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Awakening Mindfulness in Science Education

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ABSTRACT

Contemplative/mindful education focuses on practices that enable class participants to develop awareness of the events that transpire in the moment in the classroom. Breathing meditation, radical listening, awareness of own and others' emotions, compassion for self and others, reflection and conversation, are practices used as interventions to manage and ameliorate diverse emotions that often arise in the science classroom. This study took place in a graduate History and Philosophy of Science Education class for pre-service and inservice teachers at Brooklyn College of the City University of New York in the spring of 2014. The goal was to encourage participants to embrace mindfulness practices throughout the semester in an effort to awaken their sense of compassion with themselves and others during class interactions. Controversial topics involving history of science, religion, gender, ethics and other issues were presented and discussed every week as part of the curriculum. Historically, the aforementioned topics generate a rollercoaster of emotions in class participants; this factor and the experiences class participants deal with in their daily personal lives can present challenges to the class dynamics and to teaching and learning. Mindfulness practices were used in this class as pedagogical tools to provide a judgment-minimized space where class participants could express freely their emotions and perspectives on debatable topics in the field of science education while teaching and learning.

Keywords: breathing meditation, radical listening, compassion, mindfulness

Mindfulness is a term that has been described by Malgorzata Powietrzynska and Kenneth Tobin (2015) as a non-judgmental act that involves paying attention to present moment experience in a way that challenges our innate constant preoccupation with past or future thoughts of events passing through our minds. I have adopted mindfulness in the science classroom after being introduced to the practice in a previous study at Brooklyn College. I consider contemplative/mindful pedagogy a rounded approach in the process of teaching and learning. However, most present-day teaching focuses on the empirical aspect of epistemology without paying much attention to how the brain receives information, processes

it, and transforms it into a valuable lifelong asset to the learner. This prevalent pedagogic approach is rooted in the traditional Western Aristotelian logic approach. In science education, the method is further reinforced by the Cartesian-Newtonian-Baconian ideology where objectivism is not only the best, but also the only way to understand science and the world (Kincheloe, 2003). In my class, participants practice contemplative/mindfulness education that provides a deeper focus to what is being learned. Several mindfulness tools that include radical listening, empathy, respect, compassion, and collaborative work are nurtured throughout the semester, thus facilitating an atmosphere of comfort, respect, and openness about ideas, thoughts, and different perspectives on controversial issues. A series of mindfulness characteristics (Figure 4.1) in the form of a heuristic developed during the previous study (Powietrzynska, 2015) was given to students at the beginning and end of the semester. The purpose of having students complete the heuristic was to awaken awareness in the classroom and obtain feedback about their experience utilizing these tools while teaching and learning. In this chapter, I use hermeneutic phenomenological narratives to describe how a pedagogical mindfulness approach allows participants of a History of Science Education class for teachers to focus and concentrate their attention on the in-the-moment events. One of the main goals shared by Brooklyn College as an academic institution and me, as a teacher, is for all class participants to increase their cultural capital while completing the curriculum. It is my responsibility to help develop a safe place where students feel free to express their ideas and views without feeling judged. Discussing emotional topics in a mindful, respectful, and supportive atmosphere helps create safe spaces for different voices and values to be heard and for learning from the “other” to take place (Tobin et al., 2015).

The positive implications of approaches such as mindfulness meditation have been suggested by Fadel Zeidan and colleagues to be involved in the promotion of higher-order cognitive processing that deal with facets of monitoring and cognitive control processes (Zeidan et al., 2010). Zeidan and associates push further this idea by providing robust evidence and correlations of mindfulness meditation with decreased negative mood, enhanced ability to sustain attention, improved visual-spatial processing, maintenance of focus and accurate retrieval of information from working memory under conditions that require more rapid stimulus processing (Zeidan et al., 2010). I believe that such cognitive aspects are pivotal in promoting a healthy and productive learning and teaching environment. Furthermore, there is personal enrichment through individual and collective interactions. Mindfulness interventions were encouraged in this class with the purpose of transforming the axiology of class participants (i.e., their respective value systems). At the same time, the expectation was that participants would grow comfortable using these tools and become mediators of the practice in their own classrooms. The design of the curriculum embodies scientific epistemology tangled up with sociocultural forces that have shaped and continue to shape teaching science.

1. *I am curious about my feelings as they rise and fall.*
2. *I find words to describe the feelings I experience.*
3. *I identify distracting thoughts but let them go (without them influencing future action).*
4. *I am not hard on myself when I am unsuccessful.*
5. *I recover quickly when I am unsuccessful.*
6. *I pay attention to my moment-to-moment sensory experiences.*
7. *I am aware of the relationship between my emotions and breathing patterns.*
8. *I am aware of changes in my emotions and pulse rate.*
9. *I maintain a positive outlook.*
10. *I can tell when something is bothering the teacher.*
11. *I can tell when something is bothering other students.*
12. *The way in which I express my emotions depends on what is happening.*
13. *The way in which I express my emotions depends on who is present.*
14. *I can focus my attention on learning.*
15. *I feel compassion for myself when I am unsuccessful.*
16. *I feel compassion for others when they are unsuccessful.*
17. *When I produce strong emotions I easily let them go.*
18. *I gauge my emotions from changes in my body temperature.*
19. *I am aware of others' emotions from characteristics of their voices.*
20. *I am aware of my emotions being expressed in my voice.*
21. *I recognize others' emotions by looking at their faces.*
22. *I am aware of my emotions as they are reflected in my face.*
23. *My emotions are evident from the way I position and move my body.*
24. *The way I position and move my body changes my emotions.*
25. *I can tell others' emotions from the way they position and move their bodies.*
26. *I am aware of emotional climate and my role in it.*
27. *Seeking attention from others is not important to me.*
28. *Classroom interactions are characterized by winners and losers.*
29. *I meditate to manage my emotions.*
30. *I use breathing to manage my pulse rate.*
31. *I use breathing to manage my emotions.*

Figure 4.1. Characteristics in the mindfulness in education heuristic

TRYING TO START WITH A CLEAN SLATE

The brain is wider than the sky,
 For, put them side by side,
 The one the other will include
 With ease, and you beside.

