



7-2015

Mindfulness Training: A Transdisciplinary Approach to Assessing Efficacy in Education

Elizabeth Mackenzie

University of Pennsylvania, emackenz@gse.upenn.edu

Follow this and additional works at: http://repository.upenn.edu/gse_pubs

 Part of the [Education Commons](#)

Recommended Citation (OVERRIDE)

Mackenzie, ER. (2015) Mindfulness Training: A Transdisciplinary Approach to Assessing Efficacy in Education. In K. Ragoonaden (Ed.), *Mindful Teaching and Learning: Developing a Pedagogy of Well-Being* (pp. 1-16). Lanham: Lexington Books.

This paper is posted at ScholarlyCommons. http://repository.upenn.edu/gse_pubs/403

For more information, please contact repository@pobox.upenn.edu.

Mindfulness Training: A Transdisciplinary Approach to Assessing Efficacy in Education

Disciplines
Education

Chapter One

Mindfulness Training

A Transdisciplinary Approach to Assessing Efficacy in Education

Elizabeth R. Mackenzie

Evidence-based practice is the standard of excellence in many fields, particularly the health sciences. The fields of educational psychology and education policy also call for a robust set of data in which to ground innovations, ensuring that policies and practices are built upon a dependable framework of factually based theory. Recently, an increasing number of studies on mindfulness training (MT) and related contemplative practices from a range of academic disciplines have underscored their relevance for the field of education.

What makes mindfulness training (MT), in particular, so intriguing is that early research suggests that MT can enhance: 1) cognitive skills, 2) brain function, 3) immune system function, 4) emotional regulation and coping with stress, 5) psychological resiliency, 6) pro-social behavior and communication skills, as well as, 7) address some mental health problems and learning disorders. While this may seem like an extravagant claim, neuroimaging studies on contemplative practices point toward a surprising finding: these practices appear to allow us to use our minds to shape our brains across the lifespan and especially in childhood (Zelazo and Lyons 2012). In other words, the mental training of meditation functions as any other skill acquisition to induce plastic changes in the brain (Davidson and Lutz 2008), which in turn shape cognition, mood, and behavior. Assuming these early findings are replicated, it would explain how mindfulness training (and contemplative practices in general) could be a catalyst for improvements in so many disparate areas of evaluation.

THE CONTEMPLATIVE SCIENCE PROJECT

These issues are especially pertinent to the emergent field of contemplative science (Frank et al. 2013). Also referred to as the *Contemplative Science Project* (CSP) (Roeser 2013), it has been described as “an interdisciplinary effort to derive a new understanding of the mind-body system and its prospects for transformation . . . through the lens of mental training and neuroplasticity” (Roeser 2013). Goals of the CSP include developing a comprehensive understanding of the effect of contemplative practices on persons across the lifespan, applying these findings to optimize human development, and evaluating how secularized versions of contemplative practices can be widely implemented to relieve suffering and foster positive development (Roeser 2013; Frank et al. 2013). This transdisciplinary approach to building the evidence-base, *one that transcends academic disciplines*, is crucial to an accurate assessment of mindfulness and other contemplative practices as they are applied to education due to the important scientific studies conducted across many academic fields.

Central to the field of contemplative science is mindfulness or “mindfulness training” (MT) (Roeser 2013). Mindfulness has entered into U.S. discourse largely through the work of Jon Kabat-Zinn, PhD, a molecular biologist who adapted an Eastern meditation practice for clinical settings. He dubbed the clinical intervention Mindfulness-Based Stress Reduction (MBSR), a wholly secular tool designed for clinical populations. MBSR has been tested for three decades in clinical settings and has been demonstrated to provide benefit in a number of areas, including: anxiety, depression, chronic pain, immune system function, heart disease, substance abuse, and eating disorders (Ludwig and Kabat-Zinn 2008). MBSR has been so successful that numerous “spin-off” interventions have been created. These mindfulness-based interventions (MBIs) have made a significant impact on behavioral medicine: Acceptance and Commitment Therapy (ACT), Mindfulness-Based Cognitive Therapy (MBCT), Mindfulness-Based Relapse Prevention (MBRP), Mindfulness-Based Childbirth and Parenting (MBCP), and Mindfulness-Based Eating Awareness Therapy (MB-EAT), to name but a few (Greeson 2009; Cullen 2011). Furthermore, brain-imaging studies performed on persons who meditate have yielded intriguing new findings about brain plasticity, findings that suggest that brain structure, neurocircuitry, and cerebral blood flow all respond over time to mental activity and that this plasticity endures across the lifespan (Fox et al. 2014; Chiesa et al. 2011; Newberg et al. 2010; Lutz et al. 2008). Finally, a subset of studies point to significant benefits of mindfulness practice on focus, attention, working memory, and academic performance (Jha et al. 2007; Mrazek et al. 2013; Tang et al. 2014). All of these studies, though strictly speaking not within the field of education *per se*, clearly have implications for educational practice

and policy. Salient findings from clinical medicine, behavioral medicine, and neuroscience can inform the educational sciences in important ways. It is necessary to look beyond the confines of a single academic discipline when evaluating the efficacy of contemplative practices.

