Chapter x

Heuristics for Mindfulness in Education and Beyond

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Abstract: Mindfulness may be a powerful tool in raising awareness of and ameliorating intense emotions that often accompany teaching and learning. One way to introduce mindfulness into the classroom is through a heuristic. Heuristics afford changes in practice by mediating reflexivity. Therefore, we refer to a heuristic as a low-grade intervention. In this chapter, I describe our hermeneutic approach to the development of a mindfulness heuristic. Included are three iterations of the heuristic and an account of how they evolved. I emphasize the flexibility and adaptability of heuristics, which make them easily applicable to various contexts.

Keywords: Mindfulness • Heuristic • Emotions • Reflexivity • Low-grade intervention

"Teaching Should Not Make You Sick"

In our research conducted in a graduate science education course, we discovered that often when students cotaught classes, their heart rates and oxygenation of the blood reached dangerous levels (Alexakos and Tobin, forthcoming). We considered these physiological markers as manifestations of heightened emotional states associated with teaching. Many of the study participants were unaware of the impact of emotions on their physiology and expressed a profound surprise when faced with this realization. Jonathan Turner (2002) and Randall Collins (2004), who argue the primacy of emotions in human interaction, confirm that much of what happens in social life happens without conscious awareness. We are often unaware and inattentive to the moment-to-moment emotional states that accompany our experiences. If sustained and not regulated for extended periods of time,

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negative emotions may inevitably lead to poor health. Richard Davidson, a leading scholar of affective neuroscience, provides evidence that human emotions may be the most powerful influence on our physical health (Davidson and Begley 2012). In the field of education, a potential result is a well-documented high teacher turnover as reported by Richard Ingersoll and David Perda (2010) as well as absenteeism among students such as that described in the study by Kenneth Tobin, Gale Seiler, and Edward Walls (1999).

Since we believe that teaching should not put in jeopardy the health of teachers or students, we undertook research promoting self-awareness of emotional states. Our research was conducted with 19 pre-service and in-service science teachers of diverse cultural, ethnic, and racial backgrounds at a large, urban, public college in the Northeast. I was among the group of Ph.D. students invited to collaborate on this project by the principal investigators Kenneth Tobin (my advisor) and Konstantinos Alexakos (the class instructor). Our aim was to develop interventions that would allow teachers (and students) to monitor their emotions, to counteract their negative impact and to maintain wellbeing. We are among a growing number of educators who believe that mindfulness, through raising awareness, may be a powerful tool in shaping our emotional states. We decided to introduce mindfulness into the class through the use of a *heuristic*, which we refer to as a *low-grade intervention*. A low-grade intervention relates to a construct illustrated in the heuristic by a set of characteristics, which are salient to the contexts in which the construct is applicable. In this chapter, I discuss our approach to theorizing, developing and applying a mindfulness heuristic. The roles of reflexivity, contingency, and interpretive inquiry, all essential to our methodology, are emphasized.

Introducing Mindfulness Reflexively

A multi-faceted, subtle and somewhat elusive construct, mindfulness may be challenging to explain. One analogy to how our minds work is that of a DVD player. We often find ourselves in a fast-forward (thinking about the future) or rewind (focusing on the past) mode rather than being in the moment. In other words, we experience what is often referred to as *mind wandering*. Amishi Jha (2012) points out that while mind wandering may have some benefits, it is associated with difficulties performing current tasks. The trick is to be able to focus our mind on the present experience and that is where mindfulness may be of assistance. Jon Kabat-Zinn (1994), a leading mindfulness scholar, defines mindfulness as paying attention in a particular way: on purpose, in the present moment, and non-judgmentally. Since there is growing interest in secular applications of mindfulness, Scott Bishop and his colleagues (2004) convened a panel of researchers who reached consensus on the various components of the construct and developed its operational definition. The focus was on providing greater precision and specificity of the construct and on facilitating its measurement development and hypothesis testing. The group proposed a two-component model of mindfulness. The first

component involves self-regulation of attention so that it is maintained on immediate experience, thereby allowing for increased recognition of mental events in the present movement. The second component involves adopting a particular orientation toward one's experiences in the present moment, an orientation characterized by curiosity, openness, and acceptance. Kabat-Zinn (2003) refers to this second component as "an affectionate, compassionate quality within the attending, a sense of openhearted friendly presence and interest" (p. 145). To Gordon Marlatt and Jean Kristeller (1999), mindfulness involves observing one's experiences "with an attitude of acceptance and loving kindness" (p. 70). According to Sue Kraus and Sharon Sears (2008), "one metaphor for mindfulness is a bird, with one wing of awareness and the other wing of compassion" (p. 170). Unless awareness and compassion are in balance, the bird of mindfulness cannot fly.

Awareness and acceptance rather than avoidance and suppression may prove effective in alleviating negative emotions. For example, Turner (2002) finds that defense mechanisms to mitigate the effects of negative emotions such as repression, defensive attribution, projection, and displacement are counterproductive to the smooth flow of an interaction. Instead, says Turner, "if individuals are successful in overcoming their pain, they will typically experience pride that can work to tear down the defense regime" (p. 91). We maintain that one way to overcome pain is through being mindful of one's emotions. Through mindfulness meditation, one may practice observing thoughts, feelings, and sensations moment by moment and nonjudgmentally, viewing them simply as they are: thoughts, feelings, sensations, nothing more and nothing less.

