

Digital Mindfulness-Based Intervention: Assessing Its Impact on Behavioral Outcomes in School Settings

Josipa Mihić¹, PhD,

ABSTRACT

The integration of digital technology in school-based mindfulness programs has gained attention as a potential means to enhance student well-being. This randomized controlled trial examined the effects of a digital mindfulness-based intervention implemented in a classroom setting. A total of 353 students (aged 8–10 years) from three randomly selected schools in Washington, U.S. participated in the study. The schools were assigned to one of three conditions: a structured, sequenced delivery of sessions (DMBI-Playlist, n= 208 students), an ad hoc implementation of sessions without a set order (DMBI-No Playlist, n= 101 students), and a waiting control group (n= 44 students). Results indicated no statistically significant differences between the intervention and control groups in overall behavioral and emotional outcomes. However, students in the DMBI-Playlist condition demonstrated fewer conduct problems and more prosocial behaviors compared to those in the DMBI-No Playlist condition. Several study and intervention conditions that may have contributed to the DMBI's lack of impact are discussed, including sample sizes, teacher training, dosage, students' developmental readiness, and follow-up assessments. While digital interventions hold promise as scalable, accessible and cost-saving tools, further studies on their effectiveness are needed.

KEYWORDS: digital, mindfulness-based intervention, schools, effectiveness, conduct problems, prosocial

1. INTRODUCTION

The integration of digital technologies in the implementation of preventive programs in school environments is becoming increasingly prevalent. As mental health concerns among students continue to rise, schools are seeking innovative and accessible solutions to support student well-being. Reports indicate a growing prevalence of stress, anxiety, and emotional distress in school-aged children and adolescents (UNICEF, 2021), underscoring the necessity for effective interventions. There is an evidence base for school-based mindfulness programs (Roeser et al., 2022a) dominantly implemented in a traditional way, i.e. conducted interactively in the classroom with students and facilitated with teachers or other trained professionals. Meta-analyses on the effectiveness of this kind of interventions in schools show promising effects with desired changes in students' behavior and well-being to varying degrees (Dunning et al., 2022;

¹ University of Zagreb Faculty of Education and Rehabilitation Sciences, Laboratory for Prevention Research, Borongajska cesta 83f, 10000 Zagreb, Croatia, E-mail: josipa.mihic@erf.unizg.hr
Research has been funded by Committee for Children Organization

Marshall et al., 2025; McKeering & Hwang, 2019; Phan et al., 2022; Zhang et al., 2022). The rise of digital delivery methods including mobile applications, online platforms, and interactive digital tools could potentially ensure that the benefits of this kind of practices can be extended to a broader range of students, enhancing accessibility and engagement. Digital platforms, mobile applications, and online programs are increasingly being utilized to deliver mindfulness-based interventions and other social-emotional learning programs in classrooms (Konishi et al., 2025; Lahtinen & Salmivalli, 2020; Lynn et al., 2024; Rebecchi et al., 2024). The arguments for using new technologies in this context focus on increased student engagement and accessibility, scalability, standardization, individualized learning experiences, real-time feedback, cost-saving, and teacher support. Despite the potential of implementing digital mindfulness-based interventions (DMBIs), research in this area remains limited and dominantly focused on individual use of digital technology not the group one in the classroom. to increase accessibility and student engagement and highlight the scalability of such programs, demonstrating their ability to reach diverse student populations across different schools and geographic regions (Mrazek et al., 2019a,b). Furthermore, Parson et al. (2019) suggests that interactive DMBIs offer real-time feedback and personalized monitoring, allowing educators to track student progress and tailor interventions to individual needs. A review by Osborne et al. (2023) further highlights the effectiveness of DMBIs in enhancing students' emotional regulation, stress management, and well-being. Findings indicate that accessibility and flexibility contribute to increased student engagement and adherence, particularly when interventions are delivered through interactive and gamified platforms. In their study, Lahtinen and Salmivalli (2020) tested a digital mindfulness-based program designed for upper secondary education students in Finland, with students engaging at their own pace without teacher-student interaction or real-time support. Their findings demonstrated small-to-moderate reductions in anxiety and depression, suggesting the potential of the tested digital intervention as effective mental health strategies. Findings also indicated that the intervention enhanced psychological quality of life, self-compassion, and overall happiness, highlighting its benefits beyond merely reducing negative psychological symptoms. Beyond student-centered benefits, technology can also play a critical role in supporting teachers. Digital platforms provide structured lesson plans and tracking tools that could increase teacher confidence in delivering mindfulness content. The integration of technology could ensure consistency in program implementation and offer educators valuable resources to enhance instructional quality. Moreover, digital tools allow for adaptive learning, where students can engage with interventions at their own pace, reinforcing mindfulness-based practices in a way that aligns with their unique developmental needs. When it comes to different ways of using digital technologies in the implementation of mindfulness-based programs in school settings, it is important to highlight that various models of implementation exist. As previously emphasized, research in this field is still very limited. In most of the studies conducted so far, DMBIs have been offered to students through their mobile devices, applications or web platforms, allowing them to participate in the intervention independently at their own pace, outside the classroom (e.g. Lahtinen & Salmivalli, 2020). Another possible approach to using digital technologies involves their application as a supplementary tool, an additional method alongside in-person interactive classroom interventions. In this case, the purpose of technology would be to help generalize learned skills and enhance the effectiveness of the intervention. There are very few studies (e.g. Mrazek et al., 2019a) in which digital technology has been used in a way that the mindfulness-based intervention has been delivered exclusively with using the digital technology in-class (e.g. audio or/and video sessions), but without active teacher involvement in facilitating the intervention. The purpose of this approach would be to address the existing challenge of some teachers' lack of readiness to be trained for independently conducting interactive in-person mindfulness-based interventions with students, as well as to enable a larger number of students to participate in mindfulness-based programs, even if solely through digital interventions in the classroom. The aim of the current study is to assess whether the group delivery of the DMBI in a real time, in a classroom can have an impact on students' behavior and well-being. The first research problem is to examine the mental, emotional, and behavioral outcomes of participating in the delivered DMBI for students. Due to the lack of prior research, no hypothesis was set for this particular research problem. The second research problem focused on investigating implementation factors that may affect the outcomes of DMBI implemented in the classroom. It is assumed that students who participated in the DMBI - Playlist

module (sequenced delivery of sessions) will significantly differ from those who participated in the DMBI - No Playlist module (ad hoc delivery of sessions), in such a way that the students from DMBI - Playlist classrooms will show more significant, desirable changes in the observed outcomes compared with students from DMBI - No Playlist delivery module.

