignited contentious issues surrounding police killings of African-Americans (Fausset, Perez-Pena, & Robertson, 2016, pg. A1).*

Loud silence

"I mean how are these things happening?" KA asks looking around at the rest of the class for reactions, not answers.

I want answers.

Story telling: Impressionistic Tales

> *Katelin*: The work that I do, my research, is not "objective" because it can't be. It is emotionally charged and laden with my own values. In reconstructing an experience, I can only share what I observed, felt and thought. I can only share what I understand from speaking with others about how they felt, what they observed and what they thought. Research that strives for objectivity attempts to separate actions and ideas from the actor and the knower. I argue that this is impossible. The emotions and experience of the researcher are an integral part of why the research is being done, who is involved in the work and what methods are used. Regardless of the researcher's acknowledgement of this fact, their own experiences are fundamental to their interpretations. The researcher has the power to choose what information to share, how it is shared and with whom it is shared. I do not take this responsibility lightly. My research is my story.

Stories and storytelling have been a major component of teaching and learning for different groups of people since before the advent of formal language (Egan, 1989). Whether it be drawings on cave walls, oral traditions as a way to pass on the history of a particular group of people or fables told as a way to teach morals and lessons, stories are and have always been part of teaching, learning and culture. Here, I have provided the reader with a short, contextualized snap-shot of my own experience in a college physics class taught to teachers and future teachers of all age groups and all subject areas. Although I was not the assigned instructor for the course, because of my experience as a high school physics teacher, I often took on that role by helping students work through activities and answering questions related to content. My roles as a coteacher, researcher and doctoral student were fluid and undefined throughout the course which provided me with a variety of perspectives and helped me to truly become a member of the classroom.

The focus of this story is around our difficult discussion and emotional beginning to class following the shootings of Alton Sterling and Philando Castile. Although institutional racism and the Black Lives Matter movement were not part of the explicit course content, it was an important moment in the class as it stood out as a contradiction to the way in which class was conducted previously. Kenneth Tobin and Steven Ritchie (2012) theorize such moments as events due to the resulting transformations. This event-oriented approach to interpretive research was developed by Tobin and Ritchie (2012) from William Sewell's (2005) theory that culture consists of contradictions to collaboratively constructed and permeable patterns in social life. It is within these instances, that we can explore and learn. The research may begin with a point of inquiry, but as Konstantinos Alexakos (2015) describes, feedback from participants and re-evaluation of the intended focus results in a shift and so the research emerges as new knowledge is created.

In teaching and research, decisions are made that are telling of the values and views of the teacher and researcher respectively. By illuminating particular events and actions within my narrative, I have cast a metaphorical shadow on others. The ability to make these decisions consciously is an exercise of my agency. This agency resulting from a position of power as a researcher is mirrored within the instructors decision to engage in an emotional conversation about race with his students. The axiological and epistemological stance of the teacher and/or the researcher is not only present, but essential to the way in which both teaching and research progress. As part of my own theoretical framework for teaching and conducting research I value reflexivity and transparency. If our values inevitably mediate our teaching and research decisions, it seems only right to make them clear and known. In addition, being reflexive,

becoming aware of the unaware (Bourdieu & Wacquant 1992), affords me the opportunity to transform my own practice.

Just like impressionistic paintings, a written impressionistic recreation of the events that transpired attempts to capture the atmosphere and emerging emotional climate of the moment as mediated by the author or artist's own emotions and memory (Van Mannen, 1988). In this case, I have captured my own memory and feelings from that day. In between my personal observations of the events in the classroom that day, I present my own internal voice, representing what I felt during this event and in subsequent reflections since. Many of the sections begin with an internal dialogue which I have labeled with my name and placed within a grey background. The process of writing the story and re-living the tale is just as much a part of the research as being in the room during the discussion and participating in the shifting emotional climate. The experiences I share through the construction of a narrative were not and could not be objective and consequently should be transparent and integral to the work. My role in the room included researcher, fellow physics teacher and student. My role now, in sharing this tale, is interpretive and descriptive storyteller, being clear that this is my own interpretation of the events while simultaneously inviting the reader to be part of the process. As John Van Mannen (1988) suggests, an impressionistic tale brings together "the knower and the known," which is critical to the interpretation of the experience. Making meaning through a hermeneutic phenomenological approach, supports and is supported by this research method, as the reconstruction of what was happening required me, as the writer, to think, question and rethink the experience (Gadamer, 2004). The questions that emerged in reconstructing the conversations, actions and thoughts highlight my inevitable shifts in understanding, what Hans-Georg Gadamer (2004) refers to as the hermeneutic process. All of our constructed understandings are based on our lived

experiences and because of this new understanding is the inevitable result of reliving the experience. The reader also has the opportunity to make sense of what is written based on their own experience and what resonates with them.

The process of learning through reconstructing an experience is hermeneutic in nature due to the recursive cycle of interpretation. In addition, looking at data holistically, through multiple lenses and seeking interpretations from others all contribute to the way in which we come to understand. Just as in having a conversation, there should not be an expected outcome when doing research. Gadamer (2004) refers to this idea as conducting a conversation. In doing so, the expectation is that the outcome is predetermined and the individuals participating are not allowing the view of the other to mediate their own thinking. The same is true for hermeneutic research. Before the research experience you cannot anticipate what you will learn and thus the meaning generated is emergent. The production of a narrative is a consistent dialogue with oneself, the reader and those included in the narrative production. As such, interpretation is essential to understanding.