A relationship between emotions and conduct is a big part of mindfulness. Although it may be difficult to do, the idea is to recognize emotions as they present themselves, name them, and let them go. If emotions are stuck to conduct then agency may be used to separate them. Usually examples are given concerning anger in its low-grade forms that express frustration. Consider Rey Llena, a teacher-researcher in many of Tobin's studies on emotions and author of the opening quote to this chapter. In Rey Llena's case the strident anger he exhibited as he taught continued to be expressed hours, days, and weeks later (Tobin and Llena 2012). It was like the social resonance that occurs when structures similar to those associated with the initial expression of anger reappear. Structures that serve as sites for resonance might include the same person or persons associated with the initial event in which the emotions were generated, a friend of that person or those persons, a similar prosodic pattern, and even the same classroom (Tobin, personal communication, February 19, 2012). Rey's sustained inability or perhaps his unwillingness to regulate his emotional states had serious negative implications for his physical health.

The Hermeneutics of Mindfulness

A major feature of our mindfulness heuristic was reflexivity, or becoming aware of the unaware (Bourdieu and Wacquant 1992). We theorized that once research participants (or students in the classroom) became aware of the different characteristics in the heuristic, we would witness evidence of awareness about mindfulness in their language and practices. We believed that encouraging greater mindfulness among teachers and students would assist them in regulating emotions that accompany teaching and learning. The respondents commented that the heuristic made them think and internalize their feelings; made them stop and think more and be more reflective than they usually were; made them think of things they never thought about; made them think about themselves. Thus, it was evident that the heuristic successfully mediated reflexivity since it actually worked as an enhancer of self-awareness.

There was a history to our use of heuristics. Over a decade earlier, during his close collaboration with Wolff-Michael Roth, Tobin developed and used heuristics as pedagogical tools with pre-service teachers in the Teacher Education Program at the University of Pennsylvania and with inner city school students in Philadelphia. Examples of heuristics that he developed at the time include *Heuristics for Productive Coteaching* and *Heuristics for Productive Cogenerative Dialogue* (Roth and Tobin 2002). The heuristics were generated by closely examining videotapes of coteaching involving new teachers, supervisors, and researchers. The heuristic characteristics were meant to capture practices that occurred during effective coteaching (such as *willingness to step back* and *tolerance of others' actions*) and could be used for planning and enacting such practices.

The development of a heuristic for mindfulness built on Tobin's earlier work. Tobin would also play a pivotal role in our efforts of theorizing the construct. To make the heuristic meaningful, our approach to developing the heuristic was collaborative, polysemic (involving multiple-meanings) and polyphonic (multiple-voiced). The major contributors to the development of the heuristic were the pre-service and in-service teachers who participated in our study at the time. We also extended an invitation to collaborate on the mindfulness project to scholars who worked at universities in the US and in different parts of the world. From the very onset of our study, we envisioned it to have a global reach and to become an international study that examined mindfulness in a variety of different contexts related to science education. Hence, we foresaw working with colleagues to develop contextually relevant heuristics. Many of the colleagues embraced the idea as evidenced in the following comment:

> I find your work on mindfulness most interesting and it relates well to some of my own reading of the crucial role of emotion in maintaining attention – a necessary prerequisite for any learning. Mindfulness, then, relates to awareness of emotions and focusing on it could be useful for students and classroom teachers in 'accessing' emotions of their own and their students to facilitate learning.

Because yoga practitioners deal with mindfulness much of the time, we considered it important for our study to involve people in our professional and personal

Table 1: Meanings of seven facets of mindfulness.

Mindfulness Facet	**Relevant Scale**	**Meaning of the Facet**	**Example of a Characteristic as Used in our Heuristic**
Observing	FFMQ	Includes noticing or attending to internal and external stimuli, such as sensations, emotions, cognitions, smells, sounds, and sights.	12. I pay attention to sensations, such as the wind in my hair or sun on my face.
Describing	FFMQ	Refers to labeling observed experiences with words.	2. I'm good at finding words to describe my feelings.
Acting with awareness	FFMQ	Includes attending to the activities of the moment and can be contrasted with automatic pilot, or behaving mechanically, without awareness of one's actions.	3. When I do things, my mind wanders off and I'm easily distracted.
Non-judging of inner experience	FFMQ	Refers to taking a non-evaluative stance toward cognitions and emotions.	4. I criticize myself for having irrational or inappropriate emotions.
Non-reactivity to inner experience	FFMQ	Is the tendency to allow thoughts and feelings to come and go, without getting carried away by them or caught up in them.	5. I perceive my feelings and emotions without having to react to them.
Curiosity	TMS	Reflects interest and curiosity about inner experiences.	7. I am curious to see what my mind is up to from moment to moment.
De-centering	TMS	Emphasizes awareness of experiences without identifying with them or being carried away by them.	33. I am aware of my thoughts and feelings without over identifying with them.

networks who practiced yoga. Also, because these individuals understand mindfulness in ways that are probably deeper than those of other people, they might be

able to provide input that would broaden the construct.

In order to engage these different voices in the conversation about mindfulness and heuristics, we utilized on-line resources including the SurveyMonkey® and email communication. We also discussed the heuristic in the graduate classes where we conducted our study as well as during research squad meetings and larger gatherings such as monthly USER-S (Urban Science Education Research Seminars) forums. Established by Tobin in 2004, USER-S provided an ideal platform for exchange of ideas in the research community.