2. METHOD

2.1 Participants

Three randomly selected schools from the state of Washington, US participated in this study. The first school was randomly assigned into a comparison condition group and involved 4 teachers. In this condition there were three 3rd and one 4th grade groups of students, altogether 44 students (18 female, mean age 8.9 years old). The 4 teachers had an average of 9.7 years of teaching experience. They were highly interested in mindfulness-based programs, 3 out of 4 were personally engaged in some kind of mindfulness practice outside of the school, and 2 out of 4 had some mindfulness activity with their students prior to this project. All of them said they had little to moderate experience in teaching mindfulness. Another school was randomly assigned into the intervention DMBI - Playlist condition and involved 10 teachers. Included were five 3rd grade and five 4th grade groups of students. All together there were 208 students involved in this condition (44.2% female, mean age 8.5 years old). Teachers had an average of 23 years of teaching experience. 60% of teachers were very or highly interested in mindfulness-based programs, 20% of them were personally engaged in some kind of a mindfulness practice outside of the school while 30% were doing some kind of a mindfulness activity with their students prior to this project. 60% had a moderate or a little experience in teaching mindfulness. Third school was also randomly assigned into the DMBI - No playlist condition with no playlist of digital sessions and involved 7 teachers. Included were four 3rd grade groups and three 4th grade groups with 101 students in total (48.5% female, mean age 8.7 years old). Teachers had an average of 15 years of teaching experience. 71.5% of teachers were very or highly interested in mindfulness-based programs, 28.6% of them were personally engaged in some kind of a mindfulness practice outside of the school while 28.6% were doing some kind of a mindfulness activity with their students prior to this project. 42.9% had no or a little experience in teaching mindfulness. Descriptive statistics of teachers’ and students’ baseline demographic characteristics by group are presented in Tables 1 and 2.

Table 1. Descriptive statistics of teachers’ baseline demographic characteristics by group

	Control group (n=4)		DMBI Playlist (n=10)		DMBI - No Playlist (n=7)	
	Valid n	% Mean (SD)	Valid n	% Mean (SD)	Valid n	% Mean (SD)
Gender						
Female	4	100	8	80	5	71.4
Grade teaching						
3rd grade	3	75	5	50	4	57.1
4th grade	1	25	5	50	3	42.9
Years of teaching	4	9.75 (8.42)	10	23 (9.70)	7	15 (9.26)
Interest in mindfulness programs						
Extremely interested	2	50	1	10	2	28.6
Very interested	1	25	5	50	3	42.9
Somewhat interested	1	25	4	40	2	28.6
Not so interested	/	/	/	/	/	/
Not at all interested	/	/	/	/	/	/
Experience in teaching mindfulness						

A great deal	/	/	/	/	/	/
A lot	/	/	1	10	/	/
A moderate amount	2	50	3	30	4	57.1
A little	2	50	3	30	2	28.6
Not at all	/	/	3	30	1	14.3
Doing mindfulness with students						
Yes	2	50	3	30	2	28.6
No	1	25	4	40	1	14.3
Somewhat	1	25	2	20	4	57.1
I'm not sure	/	/	1	10	/	/
Engaged in mindfulness						
Yes	3	75	2	20	2	28.6
No	1	25	6	60	3	42.9
Somewhat	/	/	2	20	2	28.6
I'm not sure	/	/	/	/	/	/

Table 2. Descriptive statistics of students' baseline demographic characteristics by group

	Control group (n=44)		DMBI - Playlist (n=208)		DMBI - No Playlist (n=101)	
	Valid n	%	Valid n	%	Valid n	%
Age						
7 years	1	2.3	1	0.5	/	/
8 years	19	43.2	100	48.1	39	38.6
9 years	7	15.9	95	45.7	48	47.5
10 years	17	38.6	12	5.8	14	13.9
Gender						
Female	18	40.9	92	44.2	49	48.5
Race						
Asian	3	6.8	82	39.4	10	9.8
Black/African	2	4.5	8	3.8	12	11.9
Caucasian	15	34.1	82	39.4	61	60.4
Hispanic/Latino	15	34.1	16	7.7	9	8.9
Native American	1	2.3	/	/	2	2
Pacific Island	2	4.5	2	1		
Other	6	13.6	18	8.7	7	6.9
1st language learned						
English	18	40.9	155	74.5	77	76.2
Spanish	14	31.8	8	3.8	7	6.9
Vietnamese	1	2.3	1	0.5	2	2
Russian	3	6.8	2	1	3	3
Korean	/	/	11	5.3	1	1
Other	8	18.2	31	14.9	11	10.9
Individual educational program						
Yes	4	9.1	13	6.3	5	5
Family composition						
Two/parent home	32	72.7	197	94.7	83	82.2
Living with mother only	8	18.2	6	2.9	10	9.9
Living with father only	/	/	2	1	/	/
Living with dual-custody	3	6.8	2	1	7	6.9
Other	1	2.3	1	0.5	1	1

In the control group of students, most students were Caucasian (34.1%) or Hispanic/Latino (34.1%), students from the DMBI - Playlist group were mostly Asian (39.4) and Caucasian (39.4%) while students from the DMBI - No Playlist were mostly Caucasian (60.4%) and Black/African (11.9%). English was the

first language learned for 40.9% of students from the control group, 74.5% of students from the DMBI - Playlist group and for 76.2% of students from the DMBI - No Playlist group. In all three conditions students were mainly living in two/parent homes.

