

**Critical Review:**  
**Among preschool and school-aged students, do mindfulness practices lead to improvements in executive functioning and self-regulation?**

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This critical review examines the evidence on mindfulness-based classroom interventions and the effect on students' executive functioning and self-regulatory behaviour. A literature search yielded eight relevant studies, four of which used a randomized clinical trial design and the remaining four used a quasi-experimental design. Overall, the evidence gathered in this review provides support for using mindfulness practices with students. Recommendations for future research and implications for clinical practice are discussed.

### ***Introduction***

Mindfulness-based programs have become a focus for addressing students' wellbeing to enhance learning and thus, are increasingly being integrated into classroom curricula (Nadler, Cordy, Stengel, Segal, & Hayden, 2017; Schonert-Reichl et al., 2015). The benefits of mindfulness meditation are well established for clinical disorders, particularly among adult populations (Crescentini, Capurso, Furlan, & Fabbro, 2016; Thierry, Bryant, Nobles, & Norris, 2016). However, only in recent years has research emerged on the effects of this approach on children's capacity to learn.

Core executive functions have a collective influence on self-regulation, "the ability to stay calmly focused and alert" (Shanker, 2010). Together, these skills have foundational implications for learning, including within the realm of language and literacy (Diamond, 2013). The ability to regulate emotions, cognitive processes and behaviour is key for student engagement in the learning process (Thierry et al., 2016). With this in mind, it is important to consider classroom approaches that facilitate the development of executive functioning and self-regulation. Mindfulness-based programs are suggested to be one such approach.

Mindfulness, or rather, mindful awareness involves controlling one's awareness as a means to focus on the present moment. The intention is to connect body and mind, by focusing on breath, external stimuli and tuning into one's sensations (visual, auditory, gustatory, tactile), thoughts and emotions (Napoli, Krech, & Holley, 2005; Flook et al., 2015). The ability to focus and maintain stillness is anticipated to improve with regular practice. The current review seeks to determine whether mindfulness practice in the classroom supports the development of executive

functioning and self-regulation, in order to further influence learning potential for preschool to elementary students.

### ***Objectives***

The primary objective of this paper is to critically review the current literature on mindfulness-based intervention approaches and their effect on executive functioning and self-regulation among children. The secondary objective is to provide a brief summary of implications for clinical practice, as well as possible directions for future research.

### ***Methods***

*Search Strategy:* Articles were searched through online databases (ProQuest, PsychInfo, Scholars Portal) with the following keywords: (mindfulness) AND (child\*) OR (student\*) OR (school) AND (executive function\*) OR (attention) OR (self-regulation). References provided in searched articles were used to find additional studies related to the present topic. The search was limited to articles written in English.

*Selection Criteria:* The studies selected for this critical review were required to investigate the impact of student-focused mindfulness-based interventions on executive functioning and/or self-regulation.

*Data Collection:* The results of this literature search yielded eight articles that met the aforementioned selection criteria. Four studies employed randomized clinical trials, while four followed a quasi-experimental design.

### ***Results***

#### Randomized Clinical Trials

Randomized Clinical Trials are an effective method of examining cause-and-effect relationships between independent and dependent variables. Random allocation to groups ensures that a difference between experimental and control groups can be determined with limited confounding variables. The following studies conducted mixed group randomized clinical trials.

Napoli *et al.* (2005) examined whether mindfulness practice training improved attention among 1<sup>st</sup> to 3<sup>rd</sup> grade students from two elementary schools in southwestern US. Classes were randomly divided into mindfulness (n=97 students) and control (n=97 students) groups. Mindfulness intervention was carried out for a 24-month period (12 bi-monthly sessions). Training sessions involved exercises that focused on paying attention to breath, movement activities and sensory stimulating activities. Before and after intervention, teachers completed gold-standard rating scales, looking at attention, hyperactivity, and social skills. Additionally, a standardized assessment protocol was used to assess students' selective and sustained attention. This study analyzed data using appropriate pre and post-test statistical methods. Results found that the students undergoing mindfulness training were significantly better at shifting attention, but no different in sustaining attention.

Some aspects of this study design are unclear, as no information on participant demographics was provided, nor on the extent of teacher training. Yet, it was indicated that students were assigned randomly to condition groups. Mindfulness sessions were infrequent, but spanned a longer duration than comparable studies. The study used a combination of measures with good validity and reliability. Overall, this study offers compelling evidence for improving students' ability to control focus of attention.