Multilogical: Whose Perspective is valued

> *"For me, the first person present is the most immediate experience one can have with a text. It allows the reader to walk in the shoes of the 'subject' being (re)presented, which is the phenomenological project in a nutshell." (Waldman, 2015, pg. 333)*

The participant perspective is essential to understanding the shared experience and all those involved have something valuable to contribute. Making meaning in this collaborative sense does not mean searching for a truth within the research but instead attempting to understand, through interpretive inquiry and multiple perspectives, what was happening and why it was happening (Tobin, 2014). Including participant voices further enhances the description by

gaining an opportunity to look at difference. In addition, discussions of the events provide opportunity for reflection and interpretation which could potentially result in ontological shifts for the participants, making the research align with the authenticity criteria outlined by Guba and Lincoln (1989).

Because all perspectives are valued and are essential to the research, the reader is also part of the hermeneutic process and that is why this research method | methodology is so valuable. By writing a literary tale of the experience, the reader, although through the lens of the writer, is invited to make his or her own interpretations. This emotional aspect of the tale is why Van Mannen (1988) argues that the impressionistic writer is obligated to write in such a way that the audience is emotionally stimulated. Peter Waldman (2015) describes it metaphorically as "walk(ing) in the shoes of the subject," becoming part of the experience. Yes, there are limitations to what is learned through the reading of the tale, but there are far more benefits from bringing in each perspective and interpretation, including that of the reader.

My Own Sons

Looking down at the chipped tile I can feel KA's heart, his tears and his emphatic smile melting away.

"I just think about my own sons." KA's voice shakes the room.

He continues. "This is why I tell my sons that you don't run from the cops."

With his hands in the air, making eye-contact with seemingly the entire room and with the deepest voice he can muster up to hide the tears that are easily visible in his eyes he says.

"You put your hands up!"

"Silence is Violence"

From my own personal reflections after class that day I became very aware of myself, and my role in the silence. In my notes to myself I wrote, "I don't think that I could have done that." I don't think that I could have started that conversation. I don't think I could have given students space to speak or given students space to not speak.

In speaking with KA after the summer physics course had ended I asked him to share his memories of the emotional conversation following the shootings of Alton Sterling and Philando Castile and why he felt compelled to say something to the class that hot summer morning. He said that he could have this conversation with his class because he felt comfortable with who he is. He said that when he sees something, he can react and when it seems important he feels that he must speak up about it because "silence is violence."

Understanding Ourselves and the Hidden Curriculum

> *Katelin*: Teaching extends far beyond the scope of the explicit curriculum and pedagogy. Our personal philosophies with respect to what should be discussed in the classroom and what is left out are essential aspects of that which is taught. Traditional teacher education programs focus heavily on lesson planning, standards and pedagogical best practices, but what if we asked teachers to consider the lessons not explicitly written in the plan? What if we taught teachers how to be reflective about their decisions and aware of the role that their personal values play in the classroom? What if we told teachers that how they felt and what they thought were an important part of their students' experience because within every interaction they share a little bit of themselves with their students? I believe that we could all use some support in learning to teach our best selves.

When entering a classroom to observe a teacher, principals are instructed to write "low inference notes." This allows the principal to look back on their notes to discuss the lesson later with the

teacher. While I believe the goal of this is to reduce bias, without context, perspective and rationale it is difficult to construct a clear picture and a clearer understanding of the experience. There are many moments during a lesson when teachers reveal themselves, their values and their experiences to their students, which goes unstated. It is not necessarily what is said but what is *done* that I would consider demonstrates teachers sharing themselves with their students. This is perhaps an unintentional curriculum, an emergent curriculum. In reflecting on the ways in which I share who I am with my own students, I consider my actions and choices, not my words. Alexakos (2015) referred to the significance of the teacher's own lived experiences with respect to their classroom decisions as the organic link. The concept of the organic link is significant to my work but more significant to my understanding of his perspective of the role of the teacher within the classroom experience. It is clear from KA's classroom actions that he is aware that his decisions are critical to the experience of his students, how they learn physics, and how they learn about teaching.

The notion of teaching beyond the explicit standards has been researched at the macro level and is sometimes referred to as the hidden curriculum, the learning that occurs due to the very structure and nature of schools. Much of the hidden curriculum is implied through established routines and education policy. Longstreet and Shane (1993) refer to the hidden curriculum as the learning derived from the structures, organization and design of schools and the attitudes, values and actions of teachers and students. The learning that occurred in KA's physics class taught us about his personal values and brought to light a very critical aspect of teaching, the teacher. In a standards-based schooling system, teachers are often viewed as and treated as robotic disseminators of information, but their influence goes well beyond their ability to clearly explain concepts. This responsibility is both a benefit and a challenge for teachers.