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The brain is deeper than the sea,
For, hold them, blue to blue,
The one the other will absorb,
As sponges, buckets do.
The brain is just the weight of God,
For, lift them, pound for pound,
And they will differ, if they do,
As syllable from sound. (Emily Dickinson, 1830–1886; Silberstein, 2005)

Mindful education is a growing trend among educators worldwide. Richard Brady, founder of Mindfulness in Education Network, describes this pedagogical practice as an invitation to new emergent possibilities for creativity and for promoting deep understanding of course content (Brady, 2007). Mindful education uses breathing exercises as a mediation instrument to focus in the present moment. This educational approach is rooted in the traditions of Buddhism and Hinduism (Tomasino, Chiesa, & Fabbro, 2014). This new pedagogical approach to teaching and learning may be met with resistance from students and teachers. In other words, not everyone in class is receptive to the idea of incorporating mindfulness into the curriculum. Explaining to students the power of breathing meditation in the context of physiological wellness, and the benefits of mental ability to pay attention and learn, is fundamental to the integration of the approach in the classroom. Mindful education means taking in what we are learning and letting it sink into the deepest part of our consciousness, dissecting it in our mind, allowing it to exist for what it is, and being open and non-judgmental as we realize it represents something different to what we thought it meant or was. Such an approach can be quite intimidating for both teachers and students. The idea of giving up the traditional way of learning and teaching seems a bit risky, since as instructors, we must relinquish control of the class and pass on much of the responsibility for *active learning* to students. On the other hand, students may feel that too much is expected of them, and ask why they should be held responsible for teaching when the curriculum has always been presented by the teacher. This History of Science Education class has been designed to be cotaught by all class participants. In a period of fifteen weeks, controversial topics such as Evolution, race, gender, Eugenics, and other science education topics are prepared and taught by all class participants. This deliberate approach enables students to have their first teaching experience among peers and at the same time to obtain feedback about the strengths and weaknesses of their teaching style.

To ameliorate some of the misconceptions about *active teaching and learning*, discussions about the role of everyone in the class occurred often during the semester. Such discussions allow time and reflection for class participants to embrace and grow into their new role in the classroom. I look at *contemplative or mindful education* not as the only way to educate, but as a succession method, taking

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over and replacing the empirical way of learning and seeing the world. I regard mindful practices as a crucial element to understanding epistemology. Especially in science education where analysis of data measurements is often limited by a rational empirical approach, contemplative perspectives, may offer valuable insights to existing knowledge. Following this train of thought, Tobin Hart alludes to the idea that the contemplative mind has the potential of balancing and enriching the analytic. It has the potential to enhance performance, character, and the depth of students' experiences (Hart, 2004). This undertaking on educating future scientists is informed by my view on the role of the teacher to afford the limitless capacity of the students, to unveil their innate inquiry and problem solving potential, while building their science identity through self-reflection.

COMING TOGETHER BY BREATHING IN SILENCE

Our class was scheduled in the evening, and by the time we got to the classroom we were all done with a full day of activities, working, taking care of children at home, and teaching for those that are already inservice teachers, or those involved in student teaching. Some of us had to drive an hour or more to get to our class, while others dealt with New York City public transportation, which can be unreliable at times. I decided that I would start each class on a clean slate and do a six-minute breathing meditation practice before we engaged in the activities of the night. I informed class participants of the mental and physiological benefits of this practice on the first day of class. I thought those six minutes of breathing meditation seemed not only a practical way to start the class every night, but could also provide a space to set aside the activities of a busy day and focus on the work we were about to do. Before we embarked on the breathing practice, I mentioned that although the roots of this practice were embedded in Eastern philosophies and religions, our practice was absolutely secular and it was being adopted to facilitate and improve mental and physiological factors associated with learning. Nonetheless, I also said that it was an optional exercise and that if anyone decided not to participate, it would be okay and it would not affect their course grade.

Many students showed interest in doing breathing meditation. Some said that they had done it before; others asked me to guide them on how to do it, because they did not know exactly how to do it in the right way. I began the introduction of this pedagogical intervention by explaining the difference between upper chest breathing and abdominal deep breathing. As we learn from the work of Kenneth Saladin, the latter is quite effective during breathing meditation because it uses the entire lung capacity as the diaphragm and abdominal muscles pull down on the abdominal cavity, expanding it to fully inflate the lungs. As a result, the types of breath tend to be slower and deeper which allow for the delivery of larger amount of oxygen (approximately 3,000 ml of air) to the circulatory system during inhalation, hence more oxygen is delivered to the brain and tissues throughout the body and a larger amount of carbon dioxide is also exhaled from the body. In upper chest breathing, only the upper lobes of the lungs inflate while the chest expands and

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contracts causing a quicker and shorter delivery of smaller amounts of oxygen to the circulatory system during inhalation (approximately 500 ml of air) and smaller amounts of carbon dioxide are exhaled out from the body (Saladin, 2012). When it was time to meditate, students asked if I could turn off the lights, so I did. That became the routine every time I announced that it was time for silence. I reinforced every time that those that opt out of the practice, were to respect those of us that were in meditation by remaining quiet for that period of six minutes. Our breathing practice was the transition period between our day experiences outside the classroom and our experience in the classroom. By making this practice part of our daily routine, we allowed ourselves to step into a unique space, where we could be mentally open to what we were about to learn and discuss.