MINDFULNESS MEDITATION AND CONTEMPLATIVE PRACTICES

Adapting traditional Buddhist meditation practices, secular mindfulness was introduced into clinical medicine in the 1980s in the form of Mindfulness-Based Stress Reduction (MBSR) by Jon Kabat-Zinn and his colleagues at the University of Massachusetts (Ludwig and Kabat-Zinn 2008); since that time, it has had a significant impact on psychoneuroimmunology, neuroscience, and especially on behavioral medicine (Baer 2003). Both psychological theory and practice have slowly been transformed by new findings emerging from mindfulness research, and there is now a subfield of study termed “mindfulness psychology” (Felver et al. 2013). Brain imaging studies of persons engaged in meditation suggest that focused mental activities can actually change cerebral blood flow, brain morphology, and neural circuitry, in addition to strengthening the immune system (Davidson et al. 2003) and improving attention skills (Jha et al. 2007). MBSR has been repeatedly documented to be effective in treating mental health problems, particularly depression and anxiety, in numerous adult populations (Baer 2003; Greeson 2009). As Daniel Siegel has pointed out,

Mindful awareness is a profoundly integrative internal process. The observing self is open and receptive to the experiencing self, moment by moment. Research has demonstrated that being present with mindful awareness promotes health across the entire triangle of well-being, involving mind, brain, and relationships. (Siegel 2012)

Now, researchers are testing MBSR and other contemplative practices in children, adolescents, and young adults as a way to treat social-emotional dysfunction as well as to promote health and enhance academic performance (Black et al. 2009; Burke 2009; Greenberg and Harris 2011; Shapiro et al. 2011; Rempel 2012). Prompted by the robust scientific findings of mindfulness as a tool to support physical and mental health in adult populations, several groups have sprung up over the last decade devoted to applying and evaluating mindfulness in K–12 educational settings as well as in higher education, such as the Garrison Institute, Mindful Schools, Mindful Education Institute, Mindfulness in Education Network, and the Association for Contemplative Mind in Higher Education. Teachers across the country are enrolling in mindfulness training programs, administrators are introducing

mindfulness to their schools, and researchers are devising ways to evaluate the effects of mindfulness in cohorts of students and teachers (Ryan 2012; Meiklejohn et al. 2012; MLERN 2012).

As noted by Greenberg and Harris (2011), although mindfulness (and other forms of secular meditation) have been shown to improve physiological and mental health in adult populations, as well as to positively affect brain function and morphology, there has been a dearth of well-designed experimental studies on the effectiveness of school-based mindfulness programs designed to improve academic performance, and the “enthusiasm for promoting such practices outweighs the current evidence supporting them” (Greenberg and Harris 2011). However, much of the preliminary evidence is promising.

PROGRAMS FOR K–12 STUDENTS

Several pilot studies on universal school-based contemplative practices (including yoga and mindfulness) have yielded limited but encouraging results. For example, in an evaluation of a twelve-week yoga and mindfulness-based program for inner-city students (fourth and fifth grades), Mendelson et al. (2010) reported that students in the intervention group showed decreases in involuntary stress responses (specifically, lower scores on rumination, intrusive thoughts, and emotional arousal). A larger-scale study of this program is currently being conducted (Mendelson et al. 2013).

Flook et al. (2010) conducted a randomized controlled trial of an eight-week mindfulness curriculum for elementary school children (the InnerKids Program). The authors report improvements in executive function (EF) in children in the intervention group who had lower baseline EF (using parent and teacher reports). Schonert-Reichl and Lawlor (2010) report on a pilot, nonrandomized, wait-list control study of a mindfulness program for fourth through seventh graders ($n=246$). Compared to controls, the intervention students reported increases in optimism and positive affect, with teacher-reported improvements in pro-social behavior.

Broderick and Metz (2009) evaluated a pilot trial of the Learning to BREATHE Program, a mindfulness-based curriculum developed for adolescents. This study looked at a group of high school girls in the program and found that students in the intervention group ($n=120$) reported increases in calm, relaxation, and self-acceptance when compared with controls ($n=17$). A follow-up study of Learning to BREATHE used a quasi-experimental pre-test and post-test design to evaluate the program in two suburban high schools ($n=216$) (Metz et al. 2013). The results suggest that this curriculum improved emotional regulation, self-regulation efficacy, psychosomatic complaints, and self-reported levels of stress.

Tang et al. (2014) found that a mindfulness-based training for adolescents (n=208) was effective in improving attention and academic performance (104 students were randomized to a mindfulness based group, 104 to an active control that included relaxation techniques only). An RCT of elementary school students (n=194) in a meditation program found that participants had reduced test anxiety and increased selective attention; teachers reported better attention and social skills (Napoli et al. 2005). In a randomized controlled trial of 100 elementary school children (fourth and fifth grades), the mindfulness-based MindUP Program integrated into the curriculum over a four-month period was found to support prosocial behavior, increase feelings of well-being, and improve math grades (Schonert-Reichl et al. 2015).

An evaluation of a mindfulness-based program for sixth-grade students (n=101) in which students were randomized to either a class with mindfulness practice or a class with another experiential activity (the active control group) found that both groups decreased significantly on clinical syndrome scales. Students in the mindfulness class were, however, significantly less likely to report suicidal ideation or thoughts of self-harm (Britton et al. 2014). Parker et al. (2014) evaluated a mindfulness-based program aimed at fourth and fifth grade students designed to decrease intent to use tobacco and alcohol; no significant differences were found in intentions toward substance use comparing the active group to the wait-list control group, though the active group reported significant improvements in executive function skills and there was a reduction in aggression and social problems.

Two recent meta-analyses have been conducted. The first was a review of twenty mindfulness interventions for youth (ages eighteen and younger) that found that mindfulness interventions were helpful with an effect size that was small to moderate in universal interventions, but with a larger effect size when analyzing mindfulness interventions in clinical populations of youth (Zoogman et al. 2014). The authors conclude that future research might best be focused on youth with psychopathological diagnoses in clinical settings (Zoogman et al. 2014). This finding is congruent with the clinical findings of the past three decades; namely, that mindfulness-based interventions (MBIs) are effective for anxiety, depression, and other mental health disorders. The second examined twenty-four studies (Zenner et al. 2014) and determined that despite the heterogeneity in methods and instruments, along with the fact that many studies were statistically underpowered, "mindfulness-based interventions in children and youths hold promise, particularly in relation to improving cognitive performance and resilience to stress" (Zenner et al. 2014).