2.2. Procedure

After gaining ethical approval from the Institutional Review Board, three schools from the Seattle, US area expressed their willingness to participate in this study. The three schools were selected and matched on school size, family socioeconomic status, average achievement scores, and ethnic and racial diversity. Another criteria for inclusion to this study was that these schools were not implementing any kind of social-emotional learning program or mindfulness-based programs at the duration of this study. Three schools were then randomly assigned to one of three conditions – the control, the DMBI - Playlist and the DMBI - No Playlist condition. The DMBI conditions differed in a delivery model of sessions. In September 2019, in-person orientation meetings were held with 3rd and 4th grade teachers in each of the selected schools. Project staff members collected active informed consent from all teachers interested in participating in this study. The teachers then obtained active informed consent from parents of children in their classrooms. Although 8 teachers from the control school gave their consent to participate, only 4 teachers took part in this study which led to a small sample size of this group, compared to other conditions. Teacher surveys were administered online via a secure survey system. Surveys were administered at two time points, before and after the completion of the intervention – 12 weeks delivery of DMBI sessions (October 2019 and February 2020 respectively). Prior to the trial period, teachers from all three conditions completed a Teacher Survey that inquired about demographics, their experience with socio-emotional learning and mindfulness, and teaching background. For each student, teachers also completed a Teacher Assessment Questionnaire. Upon completion of a 12-week trial, teachers completed the questionnaires as a post-test. Completion of the teacher surveys took approximately 10 minutes per a student. At both time points, group self-assessments of students were organized in all three schools. To guard against biases due to variability in reading proficiencies, a research assistant read each item on the questionnaire aloud, and students marked their responses accordingly. Completion of the student survey took approximately 20-30 minutes in each classroom.

2.3. DMBI Intervention

To examine the impact of DMBI implemented in the classroom, two implementation modules were designed, consisting of a set of research-based, guided audio and video lessons grounded in mindfulness techniques, aimed at developing mindfulness skills, emotional regulation, focus, and overall well-being. Teachers in both DMBI conditions were trained for the technical delivery of this digital intervention but did not participate in formal teacher training related to the content of the digital materials. Furthermore, teachers in both groups were given access to a set of 29 research- based guided mindfulness sessions covering themes such as breath (calming the body and mind), thoughts (training the wandering mind to refocus), feelings (accepting emotions without judgment), body (resetting through mindful movement), senses (using sensory awareness to enhance focus and calmness), gratitude (improving mood through appreciation), and kindness (enhancing well-being through acts of kindness). Some sessions were based on animated videos, while in other sessions, a still image was projected onto the whiteboard, accompanied by audio instructions. The sessions lasted between 5 and 7 minutes. Teachers were instructed to play the sessions from an internet platform in the classroom. Students viewed the images on the whiteboard connected to a projector, while listening to the guided sessions through the classroom speakers, which were also connected to the projector. As already mentioned, this study involved two MBDI delivery modules: the MBDI - Playlist and the MBDI - No Playlist conditions, each lasting 12 weeks. In both conditions, teachers were asked to play four educational videos about mindfulness and the brain during the first two weeks of the intervention period. Teachers from the school assigned to the MBDI - Playlist condition were instructed to play two recorded sessions from a specified playlist of sessions each school day for 12 weeks, one at the beginning of the day and another at a set transition point in their classroom schedule. Teachers in the MBDI - No Playlist condition could conduct as many lessons as they wished, in any order they

preferred. They were asked to play at least three sessions per week during the intervention period. The total number of sessions delivered by each teacher in both conditions varied. The range of the number of sessions conducted by teachers in the MBDI - Playlist condition varied from 14 to 86 sessions (of possible 116), with teachers in this group, on average, conducting 45 sessions with students. Teachers in the MBDI - No Playlist condition, on average, conducted 26 sessions, with the range of sessions conducted varying from just 1 to 52 sessions per teacher (of possible 116).

2.4. Survey measures

2.4.1. Teacher reported measures

For each student participating in the study teachers completed a Teacher Assessment Questionnaire. The questionnaire was a battery of teacher-report measures focused on assessing students' sociodemographic background (e.g., gender, age, and race/ethnicity, first language learned, family composition), and different outcomes. The following outcomes were assessed:

Hyperactivity was assessed with 5 items of Strengths and Difficulties Questionnaire –SDQ 4- 10YS (Goodman, 2001). The scale contained items like “*Restless, over-active, cannot sit still for long*” and “*Easily distracted*”. All items were rated on a three-point Likert scale, with response options ranging from “not true” to “certainly true”.

Emotional symptoms were assessed with 5 items of the Strengths and Difficulties Questionnaire –SDQ 4-10YS (Goodman, 2001). Examples include “*Many fears, easily scared*” and “*Many worries or often seems worried*”. All items were rated on a three-point Likert scale, with response options ranging from “not true” to “certainly true”.

Conduct problems were assessed with 5 items from the Strengths and Difficulties Questionnaire –SDQ 4-10YS (Goodman, 2001). Examples include “*Often loses temper*” and “*Often fights with other children or bullies them*”. All the items were rated on a three-point Likert scale, with response options ranging from “not true” to “certainly true”.

Peer problems were assessed with 5 items from the Strengths and Difficulties Questionnaire – SDQ 4-10YS (Goodman, 2001). Examples include “*Rather solitary, prefers to play alone*” and “*Gets along better with adults than with other children*”. All the items were rated on a three-point Likert scale, with response options ranging from “not true” to “certainly true”.

Prosocial behavior was also assessed with 5 items from the Strengths and Difficulties Questionnaire – SDQ 4-10YS (Goodman, 2001). Examples include “*Kind to younger children*” and “*Considerate of other people's feelings*”. All the items were rated on a three-point Likert scale, with response options ranging from “not true” to “certainly true”.