IT IS NOT ABOUT WHAT YOU SAY, BUT HOW YOU SAY IT!

Every night after our breathing meditation, we had a few minutes of housekeeping announcements and we also spoke about salient events of the past week. After that, student teachers presented topics assigned to them as part of their curriculum and practice of instruction. They were scheduled to coteach twice during the semester on various topics related to history of science education and the philosophy of science. After their presentation, they were given feedback about their teaching style and pedagogic method. In this class, we used constructive feedback at the end of each coteaching presentation. This scheme was adopted with the purpose of providing ideas of how to improve the way we teach and to make student teachers aware of how different activities used for teaching and learning were helpful in clarifying the material being presented. During these sessions of constructive feedback, there was always a sense of compassion for the presenters. There would always be praise on the method of moderating the class and if something needed improvement, it was always brought up in a clear and mindful manner to avoid anyone being offended. For instance, after Lucy presented, one student commented: “Lucy, I admire the fact that even though your English is not the best, you didn’t shy away from the role of actually taking a firm part and a major role in this discussion and there was no fear, so I encourage you to keep practicing and it will get better!” I thanked that student for bringing up the issue of language in her feedback. I spoke about my own experience as a non-native speaker of English, and how after many years of public speaking, I would sometimes still get nervous and even forget the words I want to use to express an idea. I reiterated to the class that it was okay to not have a perfect presentation and that we were there to learn from one another, and nervous or not, what better way to practice than in front of your peers! My goal was for the class to experience an atmosphere of cooperative teaching and learning. Anthony Lorsbach and Kenneth Tobin proposed the importance of the involvement of others’ participation, and using community of teaching and learning approaches where others’ feedback to our ideas cause perturbations that help us reflect on the conflicts, so we can then make adaptations to fit a new experiential world (Lorsbach & Tobin,

1992). How experienced and effective we become at teaching depends a great deal on the feedback we get from our peers. We can be very honest in our feedback, but the way we convey the message can either turn criticism into constructive critique or raise negative emotions in the person receiving the feedback. In this class, students were very cautious about the way they presented feedback to their peers. Many of the class participants, including me, had been introduced to the tenets of cogenerative dialogue (hereafter cogen) previously. In cogen, the discourse is dialectical and there is careful equitable distribution of talk among participants always maintaining focus on the topic of dialogue and carefully listening with the purpose of learning rather than opposing what is being said (Tobin & Ritchie, 2012). The mere fact that students were practicing mindfulness, contributed to the soft tone of voice used, the choice of words, and even facial expressions of class participants as they provided opinions on the presentations.

WHEN YOU ARE ENVIRONMENTALLY ATTUNED, YOU CAN HEAR A PIN DROP!

I often asked the class during feedback time what they would like to see in other presentations. Students gave their opinions about the structure of the presentations and how other activities may be incorporated as part of the lesson. One student in the class commented on how sometimes she was not able to hear what presenters were saying, because our classroom was next to another class that often made a lot of noise. I suggested that students who spoke softly tried to project their voice a little louder until I could find another room to conduct our class. Having this type of response from the class members is important in the development of effective teaching and learning. Students feel all class participants are involved and are really interested in everyone's point of view about the topics discussed. The way the topics are presented and the structure of the lecture is important, but so is the space where the class is conducted and the environment surrounding it. We were very much attuned to any external force that would disturb our class and our insightful conversations. Mindfulness in the classroom involves *radical listening* or paying close attention to what others are saying. *Radical listening* provides a platform where the listener can use what is being said to complement or expand knowledge. *Radical listening* was introduced to this group of students in the previous semester by Konstantinos Alexakos, who adopted the term from Kenneth Tobin as understanding and valuing the possibilities, personal values, and potential of others, and encouraging those with difference to participate and share their voice (Alexakos & Pierwola, 2013). Students who were new to the program quickly learned from their peers this term/quality and practiced it often.

AGREE OR DISAGREE?

One of the first activities done by student teachers was to read philosophical statements on education by Aristotle and Ibn Sina. Class participants were given an opportunity to agree or disagree with the statements and explain their reasons for

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their stand. This activity was a very effective way to implement radical listening and respect for others. Everyone took a minute or two to reflect on what others were reading, and then there was an orderly sense of respect in taking turns to talk and present individual perspectives about the reading. It was evident that students were paying close attention to what others were saying, because they would pick up on others' opinions to build their arguments. There was also a sense of having fun while learning. Groups of 3–4 students were formed to read and discuss what they had read; then a representative of each group was chosen to form a fishbowl activity, where they presented what was learned through the readings and group discussions. This type of team activity fostered a social interaction that otherwise would not happen in a traditional class setting. There were quite a few times each night when the class would burst into laughter when someone said something funny. This made me think that even if class participants were disconnected from the rest of events in their lives; at least for that moment they shared and were connected with the group in solidarity or what Randall Collins (2004) coined as collective effervescence.

WHAT IS GOING ON WITH THE CULTURE OF SCIENCE?