Three bodies of evidence all point to the promising nature of K-12 school-based mindfulness programs: 1) the large body of data on the effectiveness of mindfulness in adult populations, 2) the small but growing body of data on the effectiveness of mindfulness in children and youth, both universal and clinical populations, and 3) the emerging evidence on the feasibil-

ity, acceptability, and efficacy of school-based mindfulness programs. A recent article published in *Psychology in the Schools*, calls for the integration of mindfulness psychology into school psychology interventions using a three-tier approach: 1) universal for the whole school; 2) targeted clinical groups; 3) intensive for individuals with diagnoses of psychopathology (Fellver et al. 2013). The authors note that universal mindfulness interventions can be integrated with existing school-wide social emotional learning (SEL) programs to good effect, an observation supported by others (MLERN 2012; Lawlor 2014).

PROGRAMS FOR K–12 TEACHERS

“Early research results on three illustrative mindfulness-based teacher training initiatives suggest that personal training in mindfulness skills can increase teachers’ sense of well-being and teaching self-efficacy, as well as their ability to manage classroom behavior and establish and maintain supportive relationships with students” (Mieklejohn et al. 2012). Mindfulness-Based Wellness Education (MBWE) (Poulin et al. 2008) is an MBI for teachers and other human service professionals being piloted in Canada. MBWE is an eight-week intervention based on MBSR and grounded in the principles set out by Jon Kabat-Zinn (Poulin et al. 2008). Twenty-eight participants and sixteen controls drawn from a cohort of undergraduates in a teacher education program were included in the study. Results included increased mindfulness, life satisfaction, and teacher self-efficacy (Poulin et al. 2008). Stress Management and Relaxation Techniques (SMART) in Education (developed by Cullen and Wallace 2010) was piloted as an intervention for parents and educators of children with special needs and found to significantly improve caregiver competence, as well as to significantly reduce stress and anxiety (Benn et al. 2012). A more recent RCT of the same MT intervention supports these earlier findings. This mindfulness training for teachers (n=113) study found that elementary and secondary teachers randomized to MT had improved focused attention and working memory capacity, as well as greater mindfulness and occupational self-compassion; the intervention group also reported lower levels of occupation stress and burn-out at the three-month follow-up (Roeser et al. 2013). Jennings et al. (2013) evaluated the Cultivating Awareness and Resilience (CARE) Program, a mindfulness-based intervention for teachers with a randomized controlled trial of fifty teachers (assigned to CARE or a waitlist control group). This study found that participants in the intervention group showed improvements in well-being, efficacy, burn-out and mindfulness. The authors discuss the importance of mindfulness-based interventions for cultivating social emotional competence (SEC) in teachers. Frank et al. (2013) used a quasi-experi-

mental pre- and post-test design with a comparison group to test the effects of an eight-week MBSR program in a population of thirty-six high school educators. Findings from this study include gains in self-regulation, self-compassion, sleep quality, and mindfulness-related skills. Abenavoli et al. (2013) did a cross-sectional analysis to determine whether or not mindfulness is negatively related to burnout. The authors found that mindfulness had strong negative associations with emotional exhaustion, depersonalization, and low personal accomplishment, all important dimensions of burnout. Mindfulness was also associated with better sleep quality.

Jennings (2014) makes a case for careful consideration of teachers' psychosocial characteristics and how these impact the quality of learning environments, particularly for young children. In this study of thirty-five preschool teachers' self-reports, the author explored how mindfulness, self-compassion, personal efficacy, and positive affect were associated with being better able to offer emotional support to challenging students, while emotional exhaustion, depression, and depersonalization were associated with negative outcomes. These and similar studies underscore the need to better understand how mindfulness-based practices incorporated into teacher professional development programs can support social and emotional competence, thereby improving learning environments.

HIGHER EDUCATION

A burgeoning body of literature is devoted to examining the role of mindfulness and other contemplative practices in higher education, both at the undergraduate and the graduate level (Shapiro et al. 2011; Barbezat and Bush 2014). There are three main rationales for integration of these practices into higher education: 1) stress management, 2) improved academic performance, and 3) "whole person" development (Shapiro et al. 2011: 496); some programs are specifically aimed at one of these goals, while others may embrace all three dimensions.

Numerous Mindfulness-Based Stress Reduction (MBSR) programs have been implemented on college campuses with generally positive results (Astin 1997; Jain et al. 2007; Shapiro et al. 2007; Oman 2008). A meta-analysis of twenty-four cognitive, behavioral, and mindfulness studies conducted in populations of university students found that all these interventions were effective in reducing stress (Regehr et al. 2013). Now there have emerged several new approaches adapted to be most effective and feasible for higher education settings. For instance, Greeson et al. (2014) conducted a randomized-controlled trial of Koru Mindfulness (n=90), a practice designed specifically for emerging adults (ages eighteen to twenty-nine) that condenses the program to four seventy-five-minute sessions, with just ten minutes of home

practice required each night (Rogers 2013). This adaptation was found more effective and feasible with college students than the original MBSR format which requires eight weeks of classes with up to forty-eight minutes of home practice each night. The RCT found that the active group ($n=45$) showed significant improvements in perceived stress and sleep problems and increases in mindfulness, self-compassion, and gratitude. Similarly, a study of mindfulness programs for university students that compared formal versus informal practice, found that formal mindfulness-based stress management techniques produced greater levels of mindfulness, self-compassion, and lower levels of stress (Hindman et al. 2014).