First Iteration of the Heuristic

Since Tobin asked me to take the lead on the development of the heuristic, my first instinct was to review the extant literature. Knowing that in its format our heuristic would resemble a survey, I identified several mindfulness-related scales whose reliability and validity evidence appeared to have been well established through multiple studies. In my search for the broadest construct possible as a starting point, I chose to focus on two surveys: the Five-Facet Mindfulness Questionnaire or FFMQ (developed by Ruth Baer, Gregory Smith, Jaclyn Hopkins, Jennifer Krietemeyer, and Leslie Toney (2006)) and the two-factor trait version of the Toronto Mindfulness Scale or TMS (as proposed by Karen Davis, Mark Lau, and David Cairns (2009)). When combined, the two scales offered seven facets of mindfulness: observing, describing, acting with awareness, non-judging, non-reacting, curiosity and de-centering (see Table 1 for definitions of the seven facets as offered by Ruth Baer, Erin Walsh, and Emily Lykins (2009)).

Typically, in contemplative-related psychology literature, scales, questionnaires or surveys are developed, validated and utilized to provide self-reported measurement of mindfulness pre- and post-intervention. The idea is to empirically demonstrate the effectiveness of the treatment in raising levels of mindfulness. For example, James Carmody and Ruth Baer (2008) demonstrated significant increases of scores as measured by the FFMQ administered to individuals before and after they completed MBSR (Mindfulness-Based Stress Reduction) program. In light that our heuristic was meant to act as an intervention in its own right, our major concern was not with using it to document the pre/post-treatment difference. Establishing causality (the direct effect of the intervention) was not central to our hermeneutically driven research and we were not focused on measuring the levels of mindfulness or on developing an all-encompassing definition of it. Instead we saw our heuristic as generative in the sense that once a person read the characteristics and responded to them, the characteristics became objects for reflection and changes in practice. In other words, completing the heuristic would provide a context for reflexive changes.

Having selected 5 characteristics for each mindfulness facet, we generated a 35-characterisic multidimensional instrument complete with a 5-point Likert scale (see Figure 1). We were interested not only in the relationship between how peo-

ple rated themselves vis-à-vis mindfulness but also in their concepts of spirituality, meditation and emotions. Additionally, in our hermeneutic approach, it was essential to allow for comments regarding the experience with the heuristic. Consequently, relevant open-ended questions were added.

Even though the resultant instrument looked like a survey, its different purpose made it something radically distinct. The inclusion of a rating scale with each characteristic is meant to assist in creating a personal bond between each individual and a particular mindfulness characteristic. A respondent thinks briefly about each characteristic in relation to his/her own conduct and chooses a point on the rating scale to represent the extent to which he/she enacts that characteristic. It

Figure 1: Characteristics in the first iteration of the Mindfulness Heuristic.

1. When I'm walking, I deliberately notice the sensations of my body moving.
2. I'm good at finding words to describe my feelings.
3. I do not allow myself to get distracted from the task at hand.
4. I don't criticize myself for having irrational or inappropriate emotions.
5. I perceive my feelings and emotions without having to react to them.
6. I have a hard time separating myself from my thoughts and feelings.
7. I am not curious to see what my mind is up to from moment to moment.
8. It is hard for me to put my beliefs, opinions, and expectations into words.
9. I do not feel the need to judge how I feel.
10. I seek to control unpleasant thoughts and feelings.
11. When I have distressing thoughts or images, they tend to consume me.
12. I rarely notice the wind in my hair or sun on my face.
13. I focus consciously on everything I do.
14. I am not curious about my thoughts and feelings as they occur.
15. When I'm terribly upset, no words can describe how I feel.
16. I make judgments about whether my thoughts are good or bad.
17. In difficult situations, I can pause without immediately reacting.
18. I remain curious about the nature of my experiences as they arise.
19. I am more invested in just watching my experiences as they arise, than in figuring out what they could mean.
20. I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing.
21. My natural tendency is to put my experiences into words.
22. I rush through activities without being really attentive to them.
23. I approach my experiences by trying to accept them, no matter whether they are pleasant or unpleasant.
24. I am curious about my reactions to things.
25. I notice the smells and aromas of things.
26. I do jobs or tasks automatically without being aware of what I'm doing.
27. I am curious about what I might learn about myself by just taking notice of what my attention gets drawn to.
28. I think some of my emotions are bad or inappropriate and I shouldn't feel them.
29. I tend to react strongly to distressing thoughts and/or images.
30. When I have distressing thoughts or images, I judge myself as good or bad, depending what the thought/image is about.
31. I have trouble noticing visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow.
32. I can usually describe how I feel at the moment in considerable detail.
33. I am aware of my thoughts and feelings without over-identifying with them.
34. I find myself doing things without paying attention.
35. When I have distressing thoughts or images, I just notice them and let them go.

may be of little significance whether the selected point is an accurate reflection of how the person actually conducts social life. As long as the description of the characteristics and the associated rating scale assists in creating a personal bond, the objective has been met. As a person subsequently enacts social life, it is possible that this characteristic frames what is happening. In other words, associated interactions that are salient to this characteristic might be undertaken with greater awareness of the phenomenological *what happens* and the hermeneutic *why it happens*. We are not arguing that this occurs in a deterministic way but rather that heightened awareness about (in this case) the construct of mindfulness in terms of a diverse set of characteristics is an affordance for making sense of social life through mindfulness (Tobin, personal communication, October 23, 2012).