One of the topics scheduled for class discussion was the culture of science. The purpose on presenting this topic was to dig into the factors that constitute the science culture, such as the way people involved in science think and try to make sense of the world around them, the inquisitive and problem solving approach people in science use to explain phenomena, and the underlying reasoning behind natural processes. In the culture of science discussion, inservice teachers expressed how sometimes they feel a lament from their students about an inability to connect to science. This pattern of longing to connect science to life is a constant issue teachers deal with every day in their classroom. One of the presenters posed a question to the class regarding the possible ways culture affected their learning of science. The question provoked an interesting interaction among five students, in which they described personal anecdotes about their respective families' approach to learning and how this persuaded them and how it ignited their passion for learning science. One of the remarkable features of the conversation was the careful attention and radical listening that happened throughout the room. Once a student finished her own story, words of affirmation and stories told by other class participants reflected how all stakeholders were paying attention to those who have spoken before them. At one point, a student asked what the class thought was wrong with the culture of science learning. A few class participants expressed their thoughts by saying that a lot of it has to do with the fact that students don't feel that science connects to their lives and they often do not see the relevance of learning science and its application to their lives. The discussion on the issues that have shaped the culture of science provided a platform for class participants to think and reflect on the issues that the field of science education faces. Students were aware and attentive to what others were saying and they also wanted to express their views based on their own experiences as students

and as prospective science educators. I believe having reflective discussions on the evolution of science education is crucial in the preparation of future science teachers. The teacher's axiology or own experience with science has powerful value on the way science is taught. His perspective of science often contributes to their approach to teaching. After a few comments on historical events in science and the students' own experiences learning science, there were a few seconds of silence in the class. Pausing between speakers had become a common practice among the members of the class after the mindfulness heuristic was introduced. Pausing is one of the conditions for radical listening, one of the tenets of mindfulness. Radical listening is a quality of mindfulness that was constantly practiced and observed by members of this class.

I AM SO TIRED! – A PLEA FOR COMPASSION?

It was week five of the semester and we were about to get into a discussion about race and education. After our breathing meditation, I asked if someone wanted to share any news events from the past week. Someone mentioned the conflict in Ukraine and the Russian occupation of that territory. The news of the week was not uplifting and it was coupled with the harsh cold winter we were experiencing. I could see that everyone was less enthusiastic about being in class than other nights. Perhaps the gloomy mood had to do with the topic we were going to discuss. In my experience teaching, the topic of race is one of the most challenging parts of the curriculum. When race is discussed, it triggers all types of emotional arousal in class participants, and most people hesitate to express their opinion about it, whether they are white, black or any other skin color. While students were setting up their weekly coteaching presentation, a student in the back of the room commented that she was tired. I could sense an overwhelming feeling across the room. I asked if there was anything in the class that was contributing to the stress level the students were experiencing. There was silence and students were just in a quiet mood until finally one of them expressed concern about the amount of work I was requiring for the semester. I have to agree that the amount of reading and writing expected for the course was intense. Most of us are given a syllabus by the institution to follow, which includes the objectives of the curriculum. However, I felt that as the instructor of the class, I could make slight changes that are deemed appropriate, and that in this case I could decrease the level of stress to students. I decided to adjust my syllabus and reduce the number of reading and writing assignments for the remainder of the semester. I do not think I would have done this if I had not asked the class about what was contributing to their stress level. Asking students for feedback about the amount of work expected of them may not be a common practice among teachers. Yet, I believe that in this case, it was appropriate, because of the mindfulness approach I have decided to adopt when teaching the class. My interaction with students in the classroom has definitely changed since I started teaching 14 years ago. My approach to dealing with students has evolved into a more relaxed and confident relationship. I try to keep a balance between the goals

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of the curriculum and the ability my students have in understanding complex themes. Furthermore, I believe that there has been a deeper transformation in my approach to dealing with students since I incorporated mindfulness into the classroom. I have a sense of calmness, patience and compassion towards students, that I had no idea I was capable of having. I have a responsibility to educate in science, but that responsibility extends to identifying factors and challenges that may cause struggles and low academic performance of my students. A simple question on how they are doing or what they think of the organization of the course can provide me with valuable insights into students' capabilities. The design of the class to cover the curriculum through collective activities such as coteaching by all participants provides possibilities for development of teaching strategies often absent in individual teaching. Wolff-Michael Roth and Kenneth Tobin refer to this approach as a "dialectical relationship with the collective," in that individual development automatically means collective development (Roth & Tobin, 2005). In other words, we all learned in this class, including me.

HISTORY PREVENTS US FROM MAKING THE SAME MISTAKES

After our class introduction, the student-presenters for that night started a series of activities where the history of education for Blacks was discussed. Race may be considered a "thorny issue," because it often triggers feelings of tension, anger, frustration and pain among class participants. Thorny issues have been described by Alexakos and his colleagues (2016) as "sensitive and vulnerable sociocultural questions associated with identity and valance with strong emotional energy" (p. 2). Throughout the night some people expressed their views about race in relation to education, while others chose to remain quiet and just listened. The following are excerpts of a powerful conversation that happened that night.

Maria (Caucasian student): I have a question and it may be controversial. Is it completely necessary to talk about history? Not to downplay anything, but to look at the history to study the current situation? Could we have had the discussion without the history and could we in a sense advance us even more? Maria reiterates: not to forget the history ...

Kurt (Caucasian student): I know what you are trying to say, that history is holding us back a little bit. I think what history does is that it gives you a perspective about certain people like when you saw the movie, after that you understand what these people went through.

Maria: And I understand, but why can it be shown that everyone has equal footage?

Maria was trying to say that talking about race and segregation was not helping us move forward, but rather challenged the idea of equality. Angie (Black student) raised her hand and said:

Angie (Black student): I think a lot of the issues we saw today are still present, but now they are more underlying as opposed to like just out in the open, and so I feel that we have to know these things, because we won't necessarily know what to look for otherwise ... it is like saying everyone is accepted in America! But that is really not the case. You have to be able to identify what still exists through our history.

Rick (Caucasian student): The equal footing is not the question! It is that we have to address every single historical problem that we have to actually close that enmity and divide. We have to go back and bury the hatchet with every type of relationship that we have with all the groups that exist in America. And you can only do that by looking at the history between us. What is the past injury? ...

Maria: But it is not about the history! I always wonder if it is potentially debilitating in a sense ...