Many mindfulness-based programs have been implemented in health professions training programs (medicine, nursing, and allied health professions), and a growing number are being piloted in schools of law, business, and arts and sciences (Barbezat and Bush 2014). Medical students ($n=140$) participating in an MBSR program showed improvements in mood disturbance compared to controls (Rosenzweig et al. 2003). Kar et al. (2014) describe a mindfulness-based cognitive therapy program for medical students for stress reduction, while Warde et al. (2014) explore the utility of mindfulness to promote leadership and resiliency among medical students at UCLA who work with underserved, vulnerable patients (e.g., prison populations). Song and Lindquist (2014) conducted a study of forty-four nursing students in Korea; twenty-one were randomized to an MBSR group and twenty-three to a wait-list control group. The study found that the MBSR group reported significantly greater reductions in depression, anxiety, and stress, while experiencing increases in mindfulness. Mindfulness-based programs are also being used in health professions training to cultivate self-awareness and reflection, thereby enhancing clinicians' capacity to deliver compassionate, sensitive, patient-centered care (Saunders et al. 2007). Several studies have examined how the cultivation of mindfulness among graduate students in professional mental health training programs can promote empathy, compassion, and good self-care practices (Newsome et al. 2006; Shapiro et al. 2007; Schure et al. 2008; Christopher and Maris 2010).

Finally, there is a movement to promote contemplative practices in general within higher education to enrich the educational experience and to support creative thinking, reflection, and increased self-awareness (Bush 2011; Shapiro et al. 2011; Sarath 2003). The American Council of Learned Societies initiated the Contemplative Practice Fellowship program in 1997, contributing to the integration of contemplative practices at over seventy-five colleges and universities (Sarath 2003). Some notable examples include Brown University's Concentration in Contemplative Studies that is open to both undergraduate and graduate students (<http://www.brown.edu/academics/contemplative-studies/>), the Contemplative Inquiry and Approaches in Education Masters program at Simon Fraser University (<http://www.sfu.ca/edu->

cation/gs/degreediploma/masters/ci-cpa2014.html) and the University of Virginia, which recently established a Contemplative Sciences Center (<http://uvacontemplation.org/>) with participation from the Curry School of Education, the Darden School of Business, and the Schools of Medicine and Nursing. In addition to supporting general student well-being, these types of initiatives seek to enhance metacognition, creativity, and transformative learning (Shapiro et al. 2011).

BRAIN IMAGING AND COGNITIVE FUNCTION STUDIES

As noted above, a subset of studies on contemplative practices has focused on their impact on cognitive function. Jha et al. (2007) found that mindfulness meditation practice improved focus and attention among a cohort of college students. Specifically, the authors explored three subsystems of attention: alerting, orienting, and conflict monitoring. Two different cohorts were studied, one group newly introduced to MT (via an eight-week MBSR course), the other more experienced. The study found that concentrative attention (focused attention) improved in the less experienced group, while the more experienced cohort exhibited greater receptive attention (open-monitoring). Mrazek et al. (2013) examined mindfulness training (MT) as an intervention for reducing mind wandering by randomizing forty-eight male and female undergraduate students to either a two-week mindfulness class or a two-week class on nutrition. They tested working memory capacity (WMC) pre- and post-intervention, along with administering a verbal-reasoning section from the GRE. The authors report that this two-week MT intervention resulted in increased working memory capacity and superior reading comprehension on the GRE (Mrazek et al. 2013). Among the notable findings of this study is that merely two weeks of MT produced measurable improvements in cognitive function, a considerably shorter period of time than the eight-week MBSR intervention and other similar MBIs.

Chiesa et al. (2010) conducted a meta-analysis of twenty-three studies on mindfulness and cognition. Overall, this review suggests that mindfulness can improve cognition (e.g., working memory capacity, attention) and executive function, though the authors caution that some of the studies included had methodological weaknesses, which subsequent studies should address.

What could account for these changes in cognition? A number of neuroimaging studies indicate that meditation practice can have an influence on the brain itself. Experienced meditators appear to exhibit beneficial changes in cerebral blood flow (CBF) (Newberg et al. 2010), and enhancements in the neurocircuitry associated with empathy and compassion (Lutz et al. 2008). Even a relatively modest eight weeks of MBSR has been shown to result in increases in the brain circuitry associated with positive affect (the anterior

left-side of the brain), along with improved immunity (Davidson et al. 2003). Lazar et al. (2005) report that areas of the cerebral cortex (the prefrontal cortex and right anterior insula) were thicker in meditators compared with matched controls; Hölzel et al. (2011) found that grey matter in other areas of the brain, such as the hippocampus, was denser in persons who meditate. It also appears that the amygdala (the part of the brain which registers threat and activates the “flight or fight” response) may exhibit decreased gray matter density in those who meditate compared to those who do not, a neurological correlate of being less reactive to perceived threat (Hölzel et al. 2010). One recent study found a correlation between dispositional mindfulness and decreased amygdala gray matter volume in a sample of 155 adults, providing further evidence for a link between mindfulness and decreased threat reactivity (Taren et al. 2013).

A meta-analysis by Fox et al. (2014) of twenty-one neuroimaging studies found convergent findings pointing to alterations in structure in eight specific areas of the brain related to: meta-awareness, body awareness, memory, self/emotional regulation, and intra- and inter-hemispheric communication with the brain. “These preliminary findings suggest that, due to the brain’s neuroplastic nature (i.e., its ability to create new neurons and neural connections), individuals can actively change their brain structure in ways that promote brain health and improve the quality of one’s life” (Meiklejohn et al. 2012). Zelazo and Lyons (2012) suggest that the emerging evidence “bodes well for the possibility that age-appropriate mindfulness practices may be beneficial for children, with concurrent and cascading benefits for academic and social success” particularly in the area of self-regulation.