Inattention-impulsiveness was assessed with 8 items of an ADHD Rating Scale (DuPaul, 1991) and examples of the items are “*Has trouble following directions*” and “*Loses important things*”. The items were rated on a four-points Likert scale, with response options ranging from “not at all” to “very much”.

Behavioral engagement in the classroom was assessed with 5 items from Engagement vs. Disaffection with Learning Scale (Skinner, Kindermann & Furrer, 2009). Examples include “*In my class, this student works as hard as he/she can*” and “*When I explain new material, this student listens carefully*”. All the items were rated on a five-point Likert scale, with response options ranging from “always” to “never”.

Behavioral disaffection in the classroom was assessed with 5 items from the Engagement vs. Disaffection with Learning Scale (Skinner, Kindermann & Furrer, 2009). Examples include “*When we start something new in class, this student thinks about other things*” and “*In my class, this student comes unprepared*”. All the items were rated on a five-point Likert scale, with response options ranging from “always” to “never”.

Emotion regulation was assessed with 7 items from a Social Competence Scale (Conduct Problems Prevention Research Group, CPPRG, 1999). Examples include “*Copes well with disappointment or*

frustration” and “*Expresses needs and feelings appropriately*”. All the items were rated on a six-point Likert scale, with response options ranging from “almost never” to “almost always”.

Besides the Teacher Assessment questionnaire, teachers also completed a self-report Teacher survey. At baseline, a Teacher Survey – baseline included 8 questions focused on a grade they teach, years of experience of working in education system, previous experience with teaching mindfulness programs to students, current implementation of mindfulness activities with students and their engagement in any type of mindfulness practice outside of a school.

2.4.2. Student reported measures

Students participating in the study completed a Student Self-Assessment questionnaire, a battery of self-reported measures focused on assessing students’ classroom behaviors including attention, anxiety, and mindfulness. Outcomes were assessed on the following measures:

Classroom behavior was assessed on six items (Mihic, 2019, unpublished). Examples include “*I enjoy being in school*” and “*I care about other students in my class*”. Six items were rated on a five-point Likert scale, with response options ranging from “all the time” to “never” while one item response options ranged from “very much” to “not at all”.

Mindfulness was assessed with a Mindful Attention Awareness Scale (MAAS-C) (Lawlor et al., 2014) which consisted of 15 items. Examples include “*I snack without being aware that I’m eating*” and “*I can’t stop thinking about the past or future*”. All of the items were rated on a six- point Likert scale, with a response option ranging from “almost never” to “almost always”.

2.5. Data analyses

Firstly, preliminary analyses were conducted to examine descriptive and distributional statistics, correlations, and attrition rates, and missing data patterns. All hypothesis tests were conducted using a mixed model design which accounts for the clustering of students within the classroom by estimating a random effect for CLASS. The CLASS variable was created by identifying each student with a teacher's last name. Clustering of classrooms within schools could not be modeled as a random effect because each condition of the experimental design was conducted in a single school. Baseline equivalence was established by conducting a separate mix model analysis for each Time 1 variable. A fixed effect for condition and a random effect for CLASS were estimated with no other control variables. No baseline differences were found for any of the 11 outcome variables. Intervention effects were estimated by conducting a separate mixed model analysis on each Time 2 variable. The effect of the 3-level intervention condition (MBDI - Playlist, MBDI - No Playlist, Comparison) variable was estimated accounting for clustering using a random effect for CLASS and controlling for baseline levels of the outcome, student gender, age, and overall academic skills. Pairwise comparisons were conducted between each pair of intervention conditions based on the estimated marginal means after adjusting for clustering and all covariates. The statistical significance of results was determined at the level of $p < .05$. To determine practical significance of results, effect size Cohen’s d were calculated as the adjusted group mean difference divided by the pooled standard deviation (Cohen, 1988). Absolute values of Cohen’s $d \geq 0.2$, ≥ 0.5 , and ≥ 0.8 are interpreted as small, medium, and large effects, respectively.

3. RESULTS

3.1. Descriptive statistics and attrition

Means and standard deviations of child behaviors are presented in Tables 3 and 4 by intervention condition at each time. Data were provided by teachers on 353 students at both time points with no attrition. However, in 5 cases teachers failed to report on overall academic performance which served as a control variable. As a result, the final analysis dataset for teacher reported outcomes was 349. Self-report data were provided by a total of 340 students at pre-intervention and 319 at post-intervention.

Of the 319 students with post-intervention data 3 did not provide data pre-intervention resulting in complete self-report data on 316 students. Of those, 7 did not have teacher data. The final analysis dataset for models on student report outcomes was therefore 309. It should be noted that the 11 measures were intercorrelated to a high degree. The highest correlation was teacher report of inattentive-impulsiveness with hyperactivity (.90 at pre-intervention). Most measures were correlated between .50 and .80 and all were significant with a few exceptions.

Table 3. Means and standard deviations of student behaviors – teacher survey

Outcome	Pre-Intervention						Post-Intervention					
	Control group (n=44)	SD	MBDI - Playlist (n=208)	SD	MBDI - No Playlist (n=101)	SD	Control group (n=43)	SD	MBDI - Playlist (n=206)	SD	MBDI - No Playlist (n=100)	SD
Inattention-Impulsiveness	6.43	6.48	6.50	6.51	7.27	6.99	5.65	6.64	4.97	5.74	6.13	6.33
Engagement with Learning	2.08	0.94	2.26	0.81	2.38	0.89	2.04	0.92	2.09	0.84	2.29	0.84
Disaffect with Learning	3.92	0.90	3.88	0.87	3.72	0.87	3.98	0.87	4.05	0.89	3.85	0.86
Emotion Regulation	4.25	1.25	4.51	0.92	4.68	1.16	4.63	1.28	4.92	0.93	4.81	1.10
Emotion Symptoms	1.32	1.80	1.50	1.90	1.17	1.77	1.28	1.88	1.28	1.93	0.92	1.55
Conduct Problems	1.18	1.66	0.84	1.36	0.89	1.67	1.05	1.83	0.55	1.28	0.96	1.54
Hyperactivity	3.64	3.31	3.19	2.87	3.38	3.22	2.86	2.86	2.57	2.79	3.10	2.89
Peer Problems	1.43	1.61	1.60	1.60	1.70	1.78	1.44	1.75	1.31	1.78	1.41	1.60
Prosocial	7.48	2.27	7.38	2.44	8.40	2.01	7.81	2.37	8.33	2.02	8	2.08