This was a moment of tension in the room, because in order for Rick to make a point about how hard it is to resolve conflict by ignoring history, he spoke about the ongoing Palestinian-Israeli conflict. Maria happens to be Jewish, so Rick was trying in a way to tell her how easy it was for her to talk about race and segregation when she never experienced it. On the other hand, he tried to explain with an analogous problem that she was familiar with. Rick also tried to explain some of the reasons why we cannot ignore history. Maria grew up in Pittsburgh and she mentioned that she never felt any racial tension where she grew up. She felt that it was in New York where the racial tension existed. I asked Maria whether she knew how others felt about racial issues in her community, and she responded that there were not many segregated communities, so everyone was just in one place and she could not really speak for others. Pittsburgh has been historically segregated and Maria was clearly unfamiliar with this fact. At this point, several class participants raised their hands wanting to respond to Maria's comments; Trish (Black student), Kris (Caucasian student) and others just looked around waiting for someone to say something.

Kris: I feel that not everyone is ever in one place. The readings made me think how there are even different levels of segregation and even teacher-student interactions.

Kris continues, she looks at Maria and says:

Kris: It is easy just to look past it, but once you become aware of it, you pick up on things like ... and think that we are all equal, but there are little discrepancies that if you are living in the majority are easy to overlook!

The room remains still for a few seconds until Angie breaks the silence; she looks at Maria and says:

Angie: If you haven't had a negative experience you seem to be inclined to think sort of that there are no negative experiences, and so for someone who

is a person of color who has had even a slight negative experience in their education, they automatically are very aware of it.

Angie's and Kris's comments triggered ideas in my mind relevant to our personal living space and our individual experience in relation to how others experience the same space. I was reminded of theoretical frameworks proposed by Michalinos Zembylas and Lynn Fendler (2007) when they reference bell hooks to make a point about the feeling of comfort about a place or situation based on how everyone may experience it: "the feeling of comfort has no universal applicability; there is no satisfactory basis on which to assume that an atmosphere that feels safe, welcoming, and caring to one person will feel that way to another person" (p. 325). Maria's past living environment seemed to pose no threats to her, yet she appeared to have been living in an area where she was sheltered from anything that would constitute making her feel uncomfortable, so she assumed that other people in her environment felt safe as well. Zembylas argues that when people acknowledge their difference in anything but trivial ways, those differences can be expected to be unfamiliar and very likely to be uncomfortable and disconcerting. Furthermore, people who face systemic injustices daily generally recognize that feelings of trust and safety are not prerequisites of participation, but privileges endowed by existing hierarchies (Zembylas, 2014). Although the people that had just spoken were very cautious about the way they said things, I could sense a little bit of tension in the room about the conversation that had taken place. I certainly did not want anyone to end our discussion on a bad note. I proceeded to say that there was a new type of discrimination on the rise in schools, a discrimination that involved charter schools and special education. We were to have that discussion in the following weeks, but for that night I thanked everyone for participating in a great discussion even though we were all tired at the beginning of class. We managed to have insightful conversations that allowed us to learn about others' perspectives on race: a topic that is rarely discussed in class with an open mind. Race, is a "thorny issue" for the majority of students in American classrooms. Discussing "thorny issues" in the classroom is often avoided, because such conversations usually bring pain to those that are sensitive to them or have had a negative experience in relation to the topic in question (Alexakos, Pride, Amat, Tsetsakos, Lee, Paylor-Smith, Zapata, Wright, & Smith, 2016). That night, class participants were open to explore talking about race; I sensed it was different for everyone in the room. Some dared to talk with what seemed to be the intention of healing, others with the purpose of trying to understand the underlying forces of this very difficult topic. Maybe those that stayed quiet were intimidated by what others would think of their perspectives and decided to keep their thoughts to themselves instead. I would like to think that those that stayed quiet were just trying to be mindful of others' feelings. I asked how people felt about talking about this topic. One person said that it was one of those topics that everyone would avoid. A couple of people said they felt comfortable talking about it and expressing their views. Trish said that she had to be reminded

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at one point by her co-presenter that this was a historical presentation on race and education. Trish felt very passionate about the topic and she wanted to jump right into the discussions and talk about social justice.

I said to the class how in the previous year there was a lot of tension in the room when we discussed the same topic, but I felt that this class was more open to bringing their thoughts to the table with less animosity. I thought it was definitely a moment of growth and awakening of awareness for all of us. I think it was a step forward in the realm of things, since we at least were willing to talk, listen and discuss this thorny issue, as opposed to avoiding it altogether as many still do.

MEDIATING EMOTIONAL AWARENESS IN THE CLASSROOM

It was the end of the semester and we were bringing everything we learned during the semester under the same umbrella by connecting it to ethics and bioethics in science and scientific research. However, before our discussion, I had students fill out the same mindfulness heuristic they had completed at the beginning of the semester. I also wanted to take 10–15 minutes of the class to hear about their thoughts on whether the mindfulness approach to the class mediated any transformation in the way they felt in the classroom and about teaching and learning. What was supposed to be a short feedback period, turned into at least 45 minutes of valuable reflections for students and me. In the following section, I present narratives about how my students experienced mindfulness in this and in another class as they became aware of the interactions among them and the instructors moderating both classes.

Angie started the conversation by saying that if, as a teacher, you become aware that something is bothering your students, you should address the issue immediately. She proceeded to describe an incident that occurred in another class and that involved Trish. Angie continued by saying that everyone in the class seemed to have been aware of what was happening. I asked Angie about her own feelings when the incident happened and she responded that they were of fear.

When I looked around the room, there was a smile with a touch of fear on everyone's face as if students were concerned that by talking about the story they were going to get Trish upset again. At this point, a few students expressed feelings of anger and frustration about what had transpired during the incident, but they also felt compassion and fear towards Trish. Marisol described holding her breath, lifting her shoulders as her body became tense; she said she definitely remembered those feelings.