Although the neuroscience of MT is still in its infancy, a picture is emerging that suggests:

1. Contemplative practices can positively affect brain circuitry, structure, and cerebral blood flow.
2. Mindfulness can improve attention, focus, executive function, and working memory.
3. Mindfulness can address deficits in social skills, behavior, and communication.
4. Mindfulness can decrease mental health problems (e.g., anxiety, depression) and increase positive affect and resilience.

Increasingly, scientific findings have shown that the human brain is responsive to both thoughts and emotions and that brain plasticity, although most pronounced in infancy, persists throughout childhood and into adulthood: “The human brain remains open to changing in response to experience throughout the lifespan” (Siegel 2012). Given these findings, it is incumbent upon educational policy makers to support activities known to shape the

brain in positive ways, enhancing self-regulation, empathy, and other dispositions linked to prosocial behavior, as well as cognition. Evidence suggests that social and emotional wellbeing is closely linked to learning (Durlak et al. 2011), and that ignoring the “heart-mind connection” may lead to behavioral dysfunction, antisocial dynamics, and poor academic outcomes in both K–12 (MLERN 2012) and higher education settings (Smeets et al. 2014; Neff et al. 2005). Understanding the physiological underpinnings, or the biomechanical pathways, of the mind-body connection can help education researchers and policy makers better utilize robust scientific findings from other fields of research to optimize student wellbeing and success. This transdisciplinary approach to building an evidence-base for innovations in education has the potential to strengthen educational policy and practice in the same way that multivalent perspectives can enrich our understanding of any phenomenon. By examining pertinent findings from a range of disciplines, a three-dimensional picture emerges, one that is more complete because it is informed by findings from multiple disciplines. While conducting studies in the contemplative sciences in school-age populations and in school-based settings is crucial, we should also not lose sight of the larger scientific context in which these explorations are conducted.

A TRANSDISCIPLINARY APPROACH

Just as the health care sector is adapting to new information about the biomechanical pathways that link mind to body (McCabe-Ruff and Mackenzie 2009), so the field of conventional pedagogical theory is responding to the work of Gardner, Goleman, and others that contextualizes learning skills and aptitudes within an understanding of the whole person (including relationships, emotions, and neurological systems) (Shapiro et al. 2011; Hyland 2014). This body of research strongly suggests that programs seeking to improve academic performance should address social and emotional dimensions of learning, in addition to cognitive skills, and that contemplative practices have the potential to enhance academic performance, promote prosocial behavior, and possibly even prevent disease and dysfunction.

Taking a transdisciplinary approach to building the evidence base by drawing on many years of scientific exploration in a variety of populations and through the lens of many disciplines may allow a fuller picture to emerge more swiftly thus supporting important, and much needed, innovations in educational practice and policy. Our students need innovations that are firmly grounded in solid scientific findings drawn from all relevant academic disciplines, including clinical medicine and nursing, neuroscience, developmental psychology, clinical psychology, school psychology, and counseling psychology, as well as education and its subfields. While the research on

contemplative practices in education may be nascent, there are other salient fields of study that should inform educational policy and practice. By taking a transdisciplinary approach to assessing the evidence we can gain a more complete understanding of the potential for contemplative practices in general, and mindfulness training in particular, to support innovations in pedagogy for children, youth, and young adults thereby enhancing learning, health, well-being, and positive human development.

ACKNOWLEDGMENT

The author would like to thank Bediha Ipekci for research assistance and Abraham Kou for research assistance and manuscript preparation.

REFERENCES

- Abenavoli, Rachel M., Patricia A. Jennings, Mark T. Greenberg, Alexis R. Harris, and Deirdre A. Katz. "The Protective Effects of Mindfulness against Burnout among Educators." *Psychology of Education Review* 37, no. 2 (2013): 57–69.
- Astin, John A. "Stress Reduction through Mindfulness Meditation." *Psychotherapy and Psychosomatics* 66, no. 2 (1997): 97–106.
- Baer, Ruth A. "Mindfulness Training as a Clinical Intervention: A Conceptual and Empirical Review." *Clinical Psychology: Science and Practice* 10, no. 2 (2003): 125–43.
- Barbezat, D., and Bush, M. (2014). *Contemplative Practices in Higher Education*. San Francisco: Jossey-Bass.
- Benn, Rita, Tom Akiva, Sari Arel, and Robert W. Roeser. "Mindfulness Training Effects for Parents and Educators of Children with Special Needs" *Developmental Psychology* 48, no. 5 (2012): 1476.
- Black, David S., Joel Milam, and Steve Sussman. "Sitting-Meditation Interventions among Youth: A Review of Treatment Efficacy." *Pediatrics* 124, no. 3 (2009): e532–e541.
- Britton, W. B., N. E. Lepp, H. F. Niles et al. "A randomized controlled pilot trial of classroom-based mindfulness meditation compared to an active control condition in sixth-grade children." *Journal of School Psychology* 52, no. 3, 263–78.
- Broderick, Patricia C., and Stacie Metz. "Learning to BREATHE: A Pilot Trial of a Mindfulness Curriculum for Adolescents." *Advances in School Mental Health Promotion* 2, no. 1 (2009): 35–46.
- Burke, Christine A. "Mindfulness-Based Approaches with Children and Adolescents: A Preliminary Review of Current Research in an Emergent field." *Journal of Child and Family Studies* 19, no. 2 (2010): 133–44.
- Bush, Mirabai. "Mindfulness in Higher Education." *Contemporary Buddhism* 12, no. 01 (2011): 183–97.
- Chiesa, Alberto, Raffaella Calati, and Alessandro Serretti. "Does Mindfulness Training Improve Cognitive Abilities? A Systematic Review of Neuropsychological Findings." *Clinical Psychology Review* 31, no. 3 (2011): 449–64.
- Christopher, John Chambers, and Judy A. Maris. "Integrating Mindfulness as Self-Care into Counselling and Psychotherapy Training." *Counselling and Psychotherapy Research* 10, no. 2 (2010): 114–25.
- Cullen, Margaret. "Mindfulness-Based Interventions: An Emerging Phenomenon." *Mindfulness* 2, no. 3 (2011): 186–93.
- Davidson, Richard J., Jon Kabat-Zinn, Jessica Schumacher, Melissa Rosenkranz, Daniel Muller, Saki F. Santorelli, Ferris Urbanowski, Anne Harrington, Katherine Bonus, and John F.