Flook *et al.* (2010) examined whether mindfulness awareness practice (MAP) program in the classroom improved executive functioning among 2<sup>nd</sup> and 3<sup>rd</sup> grade students in an on-campus university elementary school (US). Students (age 7-9 years) from four classrooms were randomly assigned to the MAP group (n=32) and the control group (n=32). The program was carried out for a total of 8 weeks, twice per week, including sitting meditation, body scans and weekly learning objectives regarding sensory awareness, attentional regulation, awareness of others and environment. Prior to and following intervention,

teachers and parents completed a gold-standard questionnaire of executive functioning abilities and behaviour regulation of students. This study used appropriate statistical analysis to compare post-test results between groups. Results showed no significant differences overall between groups, but a significant interaction suggested that students with poorer pre-test executive functioning showed greater improvements following MAP.

In this study, groups were controlled for class, gender and age. While the sole use of report measures may not be sensitive to subtle neurocognitive changes, there is good validity and reliability in the measures used. However, a report bias could have influenced results as teachers were not blind to the study goals. This study offers compelling evidence that mindfulness does not improve executive functioning.

Flook *et al.* (2015) examined the effect of a mindfulness-based kindness program among preschool children (mean age of 4.67 years). From seven classrooms from six public elementary schools in a mid-western US city, 68 students were randomly assigned to groups by classroom: mindfulness groups (n=30), and waitlist control groups (n=38). Baseline data was gathered by assessing students using gold-standard teacher-reports of self-regulation and standardized tests of executive functioning, including inhibitory control and cognitive flexibility. Students in the mindfulness group then underwent a 12-week mindfulness-based prosocial skills training during regular school hours, twice weekly for 20-30 minutes a session. Students in the waitlist control group carried on with curriculum as usual. Following the intervention period, students were again assessed using the above-named protocols. In addition, 3-months post-trial, the school grades of students were analyzed. This study utilized appropriate statistical methods for its purpose of determining significant change pre- to post-test results between groups. Results indicated significant differences in emotional regulation and small difference in cognitive flexibility with the mindfulness group being superior. No difference was found on other measures of executive functioning. The mindfulness group showed higher grades in approach to learning and social-emotional development, but no significant difference in grades for language and cognition.

The nature of this study design provides compelling evidence. The measures used have good reliability and validity, although a report bias could be present. Moreover, the delayed reporting of grades (3 months

post-intervention) may not be very sensitive to the effects of therapy due to the time-gap and potential for intervening factors to influence results.

Schonert-Reichl *et al.* (2015) examined the impact of a mindfulness education (ME) program on executive functioning, self-regulation and social-emotional competence among 4<sup>th</sup> and 5<sup>th</sup> grade students (M=10.24 years) from four suburban elementary schools in western Canada. Students were randomly divided into ME groups (n=48) and control group (n=51). Distribution of group participants was similar in terms of age, gender, language background and socio-economic status. The ME program ran for 12 weeks, once per week (40-50 minutes in duration), along with a core mindfulness practice (attentive listening to a single resonant sound) 3 times per day. Lessons targeted mindful smelling and tasting, perspective taking, empathy, optimism, and practicing gratitude. The control group followed a business-as-usual curriculum targeting social responsibility. Teachers, who administered the programs, kept a log for completion and adherence recording. Prior to and following the intervention period, students' executive functioning (attention, working memory, cognitive flexibility, inhibition) was assessed with a gold-standard assessment protocol. Gold-standard student self-report scales of mindful awareness, emotional control and perspective-taking were also used. This study used appropriate statistical methods to analyze data from student reports, teacher reports and standardized assessments. Results indicated greater increases in ME students' perspective-taking, emotional control and mindfulness, along with ability to selectively attend and inhibit distraction.

This study used measures with good validity and reliability, although a potential report bias could have influenced outcomes. Groups were matched on achievement level, socioeconomic status and ethnic diversity. However, within the mindfulness group, lesson coverage was not equal among classes, which could have impacted students' progress. Despite some limitations, this study offers compelling evidence to support mindfulness intervention.

### Quasi-experimental Studies

Quasi-experimental study designs permit examination of cause-and-affect relationships; however, because of limitations to random group allocation, results should be interpreted with some caution. This design is still appropriate for this population considering the constraints on conducting research within a school environment. The following

studies incorporated a quasi-experimental mixed group design.

Schonert-Reichl *et al.* (2010) examined the impact of a ME program, MindUP on 4<sup>th</sup> to 7<sup>th</sup> grader students' attention and self-regulation, among other variables. In 12 urban elementary public schools (Western Canada), classes were allocated to either a ME group (n=139 students) or not (n=107 students). Because groups were not matched for age, the control group was slightly older (M=11.65 years) than the ME group (M=11.10 years). Students came from diverse cultural and linguistic background, but were all deemed to be competent in English. The ME program, which was delivered by teachers, involved lessons on quieting the mind, mindful attention, managing negative emotions and thinking, acknowledgement of self and others. ME lessons were taught once per week over a 10-week period, along with practice of mindfulness attention exercises three times per day (3-minute duration). Teachers kept a practice log to determine completion of program components. Students' attention, regulating behaviours and social-emotional competence was assessed before and following the intervention period with scaled reports completed by teacher. This study used appropriate statistical methods to determine change and difference in scores. Results showed a difference in attention, concentration, emotional/behavioural regulation and social-emotional competence between groups with ME outperforming the control group.