Emerging Patterns

Along with our collaborators, we quickly identified areas where the heuristic needed improvements. Many respondents were distracted by what seemed like repetition. This was particularly true for characteristics sharing the same stem as in #11, 29, 30 and 35 all beginning with a clause: *When I have distressing thoughts or images*. Understandably, even though it was not our intention, the respondents often assumed that the repetitive/redundant structure was done on purpose in order to increase validity and to strengthen internal consistency. While these are important objectives for surveys, they tend not to be for heuristics.

Wordiness and excessive length as well as lack of clarity of some characteristics emerged as problematic. Accordingly, the respondents commented that some characteristics were too long, too wordy, too whimsical, too esoteric, difficult to respond to, unclear, confusing and not easily identifiable with other characteristics. One such case was characteristic #6: *I experience my thoughts more as events in my mind than as a necessarily accurate reflection of the way things 'really' are*.

Another challenge in the heuristic was that as many as ten characteristics were categorized as *reverse scored*. Therefore, they were negative characteristics as far as mindfulness is concerned. For example, characteristic #3: *When I do things, my mind wanders off and I'm easily distracted* refers to a mind wandering and inability to focus which is typical of non-mindful conduct. Similarly, characteristic #4: *I criticize myself for having irrational or inappropriate emotions* does not agree with mindfulness, which is characterized by acceptance of all emotional states and an effort to refrain from judging oneself. We felt that the reverse-scored characteristics did not align well with the reflection-invoking function of a heuristic. Reflecting on what mindfulness is rather than what it is not made more sense. We thought that alignment with the mindfulness construct was what should set our tool apart from a survey that adheres to certain psychometric features.

A further limitation of this version of a heuristic was that some characteristics combined distinct concepts such as 1) *feelings* and *emotions* as in #5, 2) *thoughts*

and *feelings* as in #33, or 3) *thoughts* or *images* as in #11, 29, 30 and 35. We agreed with the collaborators who noted that some words whose meanings were close to each other appeared as if they were interchangeable. Characteristic #8: (*I can easily put my beliefs, opinions and expectations into words*) may be representative of this issue. We decided that for clarity purposes each of the distinct ideas needed to be teased apart and included in separate characteristics.

Finally, we received a fair number of comments regarding the rating scale. Some respondents were uncomfortable with *never* and *always* being part of the scale. In addition, a suggestion was made to remove the word *true* from the scale and just retain frequency words. This comment aligned well with our stance that rejects ontological realism in favor of polyphonia. We accepted the suggestion that the scale should be reversed, starting with "positive" and ending with "negative", i.e., from *very often* to *very rarely*. The flexibility of a heuristic includes changing the nature of the rating scale and even forgoing the rating scale if a person does not want to use it. In fact, a heuristic could be delivered as a narrative or a story that might be appealing to different audiences including young children or senior citizens.

Ever-Present Contradictions

While the majority of our colleagues enthusiastically embraced the process of the heuristic development, at least one of them challenged our seemingly "unmindful" and "scientific" approach to discussing mindfulness. At that stage we were fully aware that our efforts to make mindfulness concrete by identifying facets of mindfulness might be perceived as incomplete and reductive. Furthermore, identifying 35 characteristics for those facets was even more reductive. We did not want to take an essentialist stance that we had fully described mindfulness in terms of seven facets and associated characteristics. On the contrary, we began with the idea of transcendence and the benefit of offering insights by providing descriptions of what mindfulness was and was not even though this could never be determined fully by categories and lists. Like any other concept, once a person starts to build up a repertoire of what belongs to it and what does not belong, there is a growing hermeneutic awareness that begins to define the construct in ways that are fluid and dynamic (Tobin, personal communication, February 19, 2012).

Another contradiction came from one of the avid yoga practitioners who felt that the instrument fell short of meeting its goal. While others pointed to the extensive length of the heuristic, he found it to be short in terms of getting an accurate assessment of people's "true mindfulness." He advocated that a more meaningful heuristic would be possible if more questions were to be put forth in different ways. This comment resonated with us and, ultimately, we expanded the heuristic to include dimensions of mindfulness (such as loving kindness and compassion) that were missing from its early iterations.

Consistent with the emergent design of our interpretive research (Erickson, 1998), we expected and were open to making evolutionary adjustments to the mindfulness heuristic. This approach is grounded in our axiological stance that values difference and complexity as a resource for learning (Tobin, 2010).

Second Iteration of the Heuristic

In addition to gathering and analyzing the comments made by our respondents, we decided to take advantage of the quantitative data obtained through the use of the rating scale. We were curious to see if analyzing underlying statistical structures might assist us further in refining the heuristic. Using SPSS, we performed factor analysis of 37 responses to the heuristic and arrived at a 6-factor solution. At this stage, we thought it was useful to retain all six of these factors and to sharpen the characteristics accordingly. In addition, the factors could be used as a basis for selecting characteristics to provide a shorter version of the mindfulness heuristic. Because of the way they were selected, these characteristics could be used heuristically to think about mindfulness but we did not expect them to load on a single factor and nor did we expect them to aggregate together to form a measure of mindfulness. In other words, psychometrically it made more sense to consider a construct that was multidimensional in nature. It would not be appropriate to sum the scores provided on the heuristic to obtain a single measure of mindfulness. Instead there was at least an empirical rationale for producing separate scores for each construct.

Following Frederick Erickson's (1998) recommendation, we were now armed with a variety of kinds, sources and amounts of evidence and ready to proceed with transforming the heuristic. Statistical analyses were not laid out as evidence for any particular stance but instead they were meant to be used to show patterns and contradictions that provided alternative insights into the construct of mindfulness. It was never our intention to present any of the analyses as truths and we did not search for coherence among the different analytical tools we used. Once again, our stance was part of an axiology that is neither monosemic nor monophonic but radically polysemic and polyphonic.

