

Chapter 17

Deep Breathing and Mindfulness: Simple Techniques to Promote Students' Self-regulation and Well-Being from the Inside Out



Kiat Hui Khng 

Abstract This chapter describes two sets of simple techniques—deep breathing and mindfulness-based practices—that have been successfully used in schools to help children cope with stress and anxiety, regulate emotions, and improve cognitive, social, and psychological well-being. Deep breathing can be easily taught to children and applied in a self-directed manner to immediately regulate adverse effects of anxiety, stress, or other negative affectivity and arousal, enhancing emotional and cognitive well-being. Though mindfulness-based practices may also be applied for immediate self-regulatory effects, practice over time brings additional benefits such as self-and-other awareness and compassion, and better intra- and interpersonal relationships. Both techniques can promote cognitive, emotional, and behavioral self-regulation, contributing towards resilience and well-being. The evidence supporting these techniques, their mechanisms, and how they complement positive psychology and social emotional learning are described. Applications in Asian school settings and issues related to implementation are discussed.

Practitioner Points

- Deep breathing and mindfulness-based practices are evidence-based techniques that can be taught to children in schools to help with their self-regulation and well-being.
- The two “inside out” techniques can complement other positive psychology and social emotional learning programs.

An important role of education is to prepare children for life. Along with the changing exigencies of modern life and society, and advancements in scientific

K. H. Khng (✉)

Centre for Research in Child Development, Office of Education Research, National Institute of Education, Nanyang Technological University, 1 Nanyang Walk, Singapore 637616, Singapore
e-mail: kiathui.khng@nie.edu.sg

research and theory, educational goals have evolved to take more holistic perspectives. Well-being, and fostering skills that enable and promote lifelong well-being, has become a prominent objective in educational systems around the world, along with the shift towards developing positive psychological assets that allow individuals to flourish and thrive (see e.g., Miller et al., 2009). An important life skill for maintaining well-being—across cultures and contexts—is the ability to self-manage or self-regulate. Schools are increasingly aware of the importance of equipping students with coping tools or resources for their self-regulation of, for example, stress and anxiety, and to develop protective factors promoting resilience and well-being.

This chapter begins with a brief introduction to the broad concepts of well-being and self-regulation, how they are intimately related, and their relevance to education. The next section introduces simple, evidence-based techniques that schools can teach to students to enhance their self-regulation and well-being. The scientific basis and evidence supporting these techniques and their mechanisms, how they relate to positive psychology (PP) and social emotional learning (SEL), and their applications in Asian school settings, are briefly discussed.

Well-Being and Self-regulation

Well-being is a broad, multifaceted construct. Conceptualizations of what constitutes a child “feeling and functioning well” vary, but core aspects of well-being generally include physical, social, cognitive, psychological (also studied as mental-health), and economic dimensions (Pollard & Lee, 2003). With increasing attention on the importance of self-regulation for lifespan development, some recent conceptualizations consider self-regulation a domain of well-being (e.g., Newland, 2014). However, as discussed later in this section, self-regulation cuts across well-being domains and should be regarded as a domain-general competency that can contribute to well-being.

Well-Being

How well-being in general and within each domain is defined and measured can vary vastly across studies. Psychological well-being has been reflected by a range of negative or deficit indicators (e.g., depression, anxiety, adjustment/behavioral problems, and psychiatric symptoms) and positive indicators (e.g., self-esteem, happiness, resilience, coping, and socio-emotional adjustment/functioning). Other components of well-being cover the social (e.g., relationships with peers and family), physical (e.g., physical health), cognitive (e.g., academic achievement), and economic (e.g., family income) realms (Pollard & Lee, 2003).

Studies of child and youth well-being typically focus more on physical, social, cognitive, and particularly, psychological domains (Pollard & Lee, 2003). The past

two decades saw a shift in child well-being research towards children's self-appraisals or their subjective well-being; a model of well-being focused on strengths and positive outcomes rather than risks and deficits (Newland, 2014; Pollard & Lee, 2003), and the associated emphasis on building preventive competencies that promote health and wellness rather than or in addition to assessing states and reducing pathology or afflictions (e.g., Miller et al., 2009). Education systems have traditionally focused on developing some aspects of children's well-being more (e.g., academic competence, physical health and fitness, character strengths) than others; the recent years have seen a new emphasis on mental health and psychological well-being, and in developing related skills such as resilience and socio-emotional competence.

Self-regulation

A key competency underlying well-being is self-regulation, which has been called the "key to success in life" (Baumeister et al., 2002). International longitudinal studies have found early self-regulation to be one of the most important predictors of success in various domains in later life (see e.g., Diamond, 2013). Related to constructs/concepts such as self-management, metacognition, coping, and self-control, self-regulation can be broadly summed as "the many processes by which the human psyche exercises control over its functions, states, and inner processes" (Vohs & Baumeister, 2016, p. 1). It refers to the various "self-corrective adjustments" an individual makes, volitionally and consciously or automatic and unconsciously, that allows the individual to "stay on track" towards current or longer-term goals or standards (Carver, 2016, p. 13). Self-regulation is sometimes used interchangeably with self-control, which tends to refer to more conscious and deliberate efforts (e.g., resisting temptations or impulse control). Self-regulation has been described to encompass a broader scope that includes automatic or nonconscious processes (e.g., physiological homeostasis to maintain a stable and optimal state of functioning) (Vohs & Baumeister, 2016).