- Sheridan. "Alterations in Brain and Immune Function Produced by Mindfulness Meditation." *Psychosomatic Medicine* 65, no. 4 (2003): 564–70.
- Davidson, Richard J., and Antoine Lutz. "Buddha's Brain: Neuroplasticity and Meditation." *IEEE Signal Processing Magazine* 25, no. 1 (2008): 176.
- Durlak, Joseph A., Roger P. Weissberg, Allison B. Dymnicki, Rebecca D. Taylor, and Kriston B. Schellinger. "The Impact of Enhancing Students' Social and Emotional Learning: A Meta-Analysis of School-Based Universal Interventions" *Child Development* 82, no. 1 (2011): 405–32.
- Felver, Joshua C., Erin Doerner, Jeremy Jones, Nicole C. Kaye, and Kenneth W. Merrell. "Mindfulness in School Psychology: Applications for Intervention and Professional Practice." *Psychology in the Schools* 50, no. 6 (2013): 531–47.
- Flook, Lisa, Susan L. Smalley, M. Jennifer Kitiil, Brian M. Galla, Susan Kaiser-Greenland, Jill Locke, Eric Ishijima, and Connie Kasari. "Effects of Mindful Awareness Practices on Executive Functions in Elementary School Children." *Journal of Applied School Psychology* 26, no. 1 (2010): 70–95.
- Fox, Kieran C. R., Savannah Nijeboer, Matthew L. Dixon, James L. Floman, Melissa Ellamil, Samuel P. Rumak, Peter Sedlmeier, and Kalina Christoff. "Is Meditation Associated with Altered Brain Structure? A Systematic Review and Meta-Analysis of Morphometric Neuroimaging in Meditation Practitioners." *Neuroscience & Biobehavioral Reviews* 43 (2014): 48–73.
- Frank, Jennifer L., Patricia A. Jennings, and Mark T. Greenberg. "Mindfulness-Based Interventions in School Settings: An Introduction to the Special Issue." *Research in Human Development* 10, no. 3 (2013): 205–10.
- Greenberg, Mark T., and Alexis R. Harris. "Nurturing Mindfulness in Children and Youth: Current State of Research." *Child Development Perspectives* 6, no. 2 (2012): 161–66.
- Greeson, Jeffrey M. "Mindfulness Research Update: 2008." *Complementary Health Practice Review* 14, no. 1 (2009): 10–18.
- Greeson, Jeffrey M., Michael K. Juberg, Margaret Maytan, Kiera James, and Holly Rogers. "A Randomized Controlled Trial of Koru: A Mindfulness Program for College Students and Other Emerging Adults." *Journal of American College Health* 62, no. 4 (2014): 222–33.
- Hindman, Robert K., Carol R. Glass, Diane B. Arnkoff, and David D. Maron. "A Comparison of Formal and Informal Mindfulness Programs for Stress Reduction in University Students." *Mindfulness* (2014): 1–12.
- Hölzel, Britta K., James Carmody, Karleyton C. Evans, Elizabeth A. Hoge, Jeffery A. Dusek, Lucas Morgan, Roger K. Pitman, and Sara W. Lazar. "Stress Reduction Correlates with Structural Changes in the Amygdala." *Social Cognitive and Affective Neuroscience* 5 (2010): 11–17.
- Hölzel, Britta K., James Carmody, Mark Vangel, Christina Congleton, Sita M. Yerramsetti, Tim Gard, and Sara W. Lazar. "Mindfulness Practice Leads to Increases in Regional Brain Gray Matter Density." *Psychiatry Research: Neuroimaging* 191, no. 1 (2011): 36–43.
- Hyland, Terry. "Mindfulness-Based Interventions and the Affective Domain of Education." *Educational Studies* 40, no. 3 (2014): 277–91.
- Jain, Shamini, Shauna L. Shapiro, Summer Swanick, Scott C. Roesch, Paul J. Mills, Iris Bell, and Gary E. R. Schwartz. "A Randomized Controlled Trial of Mindfulness Meditation versus Relaxation Training: Effects on Distress, Positive States of Mind, Rumination, and Distraction." *Annals of Behavioral Medicine* 33, no. 1 (2007): 11–21.
- Jennings, Patricia A., Jennifer L. Frank, Karin E. Snowberg, Michael A. Coccia, and Mark T. Greenberg. "Improving Classroom Learning Environments by Cultivating Awareness and Resilience in Education (CARE): Results of a Randomized Controlled Trial." *School Psychology Quarterly* 28, no. 4 (2013): 374.
- Jennings, Patricia A. "Early Childhood Teachers' Well-being, Mindfulness, and Self-Compassion in Relation to Classroom Quality and Attitudes towards Challenging Students." *Mindfulness* (2014): 1–12.
- Jha, Amishi P., Jason Krompinger, and Michael J. Baime. "Mindfulness Training Modifies Subsystems of Attention." *Cognitive, Affective, & Behavioral Neuroscience* 7, no. 2 (2007): 109–19.