Upon closer inspection, we discovered that our statistical outcomes were not in alignment with the respondent comments. In many cases, characteristics that loaded most heavily on a particular factor were "flagged" as problematic by our collaborators. It was becoming more and more clear that the heuristic was in need of a major overhaul and it made little sense to try to "rescue" any particular characteristics drawn from the original pool. To that end, it was time to finally bid farewell to the psychometric characteristics in our tool, starting with the elimination of characteristic redundancy as well as removal or re-wording of the reverse-scored characteristics.

A feature of a heuristic that makes it different from a survey is that characteristics are selected to cover the field of the construct, making sure that characteristics positioned around the boundaries as well as those in the center are included. That

is, a heuristic pays attention to difference as well as central tendency. Making sure that characteristics are coherent, in the way that the items that define a survey should be coherent, is not a goal. Instead care is given to make sure that characteristics that are "the essence" of a construct are represented in the heuristic.

As we were breaking ties with anything that might suggest our heuristic having any psychometric aspirations, a few of us participated in the Annual Conference organized by the Mindfulness in Education Network. There we came in contact with the work of Sharon Solloway, the author of the Solloway Mindfulness Survey (SMS). Similar to us, Solloway conducted studies with students in a preservice teacher education program (though in her case the participants were in an undergraduate program). She argued that mindfulness practice is measurable, teachable and learnable, and may be an object of experimental research. Additionally, like us, she and her collaborator developed the scale through a hermeneutic integration of qualitative (drawing on students' journal entries) and quantitative (using Rash model) processes (Solloway and Fisher 2007). Solloway claims that this approach allowed her to translate the cumulative voices of her students into a scale that corroborated their journal entries retaining the individuality of experience just as the journal entries did. When we reviewed her scale, we were drawn to the idea that for some of the SMS items, the respondents were asked to describe in their own words what the item meant and to write an example from their life. Since we were deeply concerned with creating opportunities for reflective pauses, we decided that we would provide space for free-flowing reflections over each of the characteristics in our heuristic. Such an approach would allow for making even deeper connections with each mindfulness trait.

A strong influence on reshaping the heuristic came from Richard Davidson's seminal work in *affective neuroscience* (the study of the brain basis of human emotions). In his 2012 co-authored book, that was released as we were engaged in our research, Davidson identified unique neural signatures for *Emotional Styles* that underlie human personalities and traits. Davidson demonstrates the power of neuroplasticity (the brain's ability to change its structure and function) in altering Emotional Styles through contemplative practices such as mindfulness. For example, *resilience* is a measure of how quickly one recovers from adversity. Davidson's experiments show that strengthening and increasing the connections between the left prefrontal cortex and the amygdala through mindfulness practices can increase resilience.

This idea that our Emotional Styles can be transformed through practices that modify our brains has very important implications for education. For example, a teacher's (or a student's) low *outlook* (inability to maintain a positive emotion) or poor *attention* skills (how sharp and clear one's focus is) may have devastating consequences for school performance. Both *outlook* and *attention* may be improved through mindfulness meditation, which fosters concentration, promotes compassion and kindness, and consequently may create a happy and optimistic classroom in schools. Davidson's findings resonated with us in light of our work on emotions in education and our interest in self-regulating emotional states. Raising *self-awareness* (how well one can perceive bodily feelings that reflect emotions) aligned well with our efforts to assist teachers in making a connection between emotions and their physiological markers such as heart rate and breathing

pattern. We were also interested in increasing levels of *resilience* (ability to recover from adversity or not getting stuck with a particular emotion as was often the case with Rey Llena). We concurred with Davidson that being mindful about areas of potential brain activity could be associated with gaining some control over them. For this reason, we thought it important to develop one or two characteristics for each of the six dimensions of Emotional Style and weave them into the heuristic (see Table 2 for examples of the new characteristics).

Table 2: Emotional Style Dimensions as represented in the Mindfulness Heuristic.

Emotional Style Dimension	**Meaning**	**Related Mindfulness Characteristic**
Resilience	How quickly you recover from adversity.	6. I quickly recover when things go wrong for me.
Outlook	How long you are able to sustain positive emotion.	10. I maintain a positive outlook on life.
Social Intuition	How adept you are at picking up social signals from the people around you.	11. I can tell when something is bothering another person just by looking at him/her.
Self-Awareness	How well you perceive bodily feelings that reflect emotions.	9. When I am emotional, I notice changes in my heartbeat.
Sensitivity to Context	How good you are at regulating your emotional responses to take into account of the context you find yourself in.	13. The extent to which I show my emotions depends on where I am.
Attention	How sharp and clear your focus is.	14. If I decide to focus my attention on a particular task, I can keep it there.

We found it intriguing that Paul Ekman, whose best-known work is on the universal elements in emotion, was proclaiming a strong interest in how each individual's emotional experience is unique. What Davidson labels Emotional Style dimensions, Ekman (2003) appears to refer to as "emotional profiles" (p. 238). Similar to scholars with interests in contemplative practices, Ekman acknowledges that emotional behavior awareness and impulse awareness may be accomplished through mindfulness meditation.