What is not discussed in classrooms is just as much a part of what is learned as that which is discussed. Eisner (1994) writes about this idea as the "null curriculum" which is all of the things that are taught in schools because they are not part of the official curriculum. He suggests that what we don't talk to students about is just as integral to the lessons learned and values shared and it is important for educators and school systems to recognize. KA's decision to walk into his physics class that day and begin a discussion around social justice was part of the emergent curriculum and it was so even before he said something. In a personal essay on the kind of schools that we need, Eisner (1998) suggests that when humans engage in a shared objective they will always learn beyond the scope of the objective and therefore any teaching that is not tied to standards often allows students and teachers to learn beyond the scope of the original task. All of our interactions with students as we learn together are constantly reinforcing our own axiology and epistemology whether explicitly or through our decisions and actions. All of the subjects and experiences excluded from schools represent a clear message about what is valued and what is considered learning. And while it is easy to make the objectives and standards of a curriculum explicit, it is in the execution that variation is inevitable. Jean Anyon (1980), who studied social class and the hidden curriculum found that the variation in teaching approaches, expectations for student performances and the experiences created for and with students come with great variation and result in varied outcomes. And while no single educator can recreate the same lesson with a different set of students, because every experience is a new experience, the expectations that a teacher has for their students is just one example of what is learned.

In Dewey's description of curriculum (1902), he too discusses the idea of reproduction and reconstruction. For Dewey, ideally this reconstruction would originate from the child's own

experience and be driven outward from there. What actually happens often in schools is that these experiences are organized into sets of studies that are predetermined and value laden. School then becomes a space where students reproduce societal norms and take on the values of those who decide what is taught, what is discussed and what is left out (Dewey, 1990). Ignoring the dialogic nature of learning from and with the other and ignoring the significance of what is going on in students' lives and the world outside of the classroom can be detrimental.

Erickson (1986) argues that within a classroom, choices and actions of all members are part of the curriculum that is enacted in the classroom, meaning the teachers and students together make decisions based on acquired and shared understandings that are learned from and with the other. As a result, it is only by being part of the classroom experience that the researcher can discover these experiences. This was an important part of my own experience taking on roles of teacher, student and researcher simultaneously in a college physics class for teachers.

Event-Oriented Emotional Inquiry

> *Katelin*: The greatest shift that I have encountered in my own thinking is in the understanding that we can learn the most by examining difference. An action that occurs outside of the regular pattern of experience or an alternate perspective on a single act provides the greatest opportunity for growth. If we constantly seek confirmation and validation of what we already know how will we ever move forward?

Event oriented inquiry is a key part of my own framework and informs my methods and therefore my research. Tobin and Ritchie (2012) explain event oriented social research as selecting a moment that is outside of the patterns of the everyday experience. For research that is based on a specific set of research questions, this would mean an ever-changing set of research questions that lead to even more questions to consider. Instead, inquiry based on studying specific contradictions is focused around learning from difference, looking for moments of

interest and trying to understand it from multiple perspectives. Sewell (2005) discusses macro level events with respect to historical shifts and cultural change. Looking at the macro level structures that mediate a shared experience and then looking more closely at the events that are happening within an experience help to expand my understanding as well. This multilayered approach adds further to a fuller understanding of the whole picture.

Delayed Reactions: Moved to Speak

Sometimes it is difficult to tell when a class is over. Students file out of the room, while some stay seated. I walk to the front of the room to gain a different perspective of the space. Wanting to be supportive but not overwhelming I approach a group of three students still finishing the lab activity while a second group of three students remain seated on the other side of the room.

"Do you have any questions?" I ask.

I get irritated with myself for asking them. Of course they have questions, what I really want to know is how I can be of assistance. When I ask this same thing of my high school students, I get a similar response. Silence. In eight years of teaching I have yet to illicit a question from this request. Each time I ask, I cringe; yet I ask it, consistently.

On the other side of the room, Zara, Ittra and Arta, positioned as if afternoon tea were to be served momentarily, smile and laugh in synchrony.

KA, seated on a stool hovered over their table, calls me over. "Come here Katelin." I smile to communicate, "I hear you, one moment." The teacher within me is too apprehensive to leave

students unattended. I remain positioned in front of the last three students completing the lab activity as they finish.

As the students completing the lab activity and exit the room wishing me a good afternoon, I walk over to the table to which I was summoned and hear Arta exclaim.

"You know, Terrorism has no religion."

I sit down.

Cogenerative Dialogue

In reflecting on why she decided to stay in the classroom after class was over following our emotional discussion, Ittra writes:

> Ittra: I felt like we all have something in life that affects us emotionally and mentally. The incident that happened the day before, with a shooting of Alton Sterling, caused us to have a discussion on how hard it is to live as minorities in a country that is supposed to be free of racism. As a Muslim girl living in the United States, I always feel a fear of going outside alone because of events that can cause people to look at me differently. These things do not bother us all the time, however, the emotional pain stays with us.
>
>   Ittra, reflection, November 13th 2016

Ittra, a graduate student and aspiring chemistry teacher, wears a hijab. She has been wearing the hijab since 10th grade for privacy and modesty. The pride in her voice as she shares her reasoning for wearing a hijab is profoundly beautiful. She explained that although "the Paris

attack, caused many Muslim girls to take off their hijabs" she wrote in her reflection that she did not even consider it.