Self-regulation involves a balance between top-down cognitive control and bottom-up, stimulus-driven arousal (Blair, 2016). Top-down cognitive control is supported by a set of executive functions (EFs): *working memory* (WM) enables one to monitor, update, and manipulate information in one's mental workspace; *shifting, switching, or cognitive/mental flexibility*, enables one to switch between mental sets (e.g., task rules); *inhibition or inhibitory control* enables one to resist interference from irrelevant or conflicting information, inappropriate impulses and prepotent responses (e.g., Perone et al., 2018). In self-regulation, EFs work together to regulate cognition, emotions, and actions in support of goal-directed behaviors. For example, cognitive self-regulation to focus attention on an object/task involves *maintaining/updating* the task goal and rules in mind (WM), *inhibiting* distractors competing for and taking attention away from the task at hand, *monitoring* when attention has drifted (WM) and *shifting* attention back to the object/task.

Cognitive, Emotional, and Behavioral Self-regulation

Although self-regulation is often differentiated among cognitive, emotional, and behavioral domains, they are intimately related and interact. From infancy, humans show the ability to regulate emotional distress by shifting their attention to other stimuli in the environment—that is, via cognitive/attentional regulation (Harman et al., 1997). At very young ages, self-regulation is not well-developed and regulation is often other-initiated (e.g., caregiver prompting a distressed baby to look at a toy). Development in *self-regulation* across childhood increases with brain maturation, particularly the prefrontal cortex and the EFs they support (e.g., Perone et al., 2018). Sometimes studied as the development of effortful control (over automatic tendencies or responses), the stronger biasing from top-down cognitive control versus bottom-up emotional reactivity allows for better self-regulatory outcomes with development (e.g., Eisenberg et al., 2016).

Throughout development, evidence is found supporting the positive link between individual differences in attentional control (i.e., cognitive self-regulation) and emotional regulation¹ and well-being. Furthermore, poor cognitive regulation can result in poor emotional regulation, resulting in increased need for emotion-linked behavioral regulation; poor emotional and/or behavioral regulation can in turn impact children’s social functioning and development (Eisenberg & Fabes, 1992; Rothbart et al., 2016). Hence, from academic performance to psychological distress, to social competence and moral development, to substance abuse and criminality, self-regulation impacts practically all areas of an individual’s functioning and well-being (see e.g., Diamond, 2013; Eisenberg et al., 2016).

Promoting Self-regulation and Well-Being in Schools

Several approaches such as positive psychology/education and SEL are used in schools around the world to enhance children’s resilience, social-emotional competences and mental well-being. A related approach that has seen growing subscription from pre-kindergarten to university education, extending to even educators and parents (i.e., a community approach) is mindfulness-based programs and mindfulness-based practices (MBP)—which overlap with and are sometimes incorporated with larger PP and SEL programs.

¹ Apart from where regulation is specifically other-initiated, regulation in the individual refers to self-regulation.

Mindfulness and Cognitive-Emotional Self-regulation and Well-Being

The practice of mindfulness “as a self-regulatory coping strategy” was first introduced to help patients cope with the stress and suffering of chronic pain, in a program that became the well-known Mindfulness-Based Stress Reduction (MBSR) program (Kabat-Zinn, 1982, 2003). Publications and reviews of the positive effects of MBSR has led to great interest in MBSR-based practices and their integration in a wide range of clinical and non-clinical settings (e.g., Chiesa & Serretti, 2009; Keng et al., 2011), including in education (see e.g., Maynard et al., 2017).

Mindfulness and Self-regulation

Mindfulness refers to “the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment” (Kabat-Zinn, 2003, p. 145). It is essentially about paying attention in a certain way—with deliberate intention to give attentional focus to whatever is arising in the present moment (i.e., awareness), with an attitude of openness and objectivity. Paying attention is a universal and natural ability, though the quality and the way with which attention is deployed, varies across individuals—some are more prone than others to paying attention in the mindful manner described.

Sometimes referred to as mindful attention training, a variety of MBPs are used in mindfulness-based programs to give repeated practice in paying attention in a mindful manner. Exercises typically involve directing one’s attention to focus on an object or sensation (e.g., sensations of the breath in the body during mindful breathing), *maintaining* attention on the object of present focus, *monitoring* and noticing when attention has drifted to, for example, ruminative thoughts, resisting/*inhibiting* engaging in elaborative processing of those thoughts, and *shifting* attention back to the present focus of attention. The attitude of nonjudgment involves being open and curious to the object/event/experience of attention, which necessitates *inhibiting* prepotent, automatically-triggered biases in perception, and seeing and accepting the object/event/experience as it presents itself. It is acknowledged that the mind is naturally prone to wandering, and attention prone to drifting. Any thought or emotion that arises during the practice is simply observed/noticed and acknowledged, *inhibiting* the prepotent/reflexive tendency to ascribe judgment or value to their content, such as self-blame for failing to maintain focus.