Finally, we felt that our heuristic would not be complete without the other wing of mindfulness – loving kindness and compassion. Therefore, we added a few characteristics relating to loving kindness as in #15: *I am kind to* others, as well as to compassion to self as in #5: *I am compassionate to myself when things go wrong for me* and to others as in #16: *I feel compassion for people even if I do not*

know them. Compassion was somewhat related to a non-judgment factor (taking a non-evaluative stance toward cognitions and emotions) in the earlier version of the heuristic. We discovered an interesting pattern among teachers in our study – in their responses to the heuristic they indicated that while they were compassionate to others they were often "hard" on themselves. In follow-up conversations, we were told that raising compassion to self and increasing *resilience* levels were among desirable outcomes for the study participants not only in the teaching/learning context but also in other fields of social life.

After adding the loving-kindness and compassion characteristics, the second iteration of our heuristic was complete. Now consisting of seventeen characteristics, the heuristic reflected ten dimensions of what Tobin (personal communication, April 1, 2012) refers to as *mindful action* (see figures 2 and 3).

Figure 2: Ten dimensions of mindful action.

- Being aware of surroundings, emotions and what you are doing
- Maintaining focus
- Being kind
- Acting with compassion
- Recovering from adversity
- Maintaining a positive outlook
- Being socially intuitive
- Adapting actions to context
- Separating emotions from other actions

Figure 3: Characteristics in the second iteration of the Mindfulness Heuristic.

1. I am curious about my feelings as they occur.
2. I easily find words to describe my feelings.
3. I observe my thoughts without being caught up in them.
4. I perceive my emotions without having to react to them.
5. I am compassionate to myself when things go wrong for me.
6. I quickly recover when things go wrong for me.
7. I pay attention to sensations, such as the wind in my hair or sun on my face.
8. When I am emotional, I notice how my breathing changes.
9. When I am emotional, I notice changes in my heart beat.
10. I maintain a positive outlook on life.
11. I can tell when something is bothering another person just by looking at him/her.
12. The extent to which I show my emotions depends on where I am.
13. The extent to which I show my emotions depends on whom I am with.
14. If I decide to focus my attention on a particular task, I can keep it there.
15. I am kind to others.
16. I feel compassion for people even if I do not know them.
17. When I produce strong emotions, I can easily let them go.

Third Iteration of the Heuristic – Mindfulness in Education

Since our interest is in education in general and in science education in particular, the next and natural progression was to contextualize the heuristic to teaching and

learning. Our collaborating colleagues liked the idea of "making educational contexts more reflexive places." They considered mindfulness "not only important but necessary for holistic development, which constitutes science education also." Therefore, early on, contextualizing the heuristic appeared to be a preference of our collaborators. What we did with characteristic #14 may be an example of adapting it to educational contexts. A generic statement: *If I decide to focus my attention on a particular task, I can keep it there* became a specific characteristic: *I can focus my attention on learning.* Similarly, an earlier characteristic referring to *social intuition*: *I can tell when something is bothering another person* was replaced by two related characteristics: *I can tell when something is bothering the teacher* and *I can tell when something is bothering other students.* Conversely, a somewhat specific earlier characteristic: *I pay attention to sensations, such as the wind in my hair or sun on my face* became more reflective of a windless and sunless classroom setting in *I pay attention to my moment-to-moment sensory experiences.*

What we were hermeneutically learning from the study with the pre-service and in-service science teachers constituted another impetus for implementing modifications to the heuristic. The characteristics of a heuristic are expected to constantly change to fit the contexts of research including the axiologies (what is valued), ontologies (how life is experienced), and epistemologies (what constitutes knowledge) of participants. Thus, what an individual would be mindful about would depend on the circumstances being considered and would be included in the heuristic. Often we use the metaphor of "shape shifter" to convey the idea that a heuristic can change its shape even though a construct, such as mindfulness, might remain the same from one context to another. Because our study focused on raising awareness of emotions, their physiological manifestations, as well as ways of regulating emotional states, a pool of relevant characteristics was expanded and gained prominence in the new version of our heuristic. Thus, informed by Tobin's earlier studies on prosody and proxemics and the work of Ekman (2003), Turner (2002) and Collins (2004), we included characteristics referring to the awareness of the expression of emotions in voice, face, and body movements in addition to body temperature, breathing patterns and pulse rates. Furthermore, we added three characteristics referring to a high-grade intervention involving the management of emotions through breathing meditation that we developed and enacted as part of the study. Awareness of the emotional climate in the classroom was yet another ingredient of our study and necessarily found its reflection in the heuristic (*I am aware of emotional climate and my role in it*). Finally, we considered it essential to incorporate characteristics that would be reflective of the individual | collective dialectic (the vertical line indicates a dialectical relationship) that is typical of teaching/learning environments. Dialectical relationships refer to constructs in social fields that are a constituent of a whole and do not exist independently – existence of one presupposes the other (see Gene Fellner's chapter in this volume). An example of a pair reflective of such a relationship is a "collective" characteristic #20: *I recognize others' emotions by looking at their faces* and its "individual" counterpart #21: *I am aware of my emotions as they are reflected in my face.* Even

though the number of characteristics in the new heuristic nearly doubled as compared to the previous version, they all reflected salient aspects of our study without redundancy (see figure 4). This transformation made it easier for the study participants to identify with each of the mindfulness characteristics included in the heuristic.

Figure 4: Characteristics in the Mindfulness in Education Heuristic.

During this class:

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 pattern.
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.