Table 4. Means and standard deviations of child behaviors – self-assessment

Outcome	Pre-Intervention						Post-Intervention					
	Control group (n=45)	SD	MBDI - Playlist (n=199)	SD	MBDI - No Playlist (n=96)	SD	Control group (n=43)	SD	MBDI - Playlist (n=191)	SD	MBDI - No Playlist (n=85)	SD
Mindful Awareness	4.24	1.03	4.59	0.78	4.23	0.81	4.34	0.93	4.58	0.79	4.33	0.89
Class Behavior	4.22	0.70	4.10	0.55	3.97	0.60	4.12	0.71	4.04	0.53	3.92	0.71

3.2. Impact of DMBI on student outcomes

As it was described in previous sections, the MBDI impact on students’ outcomes was assessed through teacher-report measures and student self-report assessment. The analysis has shown that although post-test scores of students from the comparison condition on conduct problems are higher and post-test scores on prosocial behavior are lower than scores of students from both MBDI conditions, these differences were not statistically significant (Table 5). However, the analysis has shown that of the outcomes evaluated, significant effects of the MBDI intervention were found on two teacher reported outcomes. At post-test, students in the MBDI - Playlist condition had significantly reduced scores on SDQ conduct problems (mean dif= .37, df= 26.39, p=.034) and significantly improved scores on SDQ prosocial behavior (mean dif=.855, df=33.56, p=.023) compared to the MBDI - No Playlist condition. The effect size estimates of .16 for prosocial behavior and -.30 for conduct problems represent small-to-medium effects.

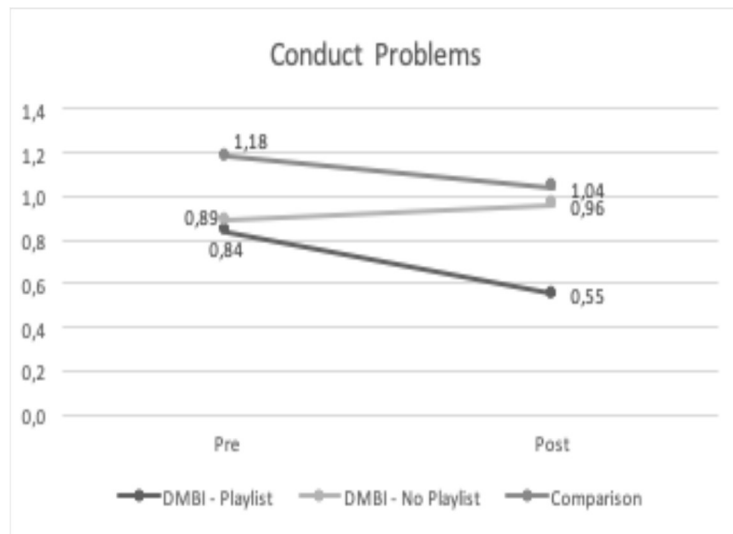
Table 5. Estimates of the intervention effects from hierarchical models

Outcome	MBDI – Playlist vs Comparison				MBDI – Playlist vs MBDI - No Playlist				MBDI - No playlist vs Comparison			
	Estimate	t value	p value	Effect Size	Estimate	t value	p value	Effect Size	Estimate	t value	p value	Effect Size
Inattention-Impulsiveness	.23	.29	.77	-.11ab	.15	.24	.81	-.20	-.08	-.09	.93	.07
Engagement with Learning	.03	.30	.76	.05	.10	1.20	.24	-.24	-.04	-.38	.69	.29
Disaffect with Learning	-.05	-.43	.67	.08	-.09	-.92	.36	.23	.03	.20	.84	-.16
Emotion Regulation	.03	.16	.87	.28	-.18	-1.13	.26	.12	-.21	-1.01	.32	.16
Emotion Symptoms	.07	.26	.80	.00	-.22	-.97	.34	.19	-.30	-.95	.35	-.22
Conduct Problems	.14	.67	.51	-.33	.37	2.23	.03	-.30	.22	1.01	.32	-.05
Hyperactivity	-.25	-.58	.57	-.10	.30	.87	.39	-.19	.55	1.19	.24	.08
Peer Problems	.01	.03	.98	-.08	-.08	-.28	.78	-.06	-.09	-.24	.81	-.02
Prosocial	-.32	-.71	.48	.24	-.85	-2.379	.02	.16	-.54	-1.13	.26	.09
Mindful Awareness	-.05	-.44	.67	.28	-.06	-.65	.53	.31	-.01	-.04	.97	-.28
Class Behavior	-.00	-.01	.99	-.12	-.03	-.48	.64	.21	-.03	-.32	.75	-.01

- a. Negative effects indicate mean levels are lower in MBDI - Playlist vs Comparison or MBDI - No Playlist conditions
- b. Effect size is the adjusted Cohen’s d (Hedge’s g)