Although she remained silent during the full class discussion, her decision to stay after class was a salient moment. The discussion that emerged resembled a cogenerative dialogue (cogen) in many ways. Gillian Bayne (2007) describes cogen as both a research and pedagogical tool, which is important to my understanding of the unstated curriculum within KA's class and from the perspective of KA's student, coteacher and coresearcher. In a cogen, students, teachers and researchers come together with a shared goal of collective understanding and knowledge production through dialogue (Bayne, 2007). Although the formation of the cogen seemed to stem from the desire to continue the earlier discussion with respect to race and religion, the norms of cogen had been discussed in other courses that these students had taken.

After the conversation with Zara, Ittra, Arta, KA and myself began at the end of class, I started to video record it so that I would have the opportunity to revisit the discussion as both a way to remember the details and as a way to reflect on my experience as a member of the dialogue. As Professor KA (2015) discusses, in his book about being a teacher and a researcher, cogen serves as both a method and a methodology. This is telling of his personal perspectives on the value of student voice in research. Through my role as KA's doctoral student and as a researcher I can see clearly that in teaching me how to be a researcher, I have learned a lot about what he values as well as the importance of what I value. My view of the roles of teacher, researcher and student as completely separate entities has changed throughout this experience. If to be a student is to learn, then I feel that I am a student in all aspects of my social life, especially when I am teaching.

You Look Very Emotional

Arta's voice suddenly increases in pitch and pace.

"Anybody that does the act of terrorism has no religion, that is my comment."

KA stops her and says "Let me ask you a question, when you talk, you speak very emotionally, I don't know if you notice that" his voice is calm.

Did he ask her because he thought she didn't notice? Maybe he asked because he is trying to help her become aware of changes in her own emotional state. Did her breathing change?

KA turns to Zara and Ittra seated across from Arta. "You notice that?"

"Yeah you're looking very emotional" Zara says laughing and looking at KA, then making eye contact with Arta and finally turning to Ittra looking for reassurances.
"Very intense." Ittra confirms and joins in the laughter.

Yet again, all three in complete synchrony, each laughing along with the other.

Arta, looking up to KA who is still seated on a stool perched over the table continues.
"It's just that in the morning you talked about it, and I couldn't speak about it. I guess it's from there."

"What was it that you wanted to say?" KA invites her comment.

"It was what you said about children. It made me very emotional."

Zara puts her hand up at chin height and stretches her neck high in the air. Her posture immediately improves.

"So many people are getting targeted"

"Black Lives Matter. Muslim Lives Matter. LGBTQ Lives Matter. It's so emotional"

Now moving her hand toward her heart and raising her shoulders above her collarbones forming a concerned shrug, she turns toward KA and asks.

"Who is safe?"

"Safe": Unexposed to Danger or Risk

> *Katelin*: We communicate not only through our words, but also through our tone, posture and the way we move our bodies. Regardless of sharing a common language, our words and the way in which they are delivered are ultimately left to the interpretation of those with whom we converse. Because there is no way to predict with certainty how our words will be received, we have no way to guarantee the safety of the interpreter. No conversation or experience is free of risk. I cannot guarantee that my words will never hurt you, but I can promise that I will listen to and learn from yours.

Although I believe that all conversations are worth having, I also think that there are far more risks associated with discussion around topics such as race, gender and sexuality. What I have learned from KA's discussion about the shooting of Alton Sterling and the fear that young men and women of color live with in the US, is that the decision to have the conversation sends a message to students. It is a choice that lets students know that their voices are important and that, as teachers, we care about their whole selves. Zara, Ittra, and Arta, the women who decided to continue the conversation about race and religion after class, as well as those who left, left the room with a clearer understanding of the values of their professor.

My tales and subsequent interpretations have illuminated my own emotional experience and highlighted the experience of three students from the class. What the discussion has failed to address is the experience of the students who did not stay behind. Students that decided not to continue the discussion, may have left at the end of class that day for a variety of reasons. It is important to consider that one of these reasons could have been the desire not to engage in this dialogue. Conversations involving sensitive topics can heighten an individual's emotional

experience. Tobin and his research colleagues (2016) have extensively considered the physiological expression of emotions and the connections to wellness. Through micro level analysis of heart rate and blood oxygen concentration, and the use of Polyvagal theory, Tobin et al. (2016) point out the danger of intense emotions. If an individual perceived the classroom environment to be unsafe they may enter "fight or flight" mode. When this happens the emotions of anger and fear can result in physical harm due to sudden changes in heart rate and blood oxygen concentration. The implications of their work should be seriously considered when engaging students in emotional conversations.

This becomes challenging when one considers that the decision to engage students in emotional conversations comes from a position of power. As a teacher, who often holds this position of power with respect to what is discussed in a classroom, it is essential to be aware of the potential positive and negative implications. It is important to consider what options students have when they wish not to engage in conversations about race, gender or social issues and what can be done to mitigate the potential violence associated with engaging in emotional discussions. I believe that these concerns are important and need to be explored and studied further. For me, the intentional regulation of my own breathing upon realizing that my heart rate was increasing is one example of an intervention that is in support of wellness.