Practicing mindfulness is, thus at its core, practicing attentional self-regulation and the underlying EFs. Improvement in EF, attentional control and self-regulation is often found with mindfulness-based training (e.g., Chiesa et al., 2011; Meiklejohn et al., 2012), including evidence suggesting an enhanced self-regulatory neural system (Kilpatrick et al., 2011; Malinowski, 2013). As previously discussed, the improvement in attentional control and self-regulatory functions also allow for better

emotion and behavior regulation, which can in turn facilitate interpersonal or social functioning and well-being (e.g., Malinowski, 2013).

In addition to mindful breathing, common MBPs include mindful listening, watching, eating, walking and movement. Body scan is often practiced, in which attention is swept over the parts of one's body (e.g., from tip of the toes to top of the head), being aware of the sensations experienced in each part as well as a sense of the body as a whole. Typically, the exercises progressively increase in duration. When stability of attention is achieved, one practices broadening the focus/scope of attention to include all sensations and mental events as they occur in the moment. Though practicing an open and nonjudgmental attitude naturally fosters self- and other-kindness and compassion, explicit kindness-compassion practices, such as sending kind thoughts to oneself/others, are sometimes included. In addition to formal practices, practicing mindful attention informally in daily activities and interactions is encouraged (Meiklejohn et al., 2012).

It is important to note that the goal in MBP is not to suppress thoughts or emotions—they are treated with the same openness, curiosity and acceptance as part of the moment's experience—but to have the self-awareness to notice when they arise and the ability to choose to redirect attention flexibly back to the object of focus. Hence, MBP may also be experienced as empowering with its emphasis on personal agency, self-awareness and choice—where individuals can assume some responsibility for and play an active part in their own well-being (Kabat-Zinn, 1982). The ability to always choose to start again, over and over as one encounters failure to keep focused during a practice can also be empowering to experience, thereby building resilience. The practice of noticing, acceptance and nonjudgement in MBP has been argued to be valuable for children and adolescents, in particular, in getting to know and be comfortable with their thoughts and emotions. The objectivity and detached observation allows one to dissociate transient negative emotions from self-identity; the self-awareness and self-monitoring also allows for timely recognition of the need for deliberate actions towards self-regulation.

Mindfulness is “a way of being that takes ongoing effort to develop and refine”, rather than “simply a method that one encounters for a brief time at a professional seminar and then passes on to others for use as needed when they find themselves tense or stressed” (Kabat-Zinn, 2003, p. 149). However, though many benefits of MBP may only surface after a period of practice (e.g., developing positive dispositional traits), some immediate benefits on cognitive, emotional, and behavioral regulation (i.e., positive subjective states and well-being) can be experienced with brief practices—even in young children (e.g., Nadler et al., 2017). On the most basic level, MBPs provide a stable “anchor” to which one's attention can always return. For instance, when it is hard to keep a clear and calm mind in times of negative emotional arousal, one can take a short pause to quickly anchor their attention back to the sensations of the breath, to a space of inner calm. Single sessions of brief practice (8–20 min) have been found to reduce physiological indicators of anger even in novices (Fennell et al., 2016), increase self-reported calmness in children (Nadler et al., 2017), and help adolescents disengage from distress ruminative states (Hilt & Pollak, 2012). Though effects can vary, documented benefits include

improved attention and EF; reduced stress, depression, anxiety and psychological distress; and increased self-compassion, empathy, and resilience (for reviews, see e.g., Chiesa et al., 2011; Dunning et al., 2018; Keng et al., 2011; Meiklejohn et al., 2012).

Mindfulness in Schools

Recognizing that MBPs provide an accessible way to help children with cognitive, emotional and behavioral self-regulation, MBPs are increasingly incorporated to support education in schools. Practices for children are typically age-appropriate versions that are shorter, include more movement-based exercises, and use analogies and metaphors involving familiar objects and activities that are engaging for children. Elements such as awareness of emotions may also be given more explicit focus. For example, “Mini-Mind” for preschools comprises 25-min sessions, with activities such as “Glitter jar” (see Wood et al., 2018), a commonly used exercise for children and youths to practice mindful watching and observing, and to illustrate the concept of how thoughts and emotions stirred up by events swirl in the mind, and how stillness and clarity can be found by learning to “settle the monkey mind” (Arthurson, 2015).