The diversity of the sample population is indicated to be representative of the greater population. The validity and reliability of the measures are not clear and a potential report bias exists considering teachers implemented program and reported on progress. Overall, this study offers compelling evidence for using mindfulness programs with students in middle year grades.

Thierry *et al.* (2016) examined the effect of ME program called MindUP on executive functioning, in addition to language and literacy skills on a pre-kindergarten and kindergarten population. In a southwestern US urban elementary school, students in two separate cohorts were followed for a period of three years. The first (control) cohort included 24 students who followed through a regular stream of pre-kindergarten and kindergarten, incorporating a pre-existing approach to self-regulation development. The second (mindfulness) cohort included 23 students who underwent a MindUP program in pre-kindergarten. The MindUP program included 15 mindfulness-based lessons (20-30 minutes each) over

the course of the school year. Additionally, students engaged in core mindfulness practices (deep breathing, focusing on a single resonant sound) three times daily, which continued in kindergarten year. Classroom teachers with 1-day MindUP training lead the program. At the beginning and end of each cohort's prekindergarten year, parents and teachers completed a gold-standard questionnaire and students were assessed with a standardized language test. This study used appropriate statistical analyses to determine between group differences. Results showed no difference in inhibiting, shifting attention, and emotional control, but greater improvements for ME group in working memory and planning/organizing. Further, significant differences were noted in language and literacy post-kindergarten.

This study provided compelling evidence for mindfulness practice. Although this study did not fully randomize participants, the groups were closely matched on all demographic characteristics (cultural/linguistic background, socioeconomic status and language skills). Measures were both valid and reliable, but could be limited by a report bias, considering teachers administered the programs and were aware of goals.

Crescentini *et al.* (2016) examined the effect of mindfulness-oriented meditation (MOM) on cognitive, social, behavioural and emotional skills of 7 and 8 years old students in a single primary school (Italy). Students were divided into groups based on class; 16 students in MOM group and 15 students in control group. Participants in each group were comparable in age, gender, ethnicity and linguistic background. The MOM group attended 3 meetings over a period of 8 weeks, participating in breathing and body awareness exercises, followed by group discussions. Meditation time gradually increased with time. The control group read books targeting emotional awareness and recognition. Teachers completed gold-standard questionnaires on classroom behaviour prior to and following intervention. This study used appropriate statistical methods to determine differences between groups on teacher reported scores, indicating greater reduction in problem behaviour and improvement of inattention and cognitive abilities among the mindfulness group.

This study offers compelling evidence for mindfulness practices, considering it controlled for many variables. Although not completely randomized to groups, participants were matched for age, gender, education, and linguistic/cultural background. Programs were matched with regards to

format, leaving mindfulness as the single differentiated component. Moreover, measures had good reliability and validity, with ensuring that both students and teachers were blind to the study goals. One limitation was the small sample size on which the study was conducted.

Nadler *et al.* (2017) looked at whether mindfulness practice increased the calmness component of self-regulatory behaviour among 7-9 year olds. Samples were gathered from a classroom in a public school (Ontario, Canada) and an after-school program. Study one included 8 children in the mindfulness program and 6 in the control. Study two included 13 children in the mindfulness group and 15 in the control. The mindfulness practice involved mindful stretching and guided breath-based meditation. This group was lead by an experienced and trained yoga instructor. The control group engaged in quiet play (colouring, playing with blocks). Participants completed a gold-standard questionnaire prior to and following intervention as a way to self-report on states of arousal vs. calmness. This study used appropriate statistical methods to determine whether differences were apparent between groups through repeated measures. Results indicated a significant difference between conditions, with greater increase in calmness experienced by the mindfulness group. These results were consistent between study 1 and study 2.

This study considered implications of language ability by eliminating participants who demonstrated difficulties understanding instructions. However, the sample size was relatively small and the extent of demographic matching between groups is unclear. The reliability and validity of this measure is good. Overall, this study offers further compelling evidence to support mindfulness intervention.