In order to have a multilogical interpretation of the conversation, I consider a critical race perspective to contextualize the classroom conversations and interactions within the social and political world. From the standpoint that racism is systemically engrained in our social reality, not acknowledging horrendous acts of violence that insight fear and anxiety for people of color can be perceived as not seeing the significance (Ladson-Billings & Tate, 1995). As emphasized in Critical Race Theory (CRT), all stories reflect the perspective of the storyteller and that is why

I find it important to include participant voice to gain a more robust understanding. I am also aware of, and acknowledge, the privileges associated with my perspective as a white woman as well as the resulting implications. I benefit from the unequal distribution of social political and economic benefits due to systemic inequities. Critical race theorists (Ladson-Billings & Tate, 1995) emphasize story telling from the perspective of groups of people who are often marginalized and encourage members of the dominant culture to examine their constructed reality through a lens of privilege.

What I have Learned

Teachers are often expected to have all of the answers. When faced with difficult questions related to course objectives, at times, teachers need to take a moment to think and research, to attempt to find an answer or craft a solution. One of the many challenges of teaching is that the questions asked don't always have easy answers. "Why are young black men dying?" "Who is safe?" What does "safe" mean? What does it imply?

The social and political world in which we live are not separate from our classroom experiences. In the class following the shootings of Alton Sterling and Philando Castile, the instructor made a choice to provide students with the opportunity to discuss what had happened. In a room full of teachers and future teachers, this opportunity acknowledged their emotions and allowed them to grapple with the realities of racism and prejudice that are part of social interactions, including teaching and learning. Some of KA's students spoke up in the moment about the empathy they felt for their students, questioning how their own students reacted to the news, while others sat silently and listened. The instructor shared his own emotions and experiences, modeling one way to have an emotional conversation with students.

Prior to my research and teaching experiences at Brooklyn College, my understanding and experience with teacher "training" programs was focused around writing lesson plans, teaching skills and delivering content. Though these are important aspects of teaching and learning, they are not the only lessons learned. When a teacher enters a classroom for the first time they are often underprepared for the moments when teaching goes beyond assignments and assessments; the moments when students need space to question what is happening in their lives, their communities and their world. It is at this time that a teacher reveals themselves and their values to their students.

Though there are teacher education programs that emphasize social emotional learning, educators afforded the opportunity to engage in emotional conversations can learn a great deal from the experience. In addition, when a professor enters their own classroom they are modeling the ways in which they share their own values with their students, which isn't always easy. Teachers and students live out their daily lives entrenched in the social and political world around them. As they walk into school they bring with them all of the experiences and events that occur locally and globally each and every day. Whether or not we choose to engage in the conversations or provide space for students to discuss with their peers, the conversation enters the room in the minds, hearts, words and actions of all those present. The conversation following the emotional discussion in class that day, between the professor, myself, Arta, Ittra and Zara, about their own classroom experiences as Muslim women, revealed a critical need for such spaces.

I must again acknowledge the many risks a teacher takes when having conversations on challenging topics like race, gender sexuality and religion. Alexakos (2015) and his research squad described discussion that focused around sensitive and vulnerable topics associated with

identity and referred to them as "thorny issues," drawing on the imagery of a thorn. These "thorny issues" are often avoided in classrooms all together because they can result in sadness, anger and discomfort (Alexakos et al., 2016). But not having these conversations can yield similar results. By promoting learning from one another and learning from difference through open dialogue we are sharing ourselves and our values with our students. These conversations should be explored with mutual respect, compassion and understanding of the potential transformations that result from learning (Alexakos et al., 2016). Deciding to value these conversations can help students to see that their experiences are important, that their values are valued, their stories are meaningful and that we have much to learn from and with each other.

Authentic Criteria and the Emergent Curriculum

> *Katelin*: Every interaction provides an opportunity for growth and knowledge production. In my research, I strive to find ways to make the most of this change. It is evident to me that the ontological shifts that I have made as a result of learning from and with participants have transformed who I am.

According to Tobin's (2013) adaptation of Guba and Lincoln's (1989) authenticity criteria, authentic research should benefit not only the researcher but also the participants. Research should contribute to similar shifts in the larger systems and structures. For me this is why we do research. As we learn and explore we cannot help but be transformed. These changes should improve the individuals and structures by addressing issues and creating positive change. Because every individual is part of multiple fields that have no boundaries, as Sewell (2005) describes, those involved in the research, take the benefits of the work with them to their next lived experiences. Not only have I become more aware of the ways in which my actions provide a window into my values and beliefs, but I am also able to see ways in which I can be more

explicit and transparent with my students at both the High school and University levels. This is the way in which the work can become catalyzed. By being transparent when working with teachers; both telling them and showing them why and how our actions are expressions of who we are, can help them to be more aware when working with students in their own classrooms.

When enrolled in a teacher education program, teachers are taught strategies to address a variety of learning styles as well as methods to engage students of different abilities. But often, teachers are not prepared for the many interactions they will have each day. Whether we are aware of it or not, teachers and students consistently construct the emergent curriculum together, collaboratively transforming the classroom experience.

I cannot help but be reflexive about my own practice and think about what I would have done if I walked into my own college class, or my own high school class, the day following these shootings. While keeping in mind the risks and potential discomfort, I believe that it is important to engage students in conversations around these issues. The culture of teaching produces knowledge as we engage in discourse with others (Sewell, 2005). By having conversations about race, gender and religion with students, we contribute to the producing and reproducing a culture where students see that their lives and the ways in which they experience the world are important. I do not propose that all educators discuss issues of race, gender and religion in their own classrooms as I have described. I suggest that educators become aware of the implications of having and not having these conversations and consider the potential significance as well as the challenges. Who we are as educators, our axiology and epistemology are not just important to what we do, they are important to why we do it and how we do it. I encourage educators and teacher educators to be reflexive about their own practice and how their values mediate their teaching.