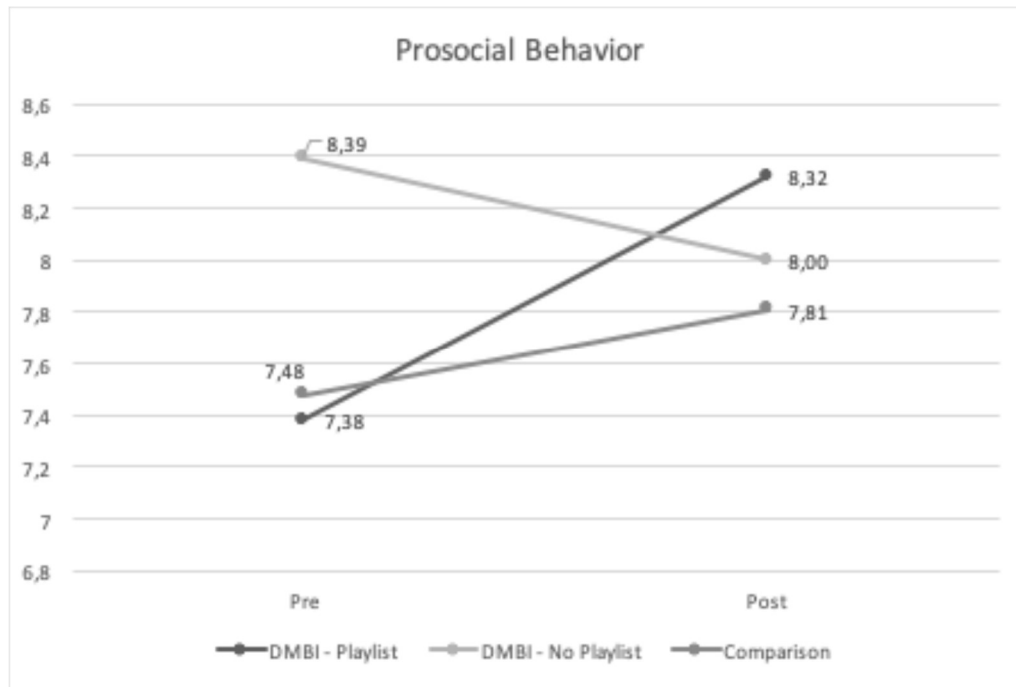
On average, students in the MBDI - Playlist condition displayed fewer conduct problems such as fighting, bullying, and lying than those in the MBDI - No Playlist condition. Pre- and post-test means on conduct problems of students in all three conditions are presented on Figure 1.

Figure 1. Pre- and post-test means on conduct problems of students



Furthermore, the analysis has shown that students who participated in the MBDI - Playlist condition on average displayed more prosocial behaviors such as being kind, sharing with others, and volunteering to be helpful than those in the MBDI - No Playlist condition. Pre- and post-test scores on prosocial behavior of students in all three conditions are presented in Figure 2.

Figure 2. Pre- and post-test scores on prosocial behavior of students



In the second stage of data analysis, relatively higher and lower risk children were identified based on their scores on SDQ emotion symptoms, hyperactivity, and conduct problems. In order to do so, a cut off of 1 standard deviation above the mean has been used. A repeated analysis on low and high-risk students only did not produce substantively different results of the MBDI effectiveness.

4. DISCUSSION

The present study aimed to assess whether the group delivery of the digital mindfulness-based intervention (DMBI) in a classroom setting could influence students' behavior and well-being. Specifically, the first research question focused on examining the mental, emotional, and behavioral outcomes of students participating in the delivered DMBI. The analysis revealed no statistically significant differences in the post-test scores between students in the comparison group and those in both DMBI conditions. As already stated, there is a lack of previous studies and evidence regarding the effectiveness of implementing DMBIs in classroom with students with no active facilitation from teachers. In one of the few studies, Mrazek et al. (2019a) reported improved emotional regulation and stress management among high school students participating in a digital 22-day long mindfulness-based attention training delivered in classrooms. The entire course included 2.25 hours of content with four 12-min lessons and daily 4-min exercises. Teachers were encouraged to have students complete the lessons and at least some of the daily exercises during class but students completed the intervention independently (e.g. using headphones on a computer, tablet or phone). In the study, teachers also did not have an active role in facilitating the intervention. However, the one-group design used in the study precludes definitive conclusions about the effects of this digital intervention. There are several possible arguments for why the intervention tested in the current study did not achieve the desired effects. Lack of teacher active involvement and implementation challenges might be the one. The effectiveness of preventive programs, including mindfulness-based programs, is significantly influenced by various implementation factors, including the training of program facilitators that is often highlighted as a crucial factor (Fixen et al., 2021). Although the available research on DMBIs effectiveness is limited, there is some evidence that the implementation of this kind of interventions in classrooms can have desirable effects on student behavior and well-being when teacher training and an active role of the teacher in implementing and facilitating the intervention are included (Lahtinen & Slamivalli, 2020). As previously described, the current study did not involve teacher mindfulness training