Angie: We were all feeling her ... with her [Angie points at Trish] and it was an awkward touch!

Rick: I remember also in that same class... I remember at the end, after our presentation, she [the instructor] asked the class is everyone satisfied? And she got nothing but positive answers.

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Trish: Well, I can answer that. At the moment, I didn't feel that we had the community or she [the instructor] hadn't established a community in her class. And I didn't feel like I wanted to revisit that moment. In my head, I thought I didn't want to recreate that moment, because I knew how I would feel afterwards. Then I went and spoke to her after class about it, but at that moment I didn't feel we had established such a community with her, to open up with her and discuss those feelings.

Angie: Umh, I get that ...

According to the recount of events, Trish had done a presentation in another class where she felt she was not given an opportunity to hear feedback from her classmates about the presentation. The instructor gave Trish feedback in front of the entire class in what Trish perceived as being a very authoritative manner. This response from the professor prompted an uncomfortable moment for Trish and her classmates.

Trish: Plus, she was perched on the table in a very authoritative status and that [deep breath] did not sit well with me ... [Trish laughs and everyone follows].

Trish's description of the instructor's body position and gestures is an indication that students are quite perceptive to emotions of classroom participants as well as the moods and the teachers' predispositions towards them.

Trish: No, I was just thinking that if you [the instructor] want for us to share how we felt, it would had been nice to be seated with us, at our eye level and take away all that authority.

The conversation was a good segue to talk about body language in the classroom. Rose mentioned that when she was an undergraduate student one of her professors had said that, as a teacher, you should be aware of how you position yourself in front of your students. Rose explained that certain postures could be perceived as being closed off and could also be taken negatively by the person you are talking to. She continued to say that your body language as a teacher affects the people you are talking to. This moment made me aware of how much students pay attention all the time to the body language of their teachers. Kurt contributed to the discussion and said that every time he had to do a class observation, he always noticed that the teachers that tended to connect with students, tended to keep their hands down. These teachers gave students a little more space. They didn't come off as authoritative, but rather as somebody in the class that is just talking. A teacher's body language is readily perceived by students and may be involved in the development of different grades of emotional climate in the classroom. "Emotional Climate (EC) is the set of emotions shared by a group of individuals implicated in common social structures and process" (Barbalet, 1995, p. 23). In research conducted in a classroom in Australia by Stephen Ritchie and colleagues, using video-recorded events, students identified patterns in speech and body language that signaled how their instructor was feeling at key moments during lessons (Ritchie, Tobin, Hudson, Roth, & Mergard,

2011, p. 752). Ritchie and his associates provide concrete and clear evidence in their research that the science classroom interactions are embedded with social constructs filled interaction rituals (Ritchie, Tobin, Hudson, Roth, & Mergard, 2011, p. 762). According to Randall Collins, “interaction rituals are momentary encounters among human bodies charged up with emotions and consciousness because they have gone through chains of previous encounters” (Collins, 2004, p. 3). Identifying such interactions in the science classroom may provide insights to “teachers and researchers that can help them change negative emotional events and change them into positive valence emotions that may be beneficial to students and teachers” (Ritchie et al., 2010, p. 762).

Angie spoke about the dynamics of class presentations for the class in comparison to another class they had taken together. She talked about how the atmosphere was different. Angie used the analogy of a road test and what was expected from the evaluator to describe what the dynamics of presentations were in the other class. She said that they were expected to exaggerate their movements and expressions as they presented for the instructor to feel that they had done an effective presentation. She continued to say that in this class they just needed to present the information in a less rigid manner and there was more freedom about what students could do.

After listening to my students talk about how the opportunities given to them to express their autonomy in different contexts in the classroom have given them a sense of freedom and comfort, I feel I can’t go back to the traditional way of conducting a class. The conversation with my students had transformed the way I teach, especially the way I listen to my students! Listening to my students’ stories about the incident that transpired in another class and the way it was handled by the instructor makes me reflect on my own teaching style. I learned from the discussion I had with this group, about the importance of developing a collective dialectical relationship in any class, which may contribute to the amelioration of negative emotions and situations that often arise during class interactions.

Eva: I feel that there is a sense of community in this class. Like, we are more understanding with one another ... and it probably has to do with Olga being more understanding of our presentations and the way we envision the presentations. So, it has to do with us being more creative and not following a strict rubric that we have to go by [People in the background responding: ... yeah, yes]. And I don’t think we are publically criticized while the presentation is going on, so that we can actually perform much better ...

People in the background: ummh ... and nodding their heads as a sign that they are agreeing with what Eva is saying.

Eva’s words provided me with an idea of how students feel in my classroom. An overall sense of respect seemed to be the pattern. My classroom is a place where I feel students are given space and freedom of expressing their views without being judged in front of a crowd. I felt at that moment that what we set out to do at the beginning of the semester had worked! I was hearing from my students in their own

words, how the approach we have taken on mindfulness practices in the classroom enabled us not only to learn from one and other, but also to transform the way we teach and learn! However, when I looked at heuristic-2 output completed by class participants at the end of the semester I was confused. Six class participants chose responses reflecting a shift of mindful mindset in a negative way. What was surprising to me was that the data conflicted with the feelings these students had expressed during cogenerative dialogue about how comfortable they felt in my class.

Kurt: I was in another class when somebody was presenting and their presentation wasn't really going well and you can tell that they really didn't get what they were supposed to be doing and the teacher was kind of on top of them, like you should be doing this, you should be doing that and what that did for me was that it totally took my mind out of the learning that was going on and the topic that she was presenting and it made me think more of what was going on and how she was feeling and I think a lot of people in the class felt like that as well ... so I think that ... to me that rigid kind of stuff doesn't work! It clams out on creativity; it puts off kids, or students that might be shy ... I feel like it creates a bad classroom atmosphere ...