Chapter 6

TRANSFORMATIONS

My Community: Hermeneutic Phenomenology

When I first entered the doctoral program at the CUNY Graduate Center I began attending research meetings immediately. Ken Tobin and Konstantinos Alexakos (KA) refer to these as *research squad* meetings. Being part of Ken's and KA's research squads from the get-go has played a significant role in my development as a researcher. In addition to exposing me to potential areas of study, squad meetings have been a place to learn, explore and question scholarship. Although I took courses with both Ken and KA, it was in these research meetings that I gained a deeper understanding of the meaning of hermeneutic phenomenology (Gadamer, 1998) and its applications in the work that we do. I do not believe that research can be done in isolation. Asking and answering questions with colleagues is one way to dialogically explore and understand from many perspectives. Through this experience, I have become aware of the different ways of making meaning and by being aware has transformed my view of knowledge.

Research squads are both a manifestation and a reproduction of this hermeneutic phenomenology. Like a community and a family, generations of scholars that have come before me have informed my approach to research. My first experience with a heuristic was during Malgorzata Powietrzynska's presentation about her dissertation work (Powietrzynska, 2014). I was absolutely enthralled during her entire presentation and the discussion of this mindfulness

intervention. Her work inspired me in many ways, including the inclusion of heuristics in my own research practices. Shequana Wright, Leah Pride and Cristina Trowbridge's work has informed my research. They encouraged me to consider what counts as research, how to include participant voice and why it is important to be honest about who I am in the work that I do. As members defend their dissertations and graduate, the squad continues on because of its new members. Corie McCallum, who entered the doctoral program shortly after I did, has read every chapter I have written. She has pushed me, cheered for me and, at times, cried with me. Providing emotional support for emotional work. The current configuration of our research squad has encouraged me to be confident and say what I mean. This community (re)produces the knowledge of the scholars that came before, which provides a profound depth to the work that is produced.

Being a member of a research community from the beginning of my doctoral journey has contributed to my growth and my scholarship. When I began teaching at Brooklyn College in my second year as a doctoral student, I was confident about the role that research plays in supporting students because of what I had observed and read in squad meetings. I was aware of the types of research that could promote student awareness. I was also able to align my work with my research frameworks because I had the opportunity to develop these frameworks collaboratively and reflexively within a supportive community.

Brooklyn College: Becoming a Teacher | Researcher

For three years of my doctoral studies, I had the incredible opportunity to teach at Brooklyn College. Three of the research studies of this dissertation took place there. My first experience as a teacher | researcher was during my first semester as an instructor at Brooklyn College *(Chapter*

4). The course that I taught was a methods course for teaching science. This experience informed my understanding of the dialectical relationship between teaching and research.

During the other two research studies that took place at Brooklyn College, *An emotional relationship with physics (Chapter 3)* and *Emotional conversations about race (Chapter 5),* KA (my advisor) was the official instructor of the course. The focus of these courses was physics and the participants were teachers of all age groups and content areas. I knew many of the students in KA's classes, because they had been my students in previous classes. This relationship made my roles as researcher and teacher more transparently and dialectically intertwined. I supported students as they learned physics and they supported me as I learned about their experiences and tried to make sense of what was happening and why it was happening.

Emotional awareness

The second chapter of my dissertation, Gender, identity and culture in learning physics, draws on my own experiences as a female physics major and a female physics teacher. I was aware that I was one of very few female physics students at the university level, but I was not critical with respect to my own emotional awareness and the role it played in my schooling and my career. In writing this chapter I considered the way in which I view knowledge and learning, which resulted in shifts in my epistemology with respect to knowledge production and culture (Sewell, 2005).

As a student of physics, what I had not considered was the way I viewed learning. I thought of myself as an empty vessel in a classroom, waiting for the knowledgeable professor to give me information and I did not think to question it. I contributed to the production and reproduction of the structures of formal schooling in each course that I took. I would take notes, do practice problems, ask for help, get frustrated when it was difficult, and stress and worry

before each exam. What I did question was my belonging. I thought that it was possible that I did not fit within the field and that physics was potentially not "for me." Even though I could see a connection between my emotions and my experience learning physics, the implications were not clear. My emotions informed the way I approached classes and my fear and anxiety contributed, at times, to my perception that I did not belong.

Fear and anxiety are emotions that are often associated with learning physics (Mallow, 1987). In the third chapter of my dissertation, An Emotional Relationship with Physics Content, I examine these emotions in a physics themed general science class. In this chapter, I present an argument for the importance of considering emotions in teaching | learning. In addition, I encourage critical approaches to teaching that urge teachers | learners to become aware of their own epistemology and axiology, and question what is presented as "truth" and how it is presented. This research experience challenged me to consider how the emotions in a classroom are informed by what is taught and how it is taught as well as past experiences and social structures. Classroom decisions are mediated by the instructor's axiology and epistemology as well as the structures of traditional schooling. Awareness of this, affords reflexivity and agency in making choices.