since the intervention was fully implemented in a digital form. While there is a lack of research focused on understanding the impact of using DMBIs in the classroom, it is possible that teacher training plays one of the crucial roles in the effectiveness of mindfulness programs in schools (Braun et al., 2024). The use of digital technologies alone may not be sufficient to achieve the desired results without teacher involvement in developing and fostering new skills. Research suggests that mindfulness-based programs not only benefit students but also significantly enhance teachers' well-being (Zarate, Maggin & Passmore, 2019), teaching efficacy, and ability to create a supportive classroom environment (de Carvalho et al., 2021). Training teachers in mindfulness equips them with personal mindfulness skills, which they can model for students, ensuring a more mindful and emotionally regulated classroom culture. Additionally, trained teachers can integrate mindfulness practices more seamlessly into the school day. Furthermore, mindfulness training for teachers enhances classroom management (Roeser et al., 2022b). Studies indicate that teachers who receive mindfulness training report improvements in their ability to manage disruptive behaviors, maintain classroom order, and build stronger relationships with students. This is particularly important as the classroom climate significantly affects students' ability to focus, self-regulate, and engage in learning. By fostering a calm and mindful classroom atmosphere, teachers help students develop essential skills such as attention regulation, emotional resilience, and stress management. Teachers who undergo mindfulness training not only experience personal and professional benefits but also contribute to the overall success of mindfulness initiatives in schools (Meiklejohn et al., 2012). The need for more active involvement of trained teachers in the development of mindfulness skills is also reflected in the importance of modelling new skills by significant others, in this case, teachers. Modelling is pivotal for the successful adoption of new skills, and the process is even more effective if it occurs throughout the school day (Roeser et al., 2012). The lack of effects found in the presented study could have been affected by the developmental readiness of students involved, also. Mindfulness-based programs delivered by teachers or other trained professionals are more effective for older students, particularly adolescents, compared to younger primary school students (Zoogman et al., 2015). Younger children (around 8-9 years old) have not yet fully developed the metacognitive and emotional regulation skills needed to effectively engage with mindfulness practices (Zelazo & Lyons, 2012). Compared to adolescents, younger children may struggle to grasp abstract mindfulness concepts and require more concrete, engaging, and interactive methods (Semple et al., 2010). Another explanation could be related to the possible insufficient duration and intensity of the intervention. Research suggests that mindfulness-based interventions are more effective when implemented consistently over an extended period (Felver et al., 2016). Children may need more extended exposure to mindfulness practices before they internalize and apply them to real-life situations (Zoogman et al., 2015). It is also important to stress that mindfulness effects may take longer to emerge. Research suggests that mindfulness benefits often become more noticeable after a certain period of sustained practice (Kuyken et al., 2008). Measuring effects only at post-test and not at follow-up might have underestimated the long-term benefits. Neuroplasticity changes related to mindfulness practice take time to develop (Tang, Hölzel & Posner, 2015). A longer follow-up period might have revealed delayed improvements in behavior and well-being. Finally, mindfulness effects depend on the classroom and family environment. Mindfulness interventions work best when integrated into a nurturing and structured learning environment (Jennings & Greenberg, 2009) and are more effective when reinforced at home (Quach, Gilber, Jastrowski Mano, 2017). The second research question sought to investigate the implementation factors that might affect the outcomes of DMBIs when implemented in the classroom. A key assumption underlying this study was that students who participated in the DMBI - Playlist module, characterized by a sequenced delivery of sessions, would exhibit more significant and desirable outcomes compared to students in the DMBI - No Playlist module, where sessions were delivered ad hoc without a fixed schedule or predetermined order. At post-test, students in the DMBI - Playlist condition exhibited significantly reduced scores on conduct problems and significantly improved scores on prosocial behavior compared to the DMBI - No Playlist condition. No significant differences were found in relation to other outcomes. On average, students in the DMBI - Playlist condition displayed fewer conduct problems such as fighting, bullying, and lying, and more prosocial behaviors such as being kind, sharing with others, and volunteering to be helpful than those in the DMBI - No Playlist condition. Research on the effects of traditional mindfulness-based programs in schools, which

are typically delivered in classrooms by specially trained instructors, often teachers themselves, also indicates that mindfulness-based interventions can improve prosocial behavior in children (Schonert-Reichl et al., 2015) and reduce the occurrence of conduct problems (Hoogsteder et al., 2023). What differentiated the two intervention groups in the current study was the dosage, intensity and sequencing of the digital sessions, with the results showing greater effects under the conditions of more dosage and structured and consistent session delivery. Previous research suggests that structured and consistent delivery of mindfulness-based interventions enhances their effectiveness (Felver et al., 2016). The structured nature of the DMBI - Playlist likely provided students with a more predictable and cohesive experience. In contrast, students in the DMBI - No Playlist condition exhibited less pronounced improvements, possibly due to the lower dosage and irregular nature of the sessions, which may have limited the reinforcement of mindfulness principles and practices. The findings suggest that the consistent and systematic delivery of mindfulness practices may help students internalize self-regulatory strategies more effectively, leading to better outcomes. This is consistent with the theoretical underpinnings of mindfulness training, which emphasize the cultivation of present-moment awareness and emotional acceptance (Kabat-Zinn, 2003).

5. IMITATIONS AND FUTURE RESEARCH

There are several limitations of this study. Firstly, the study sample was unbalanced, with the control group being significantly smaller than the intervention groups. This discrepancy may have limited the statistical power to detect significant differences. Future studies should ensure equal group sizes to enhance comparability and reliability of findings. Secondly, the study relied heavily on self-reported and teacher-reported data, which may introduce biases such as social desirability and subjective interpretation. While teacher assessments provide valuable insights into student behaviors, incorporating objective measures such as independent classroom observations could strengthen the validity of future research. Another limitation is the absence of follow-up assessment. In the conducted study, the initial plan was to conduct a follow-up assessment two months after the intervention. However, this follow-up could not be organized due to the onset of the pandemic and school closures. While the findings indicate no significant differences between intervention and control conditions, it remains uncertain whether these findings would remain consistent over longer periods. Longitudinal studies with follow-up assessments would help determine the lasting impact of mindfulness-based digital interventions on students' emotional and behavioral development. Lastly, the study was conducted within a limited geographical region, which restricts the generalizability of the findings to broader educational settings, particularly those with different cultural, socioeconomic, or educational systems.

6. CONCLUSIONS

This study evaluated the impact of a classroom-based DMBI on student behavior and well-being. The findings indicate that while there were no significant differences between the intervention and control groups overall, students in the structured DMBI-Playlist condition exhibited fewer conduct problems and greater prosocial behaviors compared to those in the DMBI-No Playlist condition. Findings indicate the trend of positive effects of DMBIs, but further research is needed. Existing research suggests that teacher-led mindfulness interventions tend to be more effective, as educators can model mindfulness skills, provide guidance, and integrate mindfulness practices into daily classroom activities. Given these findings, future research should explore the role of teacher

ACKNOWLEDGEMENTS

This randomized control trial was initiated and funded by the Committee for Children, US organization.