### **Discussion**

Collectively, the studies reviewed provide compelling evidence for integrating mindfulness-based programs into preschool to elementary classrooms. Seven studies led to statistically significant outcomes of improved executive functioning and self-regulation in some capacity (Crescentini *et al.*, 2016; Flook *et al.*, 2015; Nadler *et al.*, 2017; Napoli *et al.*, 2005; Schonert-Reichl *et al.*, 2015; Schonert-Reichl *et al.*, 2010; Thierry *et al.*, 2016), while one study indicated no overall significant outcomes (Flook *et al.*, 2010).

Throughout this review, evidence has indicated that students practicing mindfulness show improvement

in a range of executive functions, broadly speaking, such as shifting attention (Napoli et al., 2005), selective attention (Schonert-Reichl et al., 2015), inhibition (Schonert-Reichl et al., 2015), cognitive flexibility (Flook et al., 2015), working memory (Thierry et al., 2016), planning and organizing (Thierry et al., 2016). Additionally, students showed improvements in emotional regulation (Flook et al., 2015; Schonert-Reichl et al., 2010) and behavioural regulation (Schonert-Reichl et al., 2010; Nadler et al., 2017).

Conversely, it is important to acknowledge that mindfulness intervention might not be an effective approach for improving executive functioning for all students. Indeed, Flook et al. (2010) found no significant improvement in the mindfulness group compared to the control group in this domain. However, this practice was found to be more beneficial for students with poorer executive functioning skills (Flook et al., 2010) and behavioural problems (Crescentini et al., 2016). These interesting findings warrant further investigation specifically focusing on the effect that mindfulness might have on supporting students with learning difficulties.

It is difficult to determine the extent of overall change mindfulness practices promote in the way of executive functioning and self-regulation, considering the studies reviewed present inconsistent results. In fact, some studies presented conflicting results. For instance, Napoli *et al.* (2005) found improvements in shifting attention, while Thierry et al. (2016) found no improvements in this area. Moreover, Schonert-Reichl *et al.* (2015) concluded improvements in emotional control, contrary to the findings outlined by Thierry *et al.* (2016).

The inconsistency among outcomes noted might have resulted from differences among designs, causing comparison limitations between studies. First, the duration of the programs and the frequency of lessons varied. Some studies spanned only a few months (Crescentini et al., 2016; Flook et al., 2010; Flook et al., 2015; Schonert-Reichl et al., 2015; Schonert-Reichl et al., 2010) while others carried on for a full year (Napoli et al., 2005; Thierry et al., 2016). Second, some programs incorporated broader social-emotional learning beyond core mindfulness practices (Schonert-Reichl et al., 2015; Schonert-Reichl et al., 2010; Thierry et al., 2016). Third, differences in instructor familiarity and experience (e.g., training, personal mindfulness practice) could have influenced the quality of programs. This, in turn, could have influenced students' practice and progress. Finally, the measures for monitoring

progress differed among studies. Some studies used qualitative reports (Crescentini et al., 2016; Flook et al., 2010; Nadler et al., 2017; Schonert-Reichl et al., 2010) and some used both qualitative and quantitative forms of testing (Flook et al., 2015; Napoli et al., 2005; Schonert-Reichl et al., 2015; Thierry et al., 2016). The variation in measures, assessing distinct aspects of executive functioning and self-regulation could be another source of outcome variation.

Beyond the question in review, the mindfulness-based programs showed promise for fostering development of language and literacy (Thierry et al., 2016) along with social-emotional competence (Schonert-Reichl et al., 2015; Schonert-Reichl et al., 2010). These findings raise the possibility that mindfulness practices may also have an effect on communication development. Clinicians should also consider the inter-relationship between communication and executive functioning/self-regulation; an approach that influences these cognitive domains might have the potential to influence communication.

Additional research would be of value to further assess the benefits of mindfulness-based programs among preschool and school-age students regarding development and learning. It is recommended that future research expand upon the current literature with the following considerations:

- i. Consider the impact that mindfulness has on language development, literacy and other domains of learning.
- ii. Control for language ability at baseline by identifying students with receptive language difficulties. Mindfulness is a language-dense program that involves following a verbal guide, so language ability could impact progress.
- iii. Explore the effects of using supportive communication strategies during mindfulness practices (e.g., pre-teaching vocabulary, adjusting verbal instructions and using multimodal communication).
- iv. Investigate whether instructor experience with mindfulness has an impact on the student progress.
- v. Determine an ideal program duration that is feasible and yet yields greatest benefits.

### ***Clinical Implications***

This critical review outlines compelling evidence that integrating mindfulness practices into preschool and elementary curricula can be of benefit for students' executive functioning and self-regulation skills. As speech-language pathologists, we have a role in

collaborating with multidisciplinary school teams to support the learning needs of students. The evidence presented in this review may be used to inform team recommendations in developing programs that facilitate learning for all students.

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