As a high school teacher, emotional awareness has become overwhelming. I am more in tune to the emotions of others and find myself focusing on these aspects of classroom interactions more frequently. Attempting to understand the emotional experiences of my students and valuing their perspectives has been a major shift in my own teaching. Throughout this journey, I have shared much of my doctoral work with my high school students. I speak about the work that I do, so that they better understand my perspective. I talk to them about what it means to question facts that

are presented as truths and the ways in which we agentically and passively express our emotions with others. I do this because I feel that awareness is powerful and transparency is necessary.

Mindfulness

Being aware of our emotions and the emotions of others in the classroom is important but can also be overwhelming. A heuristic is a mindfulness intervention that brings about awareness and suggests ways to ameliorate emotions and improve social interactions (Powietrzynska, 2014). It is not only important to be aware of the ever-present emotions that mediate interactions, it is also necessary to have a means to improve negative emotional experiences. A heuristic is an example of a mindfulness intervention that is in support of reflexivity and emotional wellness.

In Chapter 4, Developing heuristics with students, I discuss the development and implementation of heuristics in a methods in science education course at Brooklyn College. Developing heuristics with students brought about awareness with respect to teacher voice and emotional interactions with students. It also illuminated the significance of discussing interactions and emotions in teacher education. Not all teacher education courses or teacher preparation programs note the emotional aspects of teaching and learning. Acknowledging the way that tone of voice and student voices are valued in the classroom was transformative for both me and my students. This work also helped me to understand my role as both a teacher and a researcher and the dialectical relationship between the two, helping me to become a teacher | researcher (Alexakos, 2015).

The heuristics that were developed, with input from the students that I worked with at Brooklyn College, can be found in Appendix A and Appendix B. These heuristics are examples of ways in which emotional awareness and wellness can be addressed with teachers | learners.

Each characteristic was informed by the values and perspectives of students in a graduate level teaching methods course. The shapeshifting nature of heuristics (Powietrzynska, 2014) suggests that the characteristics are not fixed. In using these heuristics in other classrooms, with a different group of students with different values and experiences, other aspects of classroom interactions may emerge. The experience of developing and using heuristics with another group may have a "family resemblance," as discussed by Tobin (2015), to our experience with heuristics, but will not replicate identical results.

Emotions are part of every interaction (Turner, 2007) and inform our experiences. It is evident from my research that this is an area in education that needs to be addressed. Studying classroom interactions and the emotional implications of learning science helped to identify areas that could benefit from positive interventions. Awareness brought about through the use of heuristics is an example of one such intervention.

Being Cautious with Feelings

One way in which heuristics act as an intervention is by bringing about awareness of possible ways to change emotions when it becomes desirable to do so. When teaching | learning or engaging in discussions with students about social life, emotions can become intensified. It is important to consider tools such as heuristics as a means for supporting the amelioration of possible negative emotions.

Having emotional conversations about gender, race and religion is challenging and often avoided in science classrooms. In Chapter 5, I have shared my experience in KA's class during a discussion about the shootings of two men of color by police. This experience informed my understanding of the significance of acknowledging what is happening in the world around our students. These experiences mediate our social interactions and discussing these events with

students is telling of the ways in which we, as teachers, value their realities. These emotional conversations can also bring about or intensify negative emotions. Being aware is important and considering ways in which to critically navigate these potentially negative experiences is essential.

My Ripples: Authenticity Criteria

The authenticity criteria as adapted by Ken Tobin (2006) from the work of Guba and Lincoln (1989), suggests that research should benefit the participant, the researcher and the institution. The research should produce knowledge and positive change. It is difficult for me to consider the impact of my research. I feel that I have learned so much from the work that I have done. But so what? I believe the largest ripples that I have made are those realized through interacting with others along this journey. Doing research with inservice and preservice teachers has been one way in which this work has contributed to the larger community. The teachers that I have worked with have become more aware of their emotions, conscious of their interactions and critical of the values associated with teaching and learning. After a presentation on my research on emotional conversations about race, at the American Association of Physics Teachers conference in July of 2017, I was approached by another high school physics teacher. She thanked me for my presentation and said that we don't talk about the emotional aspect of teaching enough. I have been a part of the learning science community at the CUNY Graduate Center for five years and in that time have forgotten that discussions about emotions and emotional topics are not the norm. Part of the work that I hope to do in the future is continuing to bring these topics of conversation into spaces where they aren't discussed enough. As a high school teacher, I have certainly been transformed. Not necessarily in a profound shift, but in the way in which I discuss knowledge with students and in the way I encourage them to question their realities.

Generalizability and Theoretical Implications

Through my own experience as a teacher and teacher educator, I am aware that each classroom is unique and changes from day-to-day. Because of these differences, it is important to consider generalizability, not as claims that suggest each classroom is the same, but instead through viability (Tobin, 2015). Detailed description, transparent views and values, and participant and researcher narrative, provide thick description, context and perspective to my research. Because of this, others may consider the viability of my work, and my experiences, in their own classroom and social life.

Teaching | Learning is emotional. This notion challenges our abilities to learn and interact with others. The day-to-day realities of the classroom are not isolated from the world in which we live. This adds to the complexity of who we are and who we teach. Awareness of our emotions is the first step toward ameliorating them. By being and becoming a teacher | researcher, I have come to value the interpersonal aspect of teaching as well as the agency (and passivity) that comes from emotional awareness. Although each member of a classroom experience mediates the experience of the other members (Turner 2007), we cannot generalize the emotional experience of the classroom. Therefore, it is important to consider the possible contradictions that may arise and what we can learn from difference.