Manualized mindfulness-based curricula for children and schools have been developed: some with training and support for educators, school leaders, and even parents; most include variations adapted for different ages. Widely-used programs include the Mindful Schools (K-12), Learning to BREATHE (adolescents), and the “.b” series (7–18 year olds). Some combine mindfulness-based training with other programs, such as SEL or PP (see e.g., Felver et al., 2016). In MindUP (PreK-8), for example, Mindful Awareness forms one of “four pillars to promote positive mental health and well-being”, together with PP, SEL, and Neuroscience (Schonert-Reichl et al., 2015). Likewise, Mindfulness forms one of the Four Pillars of Wellbeing in The Contentment Foundation’s (TCF) curriculum (PreK-12), together with Community, Self-Curiosity, and Contentment; Social, Emotional and Ethical Learning (SEE; K-12) enhances SEL with the cultivation of mindful attention, and resilience, compassion, and non-sectarian ethics.

The cultivation of mindfulness is most effective when fostered using an institutional or community approach. Programs such as Mindful Schools provide not just curricula for students and training for school teachers to teach them, but also training in school-wide implementation for educators and school leaders; many include workshops for parents. The TCF Four Pillars is a whole-school program focused on supporting schools with school-wide implementation and also provides accompanying apps for families to extend practices into the family unit and the home environment.

A Complementary Skill “from the Inside Out”

A few reasons underlie the popular adoption of MBPs to foster student well-being in schools. First, MBP is a well-being approach with the potential to enhance all aspects of self-regulation—cognitive, emotional, and behavioral—at the same time, and is one of the few, if not only, well-being approaches that also strengthens EF and attention. For the first time, instead of just demanding that students pay attention in class, schools are able to teach children *how* to pay attention, and “how to stop their mind wandering and regulate attention and emotions, to deal with feelings of frustration, and to self-motivate” (Zenner et al., 2014; p. 2). Second, the “learning” in mindfulness is largely experiential and developed implicitly through mindfulness-based activities. Hence, little material needs to be learnt. It has been called an approach that teaches “from the inside out”, focusing on the self-awareness and self-management that arise from enhancing internal attentional self-regulation, rather than the “outside in” approach in many SEL and Positive Interventions and Support programs (Semple et al., 2017). This aspect of MBP may be especially welcomed given the amount of skills and knowledge that students already need to learn “from the outside in”.

As indicated by the new-wave programs integrating MBP with SEL or PP, skills and knowledge learnt “from the outside in” and “from the inside out” are complementary in promoting social-emotional competence and well-being. For instance, though mindfulness enables a pause between stimulus and reactivity, which allows for more appropriate responding, one may not know what the appropriate response should be. Prosocial skills learnt in SEL, for example, can then come in. Conversely, one may have the full repertoire of appropriate responses for intra- and inter-personal management but lack the awareness to realize when they are required, or the “space” to inhibit inappropriate reflexive responding so as to execute appropriate ones. Self-regulation involves the self-monitoring and self-awareness of (i.e., paying attention to) a need for regulation; likewise, compassion towards the self or others first requires attending to or being aware of the presence of a need for compassion. One competency children develop in MBP is to notice and recognize physiological sensations associated with emotional responses, such as anxiety, stress, or anger. In addition to reduced physiological reactivity to such stressors over time, children can more directly recognize the need to manage their emotions as they arise, and find the pause that allows them to apply appropriate strategies.

Mindfulness in Asian Schools

The adoption of MBP in K-12 schools in Asia seems less widespread than in the West. In Maynard et al.’s (2017) review on the effects of mindfulness-based interventions for primary and secondary school students, only 5% of the studies were from Asia. However, though only two studies fell within the inclusion criteria in Maynard et al. (2017), the extent of adoption in Asian schools is slightly wider.

Notable Asian countries that have published research findings on MBPs in K-12 school settings include Hong Kong (e.g., Lam & Seiden, 2019), Korea (Kim

et al., 2019), Thailand (Siripornpanich et al., 2018), Vietnam (Le & Trieu, 2016), Indonesia (Dewi et al., 2015), and India (e.g., Anand & Sharma, 2014). In Singapore, several schools have reportedly adopted MBPs; some as part of SEL or PP programs. Some schools report integrating single practices, such as mindful breathing, into daily school routines—for example, to let students settle down after recess. Schools adopting full MBPs have mainly used “gold-standard” programs from the US and UK, such as Mindful Schools and “.b”. One school reported using the “.b” program for all their students; one study reported a controlled trial of the Mindful Schools curriculum with at-risk adolescents. Feedback collected from the above two implementations suggested that though reception and engagement with the MBPs varied across students, they were generally positively received from at least most of the participants, with some students reporting finding the techniques learnt useful for helping with emotional and/or attentional regulation. The Mindful Schools study also gathered feedback from the intervention classes’ main teachers who reported observing improvements in students’ self-awareness, attentional and behavior regulation, and interpersonal well-being in a substantial proportion of the intervention students. Spillover benefits for the teachers included better teacher-student interactions and gaining extra teaching time (from students’ improved ability to settle down) (see Khng, 2018).