Uses of Heuristics

A heuristic is meant to be a malleable tool fitting any context. Its flexibility also lies in its multiple uses. The first use is as a low-grade intervention. As noted earlier, the theory that supports low-grade interventions is reflexive inquiry where we ask participants to complete the heuristic thereby making them aware of the char-

acteristics and their relative occurrences. We theorized that becoming aware in this way would catalyze changes in practices. During our study, we found evidence suggesting that this is exactly what happens. A second use of the heuristic may be for planning where individuals involved in an activity, such as coteaching, use the characteristics and plan accordingly so that the relative occurrence of those characteristics could be targeted to reach desirable levels. Third is the use of the heuristic as a framework for interpretive inquiry concerning what happens in a social field. Hence, mindfulness heuristics may be used to describe what is happening in the science classroom from a hermeneutic phenomenological perspective. A fourth use is in undertaking landscape studies. The presence of the rating scale allows a heuristic to be used to portray landscapes (descriptions of the amount of mindfulness that crops up) for individuals and/or collectives. For each characteristic, a time series plot could be made for an individual to show how conduct in relation to the characteristic changes with time. Similarly, measures of central tendency and dispersion could be obtained for each characteristic for a collective as an illustration of patterns and contradictions. The calculation of parameters such as mean, mode, median along with appropriate measures of dispersion such as minimum, maximum, range, standard deviation, variance is a typical feature of a landscape study. It needs to be emphasized that the purpose of a landscape study is not to generalize to a population of which either the participants or the characteristics are a random selection. In the type of research in which we engage the participants are carefully selected and so are the characteristics for a social construct such as mindfulness.

In order to illustrate these four uses of heuristics, let us consider week 12 in our 15-week long study with the graduate students of a science-education program. The topic of the class was evolution. The instructor, his students and the research team anticipated this controversial topic (like many others covered in this course) to invoke high emotional states. The three students who volunteered to coteach that week (Aga, Aimee and Edward) decided to consider mindfulness characteristics when preparing for, executing and reflecting on their presentation. I worked closely with the group and we videotaped and analyzed our prep meetings, the class itself and the post-class discussions. At the forefront of all these activities was the pervasive awareness of, sensitivity to and respect for the ontological, axiological and epistemological standpoints of both the presenters (all very passionate about the theory of evolution) and other class participants (representing a wide spectrum of attitudes towards the theory in its entirety or its parts). Of the three presenters, Aga and Aimee, who became actively involved in our research, often commented on how considering mindfulness assisted them in preparing and coteaching the class. They also attributed their personal transformations to their participation in the research and being exposed to the enacted interventions, including mindfulness heuristics. In Aga's case, it was reconsidering the value of scientism with its dismissive attitude towards alternative ways of knowing. The manuscript Aga co-authored with the class instructor provides a more complete account of her experience (Alexakos and Pierwola 2013). For Aimee, who considers herself "overemotional," mindfulness was a way of learning how to replace

reacting with *responding*. As evident in the following quote, awareness development was the first important step for her:

> I'm trying to bring mindfulness into my life generally. The other day at work I was having a conversation with one of my bosses and I noticed I was raising my voice; I was getting defensive. One of my other managers had to step in. He said, "You know, Aimee, you're getting too aggressive; he is your supervisor." And I was like, "Oh, God, if I really can't contain myself even with my boss what am I going to do in the future if I'm talking to the principal."

As I noted earlier, the next step associated with a low-grade intervention may be making a decision whether a change in one's habitus is desirable. Coming to and enacting such a decision (as in Aimee's case a move "to put a lid on" emotions) may prove challenging:

> I'm actually kind of stuck here because part of me doesn't want to change myself, like, I think it's kind of, like, giving in if I say I have to put, like, a lid on it. But, at the same time, I have to, like, get by, right? Like, control my display.

In this course, heuristics were one of the methods to bring mindfulness characteristics to the awareness of the participants. Week 12 is an example of how heuristics were used as a planning tool (by assisting in enacting a mindful presentation) and, simultaneously, perhaps dialectically, as an intervention that ignited a reflection over one's way of being in the world. When heuristics are applied in these ways, they contribute to meeting authenticity criteria that guide our research. The idea behind authenticity criteria is for the research participants to benefit from research. The benefits may translate into improved practices and wellbeing.

In applying the heuristic as a framework for interpretive study, one might focus on certain mindfulness characteristics. For example, let us consider two characteristics that link emotions with their physiological markers: breathing patterns and heart rate. In our study, through the use of oximeters worn by the students during coteaching activities, we were able to record students' heart rate and oxygenation level in their blood. Both Aga and Aimee were extreme cases of what may happen when individuals are involved in teaching. While Aga's oxygen level dropped considerably, Aimee's heart rate soared to the level unmatched by any other student in the class. Of note was the fact that, like many others in their class (and possibly in classes across our educational system), Aga and Aimee were not aware of what was happening to them. As the course progressed, however, we witnessed heightening of awareness of the connection between in-the-moment emotions and physiology as well as an increased ability to rein in strong emotions. In addition, students reported that their newly acquired practices seeped into other fields of their daily lives. Reporting findings from the perspective of the research participants is a linchpin of doing interpretive research. As part of the course requirement, each student was responsible for coteaching twice during the semester. We were able to record the drop of heart rate level between the early and late instance of many student presentations. In the case of Aga and Aimee, the raising awareness associated with relevant mindfulness characteristics may also be illustrated through how they responded to the heuristic. We administered the 17-characteristic heuristic at the beginning of each class starting with week 10 and