Kurt was referring to how the emotional climate (EC) in the classroom can drive the way students learn and the overall dynamics of the class. A study by Alberto Bellocchi and colleagues (2013) on EC in a preservice teacher's class, suggested that positive EC was associated with classroom interactions in which the students and professor were engaged in dialogue. "A decrease effect on EC appeared to be indicative of instances of monologues by students and the professor" (Bellocchi, Ritchie, Tobin, King, Sandhu, & Henderson, 2014, p. 1307).

Olga: I agree, last year I had the same class and I had a student that in the middle of a presentation ... it was the first time that these two girls were presenting and in the middle of ... one that is very shy, this other student went: "that is not true" that is not that way! And I said, can you please have a little bit of respect for those that are presenting and maybe at the end you can give your feedback? I did have a conversation with this person, because as a teacher you need to have that ... compassion for your students and I think it is a quality that ... you can work on that, but sometimes we are not aware of that and I find that a lot among science people ... not that they interrupt and that they don't respect, but ... they want to get to whatever is correct, and so I think this class [pause] ... learning about the philosophy of science and seeing the scientist more as a human being ... helps us realize all of these things that we may not be aware of ... and that we may do wrong maybe ... in the classroom ... to be more compassionate about our students and not to be so judgmental.

Olga: Sandy you mentioned that in the past you were very strict and that if a student ...

Sandy: Yeah ... I learned not to take things personally in the classroom. Over the years, working in school or in summer camp, I used to think that kids were misbehaving or being rude to me and when I learned to separate that, I realized that they are just being kids and they just behave like that. It helps me a lot in managing my emotions and how I react to them ... I respond to them as their teacher, not as someone who is being affected by them.

An important aspect of dealing with emotions in the classroom is to be able to take others' perspectives with an open mind and not take responses or input from others in the class in an antagonistic way or as a personal attack.

Thea: Sometimes, students come and apologize to me about their behavior and I tell them: "next time don't apologize, just behave. You make me feel like a bad teacher" ... and that hits them and it's like ... "no, you are not a bad teacher." That sort of puts things in perspective and they see then I am not just a robot standing in front of them and that I am human, so they get it...

Sandy: I was in charge of 150, 5th graders this past summer and I used to get very upset when they did something they weren't supposed to do...

Angie: I have a question [She directs her question at Sandy]. So if you are put in that situation now, do you think now, you will act differently? You just would not?

Sandy: No, I won't let it bother me. If you want to keep doing that, it is not going to bother me. I will just concentrate my efforts on the kids that want to be there and want to collaborate. If you let it bother you, they are just going to keep doing it ... sometimes kids just want to bother you ... [Laughs]

Olga: Yes, I mean, you really need to find a balance as Thea was saying, and set your boundaries, you know. Especially with kids, sometimes they just want to play and may not want to do the work ... But there is a different way of approaching your teaching, and that is also something that I learned when I started working with Konstantinos and Ken Tobin ... umh. I used to be very explosive and show my feelings and now ... I try to step back a little, you know ... People are coming from work, they are coming tired, they have, not just this class, but they have many other classes, and so I understand. It is just the way it is ... It is kind of developing that compassion and I think everybody is capable of doing that if they want to.

FINAL THOUGHTS

After my last conversation with the class I analyzed data sets associated with two administrations of the mindfulness heuristic at the beginning and at the end of the semester in order to ascertain whether there were any differences in the participants' responses as mediated by mindfulness interventions enacted throughout the semester.

Here, I present a comparison of heuristics 1 and 2 (H1 & H2); the frequency of the type of response and the percent of responses chosen by each class participant when responding to 31 characteristics. The data were responses from each class member to heuristics one and two (H1 & H2), completed at the beginning (H1) and at the end of semester (H2). Choices in the responses scale 1 = never/very rarely and 2 = rarely are interpreted as selections representing none or rarely experienced mindful mindset. Responses 3 = sometimes, 4 = often, 5 = very often are indicative of an improvement or the presence of a mindful mindset.

Comparison of overall data (Table 4.1) indicates that at the beginning of the semester (H1) the class's overall responses to a mindful mindset was 74%, while at the end of the semester (H2) the overall class mindful mindset had increased to 82%. Heuristic 2 responses for Maria, Sandy, Shirley, Rick, Tere, Lucy, Marisol, Guy, and Holly suggest an increase in awareness about their emotions, breathing, and awareness about their surroundings and others in the class in comparison to their responses to heuristic 1 taken at the beginning of the semester (see Table 4.1). According to the

Table 4.1. Heuristic -1 versus heuristic -2 output comparison among class participants (1=never/very rarely, 2=rarely, 3=Sometimes, 4=often, 5= very often, always)