Personal Transformations

When I first considered what my dissertation research would be, I was set on studying physics education. I didn't know exactly what it would entail, but I felt strongly that this was the topic I wanted to pursue. Although many of the chapters of this dissertation discuss what I learned in physics classes, what I have learned from these experiences has nothing to do with the formal content of the course. Teaching and knowledge production are part of the culture of a classroom.

The knowledge produced through the interactions between students and teachers is what I would consider to be culture (Sewell, 2005). Although this is mediated by structures of formal schooling, standards and accountability, what is more important in a classroom is the interaction. The emotions of students and teachers are part of this interaction as well as the values and theory of knowledge of those who participate.

I believe as a high school teacher, I felt that I could only discuss physics with my students. The world outside was separate from what we learned and did within the classroom. I tried to hide my own stress, my own emotions, my own views from students because I did not see a reason to share these things. I did my best to support students when they overtly and openly approached me about something that bothered them. Other than that, I just taught physics. I realize now that even in an attempt to hide these things from my students, I wasn't just teaching them physics. This research has helped me to develop a better understanding of the knowledge and emotions produced in a classroom. A teacher's values and views on knowledge inform decisions they make as well as the moment-to-moment interactions they have with students. Part of what I have taken away from this experience is the notion that my values and emotions, and the values and emotions of my students are an important part of our classroom interactions.

Mindfulness and reflexivity (Bourdieu & Wacquant, 1992) have also been a major part of my transformations. Emotional awareness affords reflexivity and helps me to appreciate the emotions I am experiencing. I firmly believe that to appreciate something, you have to be aware of its existence. One month after I began my first semester at the graduate center I met my love and soon to be spouse. I have probably never appreciated something more in my entire life. I believe that I am able to appreciate it so much because I am more reflexive and consistently aware.

In research, we are expected to make our frameworks clear and transparent, so that others can make meaning from our experiences. I think this is also important in teaching. Because of my research journey, I am more aware of my values and the role they play in the classroom. I attempt to make this more transparent for my students, by being open, engaging in difficult conversations and discussing my own theory of knowledge as well as what I value, with my students. I value critical meaning making and challenging problem solving. I value the perspectives of my students with respect to what is taught and how it is taught. I also value their emotions. Heuristics, reflexivity, and deep breathing exercises have become part of my classroom practice. In my teaching, I no longer shy away from participating in emotional discussions with students because I see the value. Teaching is a challenging and rewarding job. In my experience, it comes with many prideful and painful moments. This research has brought about awareness of my own emotions and has helped me to conceptualize the significance of emotions in teaching and learning. I hope that in reading my work others can learn something from my stories.

Appendix A

Heuristic For Student-Teacher Interaction (Teacher version)

Your name : _____
For each characteristic circle the numeral that best reflects your thoughts with respect to the experience you just had. As necessary, provide contextual information that applies to your rating.

1. I am aware that my tone of voice can impact my interactions with students and use a tone that is

    respectful and encouraging.

    5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

    Comments:

2. When I am interacting with students, I am aware of my impact on their emotions.

    5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

    Comments:

3. When I am interacting with students, they are aware of their impact on my emotions.

    5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

    Comments:

4. I value the perspectives of my students

    5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

    Comments:

5. My students value my perspectives

    5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

    Comments:

6. I show compassion and provide support when students feel unsuccessful.

    5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

    Comments:

7. The students are aware of the emotional climate in the room and their impact on the emotional climate.

    5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

    Comments:

8. I am aware of the emotional climate in the room and my impact on the emotional climate

    5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

    Comments:

Plus/Delta Feedback

The plus column is used to record what was done well. The Delta column is used to record what could be changed to improve the lesson and suggestions for how changes could be made.

+ Plus	Δ Delta

Appendix B

Heuristic For Student-Teacher Interaction (Student version)

Your name : _____   Presenter:_____

For each characteristic circle the numeral that best reflects your thoughts with respect to the experience you just had. As necessary, provide contextual information that applies to your rating.

1. The teacher/presenter uses a tone of voice that is respectful and encouraging.

    5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

    Comments:

2. When interacting with the teacher/presenter, they are aware of their impact on my emotions.

    5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

    Comments:

3. When interacting with the teacher/presenter, I am aware of my impact on their emotions.

    5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

    Comments:

4. The teacher/presenter values my perspectives.

    5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

    Comments:

5. I value the teacher/presenter's perspectives.

    5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

    Comments:

6. The teacher/presenter shows compassion and provides support when I am feeling unsuccessful.

   5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

   Comments:

7. I am aware of the emotional climate in the room and my impact on the emotional climate.

   5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

   Comments:

8. The teacher/presenter is aware of the emotional climate in the room and their impact on the emtoinal climate.

   5= Very often or Always, 4=often, 3=Sometimes, 2= Rarely, 1= Never or very rarely

   Comments:

Plus/Delta Feedback

The plus column is used to record what was done well. The Delta column is used to record what could be changed to improve the lesson and suggestions for how changes could be made.

+ Plus	Δ Delta

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