The “success” of the MBPs in terms of student engagement and benefits can vary across students, and not all may take to the practices. The Singapore Mindful Schools study shared similarities with what was observed in the Hong Kong studies (e.g., Lam & Seiden, 2019) in terms of attendance, engagement and reception by academically poor or at-risk students. In general, approximately half the students would show interest and be consistent in attendance; those who do are more engaged and found the techniques useful for helping with attentional or emotional regulation and well-being; different students favor different MBPs, though more “active” practices such as mindful eating tend to be popular; commitment and effort to practice regularly can be challenging. Suggestions to enhance the appeal of MBPs to students include shorter, more varied and less “passive” or static practices, more use of metaphors, interpersonal rapport, small class sizes and conducive environments (Lam et al., 2015). Cultural alignment also helps: Le and Trieu (2016) attributes the success of their MBP implementation with Vietnamese youths partly to the reason that the principles of mindfulness are already implicit in some aspects of traditional Vietnamese culture. This enabled the facilitators to use stories, folklore or proverbs that were familiar and relatable to the students to illustrate ideas and concepts. Participation by subscription instead of conscription might have also helped. It is likely an issue of universal school-based programs (not limited to MBPs) that not all students will like or benefit (or to the same extent) from one single approach. It may thus be necessary to introduce to students various tools or approaches to enhance self-regulation and well-being so they may use what works best for them. The evidence thus far strongly suggests that MBP is one of them.

The fledgling state of mindfulness in schools in Asia may come across as surprising since MBPs have their roots in Eastern practices. From the limited mindfulness-in-schools literature from Asia, it appears MBPs may be better accepted

and received in some Asian societies than others—for instance, Vietnam and Thailand, where the traditional culture is more aligned with the historical roots of mindfulness practice. Although contemporary MBSR-based MBPs are secular and independent of religious values or beliefs (see Brensilver, 2016, for a discussion), concerns regarding secularity remain a barrier to more widespread implementation in schools in parts of the world. Other barriers include a lack of awareness or understanding of MBPs in stakeholders, the resource commitment required from schools to build capacity and to set aside the time and space for implementation, and issues related to student interest and engagement—though this can be countered with a school-wide implementation approach, as some have done, including schools in Singapore (see Khng, 2018).

Deep Breathing for Emotion-Cognitive Self-regulation and Well-Being

A related evidence-based technique that can easily be added to students' toolbox for cognitive-emotional self-regulation and well-being is simple deep breathing. Unlike in mindful breathing, where instructions are focused on how attention is being paid to sensations of the breath, and simply noticing what is occurring without doing anything to change how one is breathing, deep breathing involves instructions on directing the breath but not on managing how attention is being paid, including to any arising thoughts or emotions. Thus, the two techniques are very different in terms of orientation and primary targeted mechanism. Mindful breathing acts via cognitive control and attention regulation while simple deep breathing acts via direct physiological regulation.

In deep breathing, one takes slow, gentle breaths deep into the belly—also known as abdominal breathing, belly breathing or diaphragmatic breathing. This is in contrast to chest or thoracic breathing, where the breath is taken shallowly into the chest. Breathing patterns are closely tied to emotional and autonomic arousal states. Unpleasant emotionality, stress, anxiety, fear, aggression, and tension are typically accompanied by the rapid, shallow, thoracic breathing associated with the fight-or-flight response; pleasant affect and relaxation tend to be associated with slow, deep, abdominal breathing (Boiten et al., 1994). By changing or regulating respiratory patterns, emotional states can also be regulated. Our emotional states can affect our cognitive states or our ability to function cognitively. For example, it is well known that even high ability students can “choke under pressure” (Baumeister, 1984). Test anxiety is a prevalent problem affecting the cognitive (e.g., underperformance) and emotional (e.g., stress/distress, anxiety, depression) well-being of students of all ages and abilities (von der Embse et al., 2018).

As previously described, self-regulation involves the balance between top-down cognitive control and bottom-up, stimulus-driven arousal. Top-down cognitive control interacts with bottom-up activity from attention, emotion, and stress

response systems in a feedback loop system such that bottom-up arousal also affects EF and cognitive processes (Blair, 2016). Similar to the well-known inverted U-shape Yerkes-Dodson effect (Yerkes & Dodson, 1908), while some level of arousal can facilitate cognitive functioning, overly high (or low) levels of arousal can impair functioning (Blair, 2016). Regulating one's emotional arousal state (and well-being) can thus impact their cognitive state and performance.

A Better State-of-Mind: Deep Breathing Reduces Anxiety and Improves Performance

Simply deep breathing has been demonstrated to effectively enhance cognitive and emotional well-being in students. In a pretest–posttest controlled trial, Khng (2018) taught Primary 5 students (~5th graders) in Singapore to take slow, deep abdominal breaths while they sat for a timed math test under evaluative (i.e., test-anxiety inducing) conditions. Compared to the control group of students, students who practiced the deep breathing showed a significantly greater reduction in self-ratings of state anxiety at the start of the test and greater improvement in math test scores. Mediation analysis showed that deep breathing enhanced emotional well-being (i.e., reduced anxiety), leading to better cognitive well-being (i.e., state-of-mind) during the test, in turn leading to better test performance.