- Kar, Phang Cheng, Keng Shian Ling, and Chiang Kai Chong. "Mindful-STOP: Mindfulness Made Easy for Stress Reduction in Medical Students." *Education in Medicine Journal* 6, no. 2 (2014).
- Lawlor, Molly Steward. "Mindfulness in practice: Considerations for Implementation of Mindfulness-Based Programming for Adolescents in School Contexts." *New Directions for Youth Development* 2014, no. 142 (2014): 83–95.
- Lazar, Sara W., Catherine E. Kerr, Rachel H. Wasserman, Jeremy R. Gray, Douglas N. Greve, Michael T. Treadway, Metta McGarvey et al. "Meditation Experience is Associated with Increased Cortical Thickness." *Neuroreport* 16, no. 17 (2005): 1893.
- Ludwig, David S., and Jon Kabat-Zinn. "Mindfulness in Medicine." *Journal of the American Medical Association* 300, no. 11 (2008): 1350–52.
- Lutz, Antoine, Julie Brefczynski-Lewis, Tom Johnstone, and Richard J. Davidson. "Regulation of the Neural Circuitry of Emotion by Compassion Meditation: Effects of Meditative Expertise." *PLoS one* 3, no. 3 (2008): e1897.
- McCabe-Ruff, Kelley, and Elizabeth R. Mackenzie. "The Role of Mindfulness in Healthcare Reform: A Policy Paper." *Explore: The Journal of Science and Healing* 5, no. 6 (2009): 313–323.
- Meiklejohn, John, Catherine Phillips, M. Lee Freedman, Mary Lee Griffin, Gina Biegel, Andy Roach, Jenny Frank et al. "Integrating Mindfulness Training into K–12 Education: Fostering the Resilience of Teachers and Students." *Mindfulness* 3, no. 4 (2012): 291–307.
- Mendelson, Tamar, Mark T. Greenberg, Jacinda K. Dariotis, Laura Feagans Gould, Brittany L. Rhoades, and Philip J. Leaf. "Feasibility and Preliminary Outcomes of a School-Based Mindfulness Intervention for Urban Youth." *Journal of Abnormal Child Psychology* 38, no. 7 (2010): 985–94.
- Mendelson, Tamar, Mark T. Greenberg, Laura Feagans Gould, Alexis R. Harris, Jacinda K. Dariotis, and Philip J. Leaf (2013) "School-Based Mindfulness and Yoga for Urban Youth" presentation at the Opening Hearts and Minds Conference, UCSD, San Diego, CA, February 1, 2013.
- Metz, Stacie M., Jennifer L. Frank, Diane Reibel, Todd Cantrell, Richard Sanders, and Patricia C. Broderick. "The Effectiveness of the Learning to BREATHE Program on Adolescent Emotion Regulation." *Research in Human Development* 10, no. 3 (2013): 252–72.
- Mind and Life Education Research Network (MLERN): Davidson, Richard, John Dunne, Jacquelynne S. Eccles, Adam Engle, Mark Greenberg, Patricia Jennings, Amishi Jha et al. "Contemplative Practices and Mental Training: Prospects for American Education." *Child Development Perspectives* 6, no. 2 (2012): 146–53.
- Mrazek, Michael D., Michael S. Franklin, Dawa Tarchin Phillips, Benjamin Baird, and Jonathan W. Schooler. "Mindfulness Training Improves Working Memory Capacity and GRE Performance while Reducing Mind Wandering." *Psychological Science* (2013): doi:0956797612459659.
- Napoli, Maria, Paul Rock Krech, and Lynn C. Holley. "Mindfulness Training for Elementary School Students: The Attention Academy." *Journal of Applied School Psychology* 21, no. 1 (2005): 99–125.
- Neff, Kristin D., Ya-Ping Hsieh, and Kullaya Dejitterat. "Self-Compassion, Achievement Goals, and Coping with Academic Failure." *Self and Identity* 4, no. 3 (2005): 263–87.
- Newberg, Andrew B., Nancy Wintering, Mark R. Waldman, Daniel Amen, Dharma S. Khalsa, and Abass Alavi. "Cerebral Blood Flow Differences between Long-Term Meditators and Non-meditators." *Consciousness and Cognition* 19, no. 4 (2010): 899–905.
- Newsome, Sandy, John C. Christopher, Penny Dahlen, Suzanne Christopher. "Teaching Counselors Self-Care Through Mindfulness Practices." *Teachers College Record* 108, no. 9 (2006): 1881–1900.
- Oman, Doug, Shauna L. Shapiro, Carl E. Thoresen, Thomas G. Plante, and Tim Flinders. "Meditation Lowers Stress and Supports Forgiveness among College Students: A Randomized Controlled Trial." *Journal of American College Health* 56, no. 5 (2008): 569–78.
- Parker, Alison E., Janis B. Kupersmidt, Erin T. Mathis, Tracy M. Scull, and Calvin Sims. "The impact of mindfulness education on elementary school students: evaluation of the Master Mind program." *Advances in School Mental Health Promotion* 7, no. 3 (2014): 184–204.