<i>Students</i>	<i>Heuristic 1</i>	<i>Heuristic 1</i>	<i>Heuristic 2</i>	<i>Heuristic 2</i>	<i>Observed change</i>
Maria	22.60%	77.40%	9.70%	90.30%	↑
Sandy	45.10%	54.90%	35.50%	64.50%	↑
Shirley	25.70%	74.30%	3.20%	96.80%	↑
Rick	45.10%	54.90%	35.50%	64.50%	↑
Tania	19.40%	80.60%	19.40%	80.60%	no Δ
Kris	0%	100%	0%	100%	no Δ
Tere	16.30%	83.70%	6.40%	93.60%	↑
Thea	12.80%	87.20%	12.90%	87.10%	↓
Lucy	16.10%	83.90%	12.90%	87.10%	↑
Kurt	9.70%	90.30%	16.10%	83.90%	↓
Marisol	6.40%	93.60%	3.30%	96.70%	↑
Guy	48.40%	51.60%	45.10%	54.90%	↑
Holly	9.70%	90.30%	3.20%	96.80%	↑
Angie	22.60%	77.40%	29%	71%	↓
Trish	32.20%	67.80%	41.90%	58.10%	↓
Eva	9.70%	90.30%	16.10%	83.90%	↓
Rose	19.30%	80.70%	25.80%	74.20%	↓

data output of H1, Tania and Chris were very much in tune with mindfulness at the beginning of the semester and remained the same as they completed heuristic 2 at the end of the semester. Conversely, Thea's frequency of responses to heuristic 2 decreased by 0.1, when compared to her responses for heuristic 1. Also, Kurt's, Angie's, Trish's, Eva's, Rose's responses to heuristic 2 for choices indicative of an increase in mindfulness decreased by 6.4 (Kurt, Angie, & Eva), 6.5 (Rose) and 9.7 (Trish) compared to their responses to heuristic 1. The results above indicate that while 12.5% of class participants (Tania & Chris) considered having and sustaining a mindful mindset throughout the semester, 37.5% of class participants (Thea, Kurt, Angie, Trish, Eva & Rose) did not appear to gain significant benefit from the mindfulness intervention. However, 56% of class participants (Maria, Sandy, Shirley, Rick, Tere, Lucy, Marisol, Guy, & Holly) appeared to have benefited from the mindfulness pedagogic approach implemented in the class by becoming more mindful and aware of their emotions and the emotions of their peers (Table 4.1). Class participants seemed to be more in-sync with the rest of the class at the end of the semester. A greater number of participants appeared to have made use of the tools provided to them during teaching and learning, while dealing with the complexities and arousals of their emotions as controversial and difficult topics were discussed throughout the semester.

As a teacher, it is always pleasant to have feedback from students about one's pedagogy and overall class environment. Although, we like to hear that our students enjoy the environment we try to co-create with them in our classes, it is of crucial importance to look at the nuances and contradictions in some of the statements students make, in this case in the context of the mindfulness heuristic. Such nuances may be embedded with underlying issues that were not made evident to me (the course moderator), but may have been expressed indirectly in the responses in H2. After analyzing the results of the outputs/responses to H2, I was faced with a data set that contradicted the narratives of six students about their views on mindfulness in my class. My take on the contradictions between students' narratives and the data output is one that may involve existing inhibitions when expressing perspectives on controversial issues and not feeling comfortable expressing their full opinion on the issue being discussed. Coincidentally, the class participants that were more vocal expressing feelings of unhappiness and struggles with power dynamics in another class, as well as overall feelings of segregation presented earlier in this chapter, were those that had a decreased output in mindfulness mindset in H2. This contradiction triggers an open question: How can I make everyone in my class feel completely comfortable to the point that they can express both positive and negative emotions without feeling inhibited by the presence of others? I think there is always room for improvement in the way I provide a safe space to all stakeholders in my class. I continue to work towards providing and hopefully achieving a significant level of comfort that is equally perceived by all students in other classes.

Integrating mindfulness in teaching and learning through heuristics, radical listening, breathing meditation, compassion for others, and collaboration among peers, can promote an environment of wellness that extends beyond the classroom setting. The benefits of experiencing care and mindfulness by the people you interact with, not only will make people feel good in the moment, but will have long lasting effects. My first exposure to mindful approaches in science education was in Konstantinos Alexakos's 2012 graduate course of History and Philosophy of Science Education at Brooklyn College, CUNY. Alexakos and Ken Tobin from the Graduate Center designed a research project that involved approximately 19 Brooklyn College preservice teachers and about 6 PhD students. Their goal was to promote authentic research (Elmesky & Tobin, 2005) in the classroom that would have transformative ripple effects for the participants. In authentic research the researchers change their constructions as a result of doing the research; and one of the benefits is that, "it is educative to all of the participants and catalyzes changes that afford the goals of the participants" (Elmesky & Tobin, 2005, p. 811). I am a teacher researcher at a Community College and I continue to be transformed through mindful teaching and learning. I try to learn from the positive and negative emotions and experiences that arise in my classroom by reflecting on the transmuting possibilities of my praxis and that of those I come in contact with. For me, as an academic, the goal of growing as a compassionate teacher is fundamental to keeping my brain healthy and happy. Rick Hanson and Richard Mendius (2009) use garden and gardener analogy to describe the work we do to keep our brains healthy and happy. They state that our mind is like a garden and we could simply be with it, and observe its weeds and flowers without judging or changing anything. However, we could choose to pull weeds by decreasing what is negative in our minds. Conversely, when we take in positive experiences, we are not only growing flowers in our mind, we are growing new structures in our brain, but also hardwiring happiness (Hanson & Mendius, 2009). Rick Hanson and Richard Davidson have done extensive research on experience-dependent neuroplasticity. Mindfulness meditators increase grey matter, which means changes in three different regions of the brain associated with attention and tuning into others and to us. Research suggests that as synapses intercept, a signal reaches down to the DNA in the nuclei of our neurons and changes how genes operate. For example, if we routinely practice relaxation, the activity of genes that calm stress reactions will increase, making us more resilient (Hanson & Mendius, 2009).

The boundaries of emotions in education have been delineated by the agendas of political interests, by omitting emotional responses to social injustices and inequality. Historical narratives on how scientific discoveries came to be, including the biographies with the struggles and successes of important science contributors are crucial to the education of teachers, because they greatly complement and contribute to the development of the science educator. A reflective approach to emotion such as mindfulness in science teaching and learning is not only necessary in the education of teachers, but also fundamental in the holistic growth of the teacher as a person.

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