Breathing techniques have long been used in interventions or therapies, particularly in the treatment of anxiety-related issues. However, the efficacy of deep breathing as a standalone technique for emotional and cognitive self-regulation has not often been examined. Khng's (2018) findings are consistent with studies that found breathing techniques to improve aspects of emotional regulation and well-being and task performance (e.g., Brunyé et al., 2013). Khng's (2018) findings also support the aforementioned bidirectional psychobiological model of self-regulation (Blair, 2016): simply regulating one's breathing (physiological state) can have direct effects on regulating one's emotional state, and through that regulate cognitive state and performance.

Teaching Students Deep Breathing in Schools

Deep breathing is a simple technique that circumvents most of the previously discussed barriers to implementing school-based MBPs and can be easily incorporated into school curricula in a fuss-free manner. Schools can teach students to simply take deep breaths when they need to calm down and/or focus, such as in times of anxiety, anger, or other states of emotional and physiological arousal. Though the effect sizes of simply taking a few deep breaths may be, expectedly, in the small range (Khng, 2018), it is a simple and quick supplementary technique that schools can easily teach to help enhance children's well-being with minimal resource commitment. Taking deep breaths is also universal and naturalistic, with no affiliation to particular traditions and is unlikely to encounter resistance on that

front. Once learnt, it becomes an accessible coping tool for children to apply in a self-directed manner, for immediate effect.

On the other hand, though deep breathing can be a standalone coping strategy, its effects are more transitory (i.e., state-like) and limited in scope compared to the wider-ranging, longer-term and more stable (i.e., trait/dispositional-like) effects of MBP. Mindfulness awareness can also help children monitor their autonomic arousal states and identify when to apply the deep breathing technique. Khng (2018) found that deep breathing may be especially helpful in enhancing performance for children prone to autonomic manifestations of test anxiety (e.g., “my heart beats fast” when taking tests). The ability to notice changes in bodily sensations, as trained in MBP could facilitate children using the technique in a self-directed manner. Some evidence also suggest it may be particularly useful for boys to learn how to use deep breathing to regulate their emotional states (Khng, 2018). In Singapore, some schools have reportedly incorporated deep breathing into their school routines (see Khng, 2018). Future research could examine the effects of such implementations.

Conclusions

Stressors are inevitable in life. The ability to cope and self-regulate in the face of stressors is a critical skill that enables individuals to survive and to thrive and flourish. This chapter presented two techniques aligned with Seligman’s (2002) three pillars of PP that schools can use to help children develop these skills. Mindfulness and deep breathing techniques focus on expanding and enhancing children’s inner capacities for self-regulation and are complementary to other SEL and PP techniques. Deep breathing is simple and accessible and can contribute towards students’ positive subjective experiences/states and well-being; MBP, though more complex for school implementations, can additionally contribute towards students’ positive personality traits, and positive institutions and communities.

Acknowledgements This chapter includes work funded by the Education Research Funding Programme (SUG 22/12 KKH), National Institute of Education (NIE), Nanyang Technological University, Singapore. The views expressed in this paper are the author’s and do not necessarily reflect the views of NIE. The author will like to thank the funding agency, all participating children and their parents, schools and teachers, and all research assistants involved in the study.

References

- Anand, U., & Sharma, M. P. (2014). Effectiveness of a mindfulness-based stress reduction program on stress and well-being in adolescents in a school setting. *Indian Journal of Positive Psychology*, 5(1), 17–22.