- Poulin, Patricia A., Corey S. Mackenzie, Geoffrey Soloway, and Eric Karayolas. "Mindfulness Training as an Evidenced-Based Approach to Reducing Stress and Promoting Well-Being among Human Services Professionals." *International Journal of Health Promotion and Education* 46, no. 2 (2008): 72–80.
- Regehr, Cheryl, Dylan Glancy, and Annabel Pitts. "Interventions to Reduce Stress in University Students: A Review and Meta-Analysis." *Journal of Affective Disorders* 148, no. 1 (2013): 1–11.
- Rempel, Kim. "Mindfulness for Children and Youth: A Review of the Literature with an Argument for School-Based Implementation." *Canadian Journal of Counselling and Psychotherapy/Revue Canadienne de Counseling et de Psychothérapie* 46, no. 3 (2012).
- Roeser, Robert W., Kimberly A. Schonert-Reichl, Amishi Jha, Margaret Cullen, Linda Wallace, Rona Wilensky, Eva Oberle, Kimberly Thomson, Cynthia Taylor, and Jessica Harrison. "Mindfulness Training and Reductions in Teacher Stress and Burnout: Results from Two Randomized, Waitlist-Control Field Trials." *Journal of Educational Psychology* 105, no. 3 (2013): 787.
- Rogers, Holly B. "Koru: Teaching Mindfulness to Emerging Adults." *New Directions for Teaching and Learning* 2013, no. 134 (2013): 73–81.
- Rosenzweig, Steven, Diane K. Reibel, Jeffrey M. Greeson, George C. Brainard, and Mohammadreza Hojat. "Mindfulness-Based Stress Reduction Lowers Psychological Distress in Medical Students." *Teaching and Learning in Medicine* 15, no. 2 (2003): 88–92.
- Ryan, Tim. *A Mindful Nation: How a Simple Practice Can Help Us Reduce Stress, Improve Performance, and Recapture the American Spirit*. Carlsbad, CA: Hay House, Inc., 2012.
- Sarath, Ed. "Meditation in Higher Education: The Next Wave?" *Innovative Higher Education* 27, no. 4 (2003): 215–33.
- Saunders, Pamela A., Rochelle E. Tractenberg, Ranjana Chaterji, Hakima Amri, Nancy Harazduk, James S. Gordon, Michael Lumpkin, and Aviad Haramati. "Promoting Self-Awareness and Reflection through an Experiential Mind-Body Skills Course for First Year Medical Students." *Medical Teacher* 29, no. 8 (2007): 778–84.
- Schonert-Reichl, Kimberly A., and Molly Stewart Lawlor. "The Effects of a Mindfulness-Based Education Program on Pre-and Early Adolescents' Well-Being and Social and Emotional Competence." *Mindfulness* 1, no. 3 (2010): 137–51.
- Schonert-Reichl, Kimberly A., Eva Oberle, Molly Stewart Lawlor, David Abbott, Kimberly Thomson, Tim F. Oberlander, and Adele Diamond. "Enhancing Cognitive and Social-Emotional Development through a Simple-to-Administer Mindfulness-Based School Program for Elementary School Children: A Randomized Controlled Trial." *Developmental Psychology* 51, no. 1 (2015): 52.
- Schure, Marc B., John Christopher, and Suzanne Christopher. "Mind-Body Medicine and the Art of Self-Care: Teaching Mindfulness to Counseling Students Through Yoga, Meditation, and Qigong." *Journal of Counseling & Development* 86, no. 1 (2008): 47–56.
- Shapiro, Shauna L., Kirk Warren Brown, and John Astin. "Toward the Integration of Meditation into Higher Education: A Review of Research Evidence." *Teachers College Record* 113, no. 3 (2011): 493–528.
- Shapiro, S. L., K. Brown, and G. Biegel. "Self-Care for Health Care Professionals: Effects of MBSR on Mental Well Being of Counseling Psychology Students." *Training and Education in Professional Psychology* 1, no. 2 (2007): 105–15.
- Siegel, Daniel J. *The Developing Mind: How Relationships and the Brain Interact to Shape Who We Are*. New York: Guilford Press, 2012.
- Smeets, Elke, Kristin Neff, Hugo Alberts, and Madelon Peters. "Meeting Suffering with Kindness: Effects of a Brief Self-Compassion Intervention for Female College Students." *Journal of Clinical Psychology* 70, no. 9 (2014): 794–807.
- Song, Yeongsuk, and Ruth Lindquist. "Effects of Mindfulness-Based Stress Reduction on Depression, Anxiety, Stress and Mindfulness in Korean Nursing Students." *Nurse Education Today* 35, no. 1 (2015): 86–90.
- Tang, Y. Y., R. Tang, C. Jiang, and M. I. Posner. "Short-Term Meditation Intervention Improves Self-Regulation and Academic Performance." *Journal of Child Adolescent Behavior* 2, no. 154 (2014): 2.

- Taren, Adrienne A., J. David Creswell, and Peter J. Gianaros. "Dispositional Mindfulness Co-Varies with Smaller Amygdala and Caudate Volumes in Community Adults." *PLOS ONE* 8, no. 5 (2013): e64574.
- Warde, Carole M., Michelle Vermillion, and S. Uijtdehaage. "A Medical Student Leadership Course Led to Teamwork, Advocacy, and Mindfulness." *Family Medicine* 46, no. 6 (2014): 459–62.
- Zelazo, Philip David, and Kristen E. Lyons. "The Potential Benefits of Mindfulness Training in Early Childhood: A Developmental Social Cognitive Neuroscience Perspective." *Child Development Perspectives* 6, no. 2 (2012): 154–60.
- Zenner, Charlotte, Solveig Herrnleben-Kurz, and Harald Walach. "Mindfulness-Based Interventions in Schools—A Systematic Review and Meta-Analysis." *Frontiers Psychology* 5 (2014).
- Zoogman, Sarah, Simon B. Goldberg, William T. Hoyt, and Lisa Miller. "Mindfulness Interventions with Youth: A Meta-Analysis." *Mindfulness* (2014): 1–13.