ending in week 12. In this instance, in addition to its other functions, a heuristic became a tool for undertaking a landscape study. Aga's rating for the awareness of changes in her breathing associated with being emotional (characteristic #8) was the highest in week 12. For Aimee, her awareness of heart rate (characteristic #9) increased in week 11 and stayed at that level through week 12. Thus both Aga and Aimee exercised agency in gaining control over their wellbeing. When we analyzed change over time among 17 students who participated in the three administrations of the heuristic, increase in the mean score between weeks 10 and 12 and between weeks 11 and 12 were statistically significant ($p<0.05$) for characteristic #9 (see Table 3). Other characteristics that displayed increase in the mean scores included #4 (separating emotions from other actions), #7 (self-awareness), #10 (maintaining a positive outlook), #13 (being socially intuitive) and #16 (acting with compassion). The raise in ratings may indicate that these characteristics may have been salient to students in our study. Thus, we might argue that the class became more mindful in respect to these characteristics. In fact, we found that the difference in the means of the combined characteristics obtained for weeks 11 and 12 was also statistically significant ($F=23.4$, $p<0.001$). I provide more examples of how we used heuristics in my chapter in an edited volume detailing many aspects of our study (Alexakos and Tobin, forthcoming).

Table 3: Change in means of characteristic #9 over three administrations of the Mindfulness Heuristic.

					95% Confidence Interval for Difference[b]	
(I) Time		Mean Difference (I-J)	Std. Error	Sig.[b]	Lower Bound	Upper Bound
Week 10	Week 11	0.000	.243	1.000	-.514	.514
	Week 12	-.471*	.194	.027	-.882	-.059
Week 11	Week 10	0.000	.243	1.000	-.514	.514
	Week 12	-.471*	.174	.016	-.839	-.102
Week 12	Week 10	.471*	.194	.027	.059	.882
	Week 11	.471*	.174	.016	.102	.839

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

The "So What?"

With its calming effect, mindfulness has clear implications for the field of education where it is slowly gaining traction. It may help to ameliorate stressful thoughts and emotions and quiet down racing hearts of teachers like those in our

study. In turn, mindful teachers may be able to assist their students in adopting mindful conduct. This chapter presented one approach to developing a reflective tool, a heuristic, that may be used by educators interested in raising mindfulness in their classrooms. We hope that through the use of the heuristic, students and teachers will become aware of what mindfulness is and will take steps to becoming more mindful. We hope that like many of the novice teachers in our study, they will experience breakthroughs of making a connection between learning and teaching and mindfulness. We invite our colleagues to adopt and/or redesign any of the three versions of the mindfulness heuristic to fit their particular contexts and needs. We hope that our research will create ripple effects of transformations within and beyond the field of education. We also believe that this research will contribute to an emerging science of teaching and learning, which we regard as a central constituent of teacher education. Included in this chapter is a list of mindfulness-related resources we offer to those whose interest in the topic is inspired by our work (see figure 5).

Figure 5: Mindfulness in Education (and Beyond) – Select On-Line Resources in the United States

Here is a list of on-line resources related to mindfulness. Many websites will offer links to additional resources including mindfulness-related research literature.

Amishi Jha's Lab
http://www.amishi.com/lab

Association for Contemplative Mind in Higher Education
http://www.acmhe.org

Association for Mindfulness in Education
http://www.mindfuleducation.org

Center for Compassion and Altruism Research and Education, Stanford University
http://ccare.stanford.edu

Center for Mind and Brain, UC Davis
http://mindbrain.ucdavis.edu

Center for Mindfulness in Medicine, Health Care, and Society (founded by Jon Kabat-Zin), University of Massachusetts
http://www.umassmed.edu/cfm/home/index.aspx

Center for Investigating Healthy Minds
http://www.investigatinghealthyminds.org

CUNY Contemplatives' Wiki
http://cunycontemplatives.pbworks.com

Garrison Institute
http://www.garrisoninstitute.org

Garrison Institute CARE (Cultivating Awareness and Resilience in Education)

http://www.garrisoninstitute.org/contemplation-and-education/care-for-teachers

Lab for Affective Neuroscience (founded by Richard Davidson), University of Wisconsin
http://psyphz.psych.wisc.edu/web/index.html

Learning to BREATHE
http://learning2breathe.org

Mindfulness Awareness Research Center, UCLA
http://marc.ucla.edu

Mindfulness and Education Working Group, Teacher's College
http://www.tc.columbia.edu/centers/mindfulness

Mind & Life Institute and M&L Education Research Network
http://www.mindandlife.org/ & http://www.mindandlife.org/research-initiatives/mlern1

Mindfulness for Teachers and Students in NYC
http://www.learnmindfulnessnyc.com/teachersstudents

Mindfulness in Education Network
http://www.mindfuled.org

Mindfulness Research Guide
http://mindfulexperience.org

Mindful Schools
http://www.mindfulschools.org

Omega
http://eomega.org

The Hawn Foundation – MindUP™ Program
http://www.thehawnfoundation.org

The Inner Resilience Program
http://www.innerresilience-tidescenter.org

Santa Barbara Institute for Consciousness Studies (founded by B. Alan Wallace)
http://www.sbinstitute.com

The Still Quiet Place
http://www.stillquietplace.com

Solloway Mindfulness Scale & Resources
https://www.devtestservice.org/mindfulness/SMS/m-intro.html

Washington Mindfulness Community
http://mindfulnessdc.org

Waisman Laboratory for Brain Imaging and Behavior
http://brainimaging.waisman.wisc.edu

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