- Arthurson, K. (2015). Teaching mindfulness to year sevens as part of health and personal development. *Australian Journal of Teacher Education*, 40(5), 2. <https://doi.org/10.14221/ajte.2015v40n5.2>
- Baumeister, R. F. (1984). Choking under pressure: Self-consciousness and paradoxical effects of incentives on skillful performance. *Journal of Personality and Social Psychology*, 46(3), 610–620. <https://doi.org/10.1037/0022-3514.46.3.610>
- Blair, C. (2016). The development of executive functions and self-regulation: A bidirectional psychobiological model. In K. D. Vohs & R. F. Baumeister (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 417–439). The Guilford Press.
- Boiten, F. A., Frijda, N. H., & Wientjes, C. J. (1994). Emotions and respiratory patterns: Review and critical analysis. *International Journal of Psychophysiology*, 17(2), 103–128. [https://doi.org/10.1016/0167-8760\(94\)90027-2](https://doi.org/10.1016/0167-8760(94)90027-2)
- Brensilver, M. (2016). *The Secular Qualities of Mindfulness*. Retrieved September 12, from <http://www.mindfulschools.org/foundation-concepts/mindfulness-and-secularity/>
- Brunyé, T. T., Mahoney, C. R., Giles, G. E., Rapp, D. N., Taylor, H. A., & Kanarek, R. B. (2013). Learning to relax: Evaluating four brief interventions for overcoming the negative emotions accompanying math anxiety. *Learning and Individual Differences*, 27, 1–7. <https://doi.org/10.1016/j.lindif.2013.06.008>
- Carver, C. S. (2016). Self-regulation of action and affect. In K. D. Vohs & R. F. Baumeister (Eds.), *Handbook of self-regulation: Research, theory, and applications* (3rd ed., pp. 13–39). Guilford Press.
- Chiesa, A., Calati, R., & Serretti, A. (2011). Does mindfulness training improve cognitive abilities? A systematic review of neuropsychological findings. *Clinical Psychology Review*, 31(3), 449–464. <https://doi.org/10.1016/j.cpr.2010.11.003>
- Chiesa, A., & Serretti, A. (2009). Mindfulness-based stress reduction for stress management in healthy people: A review and meta-analysis. *The Journal of Alternative and Complementary Medicine*, 15(5), 593–600. <https://doi.org/10.1089/acm.2008.0495>
- Dewi, S. Y., Wiwie, M., Sastroasmoro, S., Irwanto, Purba, J. S., Pleyte, W. E. H., Mulyono, & Haniman, F. (2015). Effectiveness of mindfulness therapy among adolescent with conduct disorder in Jakarta, Indonesia. *Procedia—Social and Behavioral Sciences*, 165, 62–68. <https://doi.org/10.1016/j.sbspro.2014.12.605>
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64(1), 135–168. <https://doi.org/10.1146/annurev-psych-113011-143750>
- Dunning, D. L., Griffiths, K., Kuyken, W., Crane, C., Foulkes, L., Parker, J., & Dalgleish, T. (2018). Research review: The effects of mindfulness-based interventions on cognition and mental health in children and adolescents—A meta-analysis of randomized controlled trials. *Journal of Child Psychology and Psychiatry*. <https://doi.org/10.1111/jcpp.12980>
- Eisenberg, N., Smith, C. L., Sadovsky, A., & Spinrad, T. L. (2016). Effortful control: Relations with emotion regulation, adjustment, and socialization in childhood. In *Handbook of self-regulation: Research, theory, and applications* (3rd ed., pp. 259–283). Guilford Press.
- Eisenberg, N. E., & Fabes, R. A. (1992). *Emotion and its regulation in early development*. Jossey-Bass.
- Felver, J. C., Celis-de Hoyos, C. E., Tezanos, K., & Singh, N. N. (2016). A systematic review of mindfulness-based interventions for youth in school settings. *Mindfulness*, 7(1), 34–45. <https://doi.org/10.1007/s12671-015-0389-4>
- Fennell, A. B., Benau, E. M., & Atchley, R. A. (2016). A single session of meditation reduces of physiological indices of anger in both experienced and novice meditators. *Consciousness and Cognition*, 40, 54–66. <https://doi.org/10.1016/j.concog.2015.12.010>
- Harman, C., Rothbart, M. K., & Posner, M. I. (1997). Distress and attention interactions in early infancy. *Motivation and Emotion*, 21(1), 27–44.
- Hilt, L. M., & Pollak, S. D. (2012). Getting out of rumination: Comparison of three brief interventions in a sample of youth. *Journal of Abnormal Child Psychology*, 40(7), 1157–1165. <https://doi.org/10.1007/s10802-012-9638-3>

- Kabat-Zinn, J. (1982). An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations and preliminary results. *General Hospital Psychiatry, 4*(1), 33–47.
- Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice, 10*(2), 144–156. <https://doi.org/10.1093/clipsy.bpg016>
- Keng, S.-L., Smoski, M. J., & Robins, C. J. (2011). Effects of mindfulness on psychological health: A review of empirical studies. *Clinical Psychology Review, 31*(6), 1041–1056. <https://doi.org/10.1016/j.cpr.2011.04.006>
- Khng, K. H. (2018). Mindfulness in education: The case of Singapore. Learning: Research and Practice. <https://doi.org/10.1080/23735082.2018.1428120>
- Kilpatrick, L. A., Suyenobu, B. Y., Smith, S. R., Bueller, J. A., Goodman, T., Creswell, J. D., Tillisch, K., Mayer, E. A., & Naliboff, B. D. (2011). Impact of mindfulness-based stress reduction training on intrinsic brain connectivity. *NeuroImage, 56*(1), 290–298. <https://doi.org/10.1016/j.neuroimage.2011.02.034>
- Kim, E., Jackman, M. M., Jo, S.-H., Oh, J., Ko, S.-Y., McPherson, C. L., & Singh, N. N. (2019). Parental social validity of the mindfulness-based OpenMind-Korea (OM-K) preschool program. *Journal of Child & Family Studies, 28*(10), 2922–2926. <https://doi.org/10.1007/s10826-019-01516-3>
- Lam, C. C., Lau, N. S., Lo, H. H., & Woo, D. M. S. (2015). Developing mindfulness programs for adolescents: Lessons learned from an attempt in Hong Kong. *Social Work in Mental Health, 13*(4), 365–389. <https://doi.org/10.1080/15332985.2014.932885>
- Lam, K., & Seiden, D. (2019). Effects of a brief mindfulness curriculum on self-reported executive functioning and emotion regulation in Hong Kong adolescents. *Mindfulness, 10*(7), 12671–12677. <https://doi.org/10.1007/s12671-019-01257-w>
- Le, T. N., & Trieu, D. T. (2016). Feasibility of a mindfulness-based intervention to address youth issues in Vietnam. *Health Promotion International, 31*(2), 470–479. <https://doi.org/10.1093/heapromot/dau101>
- Malinowski, P. (2013). Neural mechanisms of attentional control in mindfulness meditation. *Frontiers in Neuroscience, 7*, 8. <https://doi.org/10.3389/fnins.2013.00008>
- Maynard, B. R., Solis, M., Miller, V., & Brendel, K. E. (2017). Mindfulness-based interventions for improving cognition, academic achievement, behavior and socio-emotional functioning of primary and secondary students. *Campbell Systematic Reviews, 13*. <https://doi.org/10.4073/csr.2017.5>
- Meiklejohn, J., Phillips, C., Freedman, M. L., Griffin, M. L., Biegel, G., Roach, A., Frank, J., Burke, C., Pinger, L., Soloway, G., Isberg, R., Sibinga, E., Grossman, L., & Saltzman, A. (2012). Integrating mindfulness training into K-12 education: Fostering the resilience of teachers and students. *Mindfulness, 3*(4), 291–307. <https://doi.org/10.1007/s12671-012-0094-5>
- Miller, D. N., Nickerson, A. B., & Jimerson, S. R. (2009). Positive psychology and school-based interventions. In *Handbook of positive psychology in schools* (pp. 293–304).
- Nadler, R., Cordy, M., Stengel, J., Segal, Z. V., & Hayden, E. P. (2017). A brief mindfulness practice increases self-reported calmness in young children: A pilot study. *Mindfulness, 8*(4), 1088–1095. <https://doi.org/10.1007/s12671-017-0685-2>
- Newland, L. A. (2014). Supportive family contexts: Promoting child well-being and resilience. *Early Child Development and Care, 184*(9–10), 1336–1346. <https://doi.org/10.1080/03004430.2013.875543>
- Perone, S., Almy, B., & Zelazo, P. D. (2018). Toward an understanding of the neural basis of executive function development. In R. Gibb & B. Kolb (Eds.), *The neurobiology of brain and behavioral development* (pp. 291–314). Academic Press. <https://doi.org/10.1016/B978-0-12-804036-2.00011-X>
- Pollard, E. L., & Lee, P. D. (2003). Child well-being: A systematic review of the literature. *Social Indicators Research, 61*(1), 59–78.
- Rothbart, M. K., Ellis, L. K., & Posner, M. I. (2016). Temperament and self-regulation. In *Handbook of self-regulation: Research, theory, and applications* (3rd ed., pp. 358–371). Guilford Press.

- Schonert-Reichl, K. A., Oberle, E., Lawlor, M. S., Abbott, D., Thomson, K., Oberlander, T. F., & Diamond, A. (2015). 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*(1), 52. <https://doi.org/10.1037/a0038454>
- Semple, R. J., Droutman, V., & Reid, B. A. (2017). Mindfulness goes to school: Things learned (so far) from research and real-world experiences. *Psychology in the Schools, 54*(1), 29–52. <https://doi.org/10.1002/pits.21981>
- Siripornpanich, V., Sampoon, K., Chaithirayanon, S., Kotchabhakdi, N., & Chutabhakdikul, N. (2018). Enhancing brain maturation through a mindfulness-based education in elementary school children: A quantitative EEG study. *Mindfulness, 9*(6), 1877–1884. <https://doi.org/10.1007/s12671-018-0930-3>
- Vohs, K. D., & Baumeister, R. F. (2016). Understanding self-regulation: An introduction. In K. D. Vohs & R. F. Baumeister (Eds.), *Handbook of self-regulation: Research, theory, and applications* (3rd ed., pp. 1–9). Guilford Press.
- von der Embse, N., Jester, D., Roy, D., & Post, J. (2018). Test anxiety effects, predictors, and correlates: A 30-year meta-analytic review. *Journal of Affective Disorders, 227*, 483–493. <https://doi.org/10.1016/j.jad.2017.11.048>
- Wood, L., Roach, A. T., Kearney, M. A., & Zabek, F. (2018). Enhancing executive function skills in preschoolers through a mindfulness-based intervention: A randomized, controlled pilot study. *Psychology in the Schools, 55*(6), 644–660. <https://doi.org/10.1002/pits.22136>
- Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology, 18*(5), 459–482. <https://doi.org/10.1002/cne.920180503>
- Zenner, C., Herrnleben-Kurz, S., & Walach, H. (2014). Mindfulness-based interventions in schools—A systematic review and meta-analysis. *Frontiers in Psychology, 5*, 603. <https://doi.org/10.3389/fpsyg.2014.00603>

Kiat Hui Khng is a senior education research scientist with the Centre for Research in Child Development (CRCD), National Institute of Education, Singapore. Interfacing developmental cognitive psychology, education, and science of learning, her research interests are focused on executive functions and self-regulation, their role in learning, development and well-being, and interventions to enhance them (such as mindfulness-based practices). She is also interested in neuroscience applications to education and utilizes functional neuroimaging techniques such as fMRI and EEG.