REFERENCES

Braun, S. S., Greenberg, M. T., Roeser, R. W., Taylor, L. J., Montero-Marin, J., Crane, C., ... & MYRIAD Team (2024). Teachers' stress and training in a school-based mindfulness program:

- Implementation results from a cluster randomized controlled trial. *Journal of school psychology, 104*, 101288.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Routledge.
- Conduct Problems Prevention Research Group (1999). Technical reports for the Fast Track assessment battery. [Unpublished manuscript].
- de Carvalho, J. S., Oliveira, S., Roberto, M. S., Gonçalves, C., Bárbara, J. M., de Castro, A. F., ... & Marques-Pinto, A. (2021). Effects of a mindfulness-based intervention for teachers: A study on teacher and student outcomes. *Mindfulness, 12*(7), 1719-1732.
- Dunning, D., Tudor, K., Radley, L., Dalrymple, N., Funk, J., Vainre, M., ... & Dalglish, T. (2022). Do mindfulness-based programmes improve the cognitive skills, behaviour and mental health of children and adolescents? An updated meta-analysis of randomised controlled trials. *BMJ Mental Health, 25*(3), 135-142.
- DuPaul, G. J. (1991). Parent and teacher ratings of ADHD symptoms: Psychometric properties in a community-based sample. *Journal of Clinical Child Psychology, 20*(3), 245–253. https://doi.org/10.1207/s15374424jccp2003_3
- 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>
- Fixsen, A. A., Aijaz, M., Fixsen, D. L., Burks, E., & Schultes, M. T. (2021). Implementation frameworks: An analysis. *Chapel Hill, NC: Active Implementation Research Network*.
- Goodman, R. (2001). Psychometric properties of the Strengths and Difficulties Questionnaire. *Journal of the American Academy of Child and Adolescent Psychiatry, 40*(11), 1337–1345. <https://doi.org/10.1097/00004583-200111000-00015>
- Hoogsteder, L. M., Van Os, R. C., Lutjens, J. B., Smeets, N., & Stams, G. J. M. (2023). A multilevel meta-analysis on the effect of mindfulness-based interventions in reducing externalizing problem behavior in adolescents. *International Journal of Stress Management, 30*(3), 309–320. <https://doi.org/10.1037/str0000275>
- Jennings, P. A., & Greenberg, M. T. (2009). The prosocial classroom: Teacher social and emotional competence in relation to student and classroom outcomes. *Review of Educational Research, 79*(1), 491–525. <https://doi.org/10.3102/0034654308325693>
- 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>
- Konishi, C., Vargas-Madriz, L. F., & Tesolin, J. (2025). Fostering equity, diversity, and inclusion through social-emotional learning: The role of digital technologies. *Journal of Research on Technology in Education, 57*(1), 1–13. <https://doi.org/10.1080/15391523.2025.1098765>
- Kuyken, W., Byford, S., Taylor, R. S., Watkins, E., Holden, E., White, K., Barrett, B., Byng, R., Evans, A., Mullan, E., & Teasdale, J. D. (2008). Mindfulness-based cognitive therapy to prevent relapse in recurrent depression. *Journal of Consulting and Clinical Psychology, 76*(6), 966–978. <https://doi.org/10.1037/a0013786>
- Lahtinen, O., & Salmivalli, C. (2020). An effectiveness study of a digital mindfulness-based program for upper secondary education students. *Mindfulness, 11*(11), 2494–2505. <https://doi.org/10.1007/s12671-020-01452-1>
- Lawlor, M. S., Schonert-Reichl, K. A., Gadermann, A. M., et al. (2014). A validation study of the Mindful Attention Awareness Scale adapted for children. *Mindfulness, 5*, 730–741.
- Lynn, S., Carroll, A., Nankervis, K., & Antrobus, E. (2024). A systematic review of delivery modes in school-based adolescent social-emotional learning programs—Current perspectives and future directions. *Review of Education, 12*(3), e70019.
- Marshall, T., Farrar, A., Wilson, M., Taylor, J., George, P., Ghose, S. S., ... & Patel, N. A. (2025). Mindfulness-Based Interventions in Schools: Assessing the Evidence Base. *Psychiatric Services, 76*(1), 49-60.

- McKeering, P., & Hwang, Y. S. (2019). A systematic review of mindfulness-based school interventions with early adolescents. *Mindfulness, 10*(4), 593–610.
- Meiklejohn, J., Phillips, C., Freedman, M. L., Griffin, M. L., Biegel, G., Roach, A., ... & Saltzman, A. (2012). Integrating mindfulness training into K–12 education: Fostering the resilience of teachers and students. *Mindfulness, 3*, 291–307.
- Mrazek, A. J., Mrazek, M. D., Reese, J. V., Kirk, A. C., Gougis, L. J., Delegard, A. M., ... & Schooler, J. W. (2019a). Mindfulness-based attention training: Feasibility and preliminary outcomes of a digital course for high school students. *Education Sciences, 9*(3), 230.
- Mrazek, A. J., Mrazek, M. D., Cherolini, C. M., Cloughesy, J. N., Cynman, D. J., Gougis, L. J., ... & Schooler, J. W. (2019b). The future of mindfulness training is digital, and the future is now. *Current Opinion in Psychology, 28*, 81-86.
- Osborne, E. L., Ainsworth, B., Hooper, N., & Atkinson, M. J. (2023). Experiences of using digital mindfulness-based interventions: Rapid scoping review and thematic synthesis. *Journal of Medical Internet Research, 25*, e44220.
- Parsons, C. E., Jensen, K. L., Roepstorff, A., Fjorback, L. O., & Linehan, C. (2019). Designing technology tools to support engagement in mindfulness-based interventions: an analysis of teacher and student experiences. *Digital Health, 5*, 2055207619868550
- Phan, M. L., Renshaw, T. L., Caramanico, J., Greeson, J. M., MacKenzie, E., Atkinson-Diaz, Z., Doppelt, N., Tai, H., Mandell, D. S., & Nuske, H. J. (2022). Mindfulness-based school interventions: A systematic review of outcome evidence quality by study design. *Mindfulness, 13*, 1591–1613. <https://doi.org/10.1007/s12671-022-01885-9>
- Quach, D., Gibler, R.C. & Jastrowski Mano, K.E. (2017). Does Home Practice Compliance Make a Difference in the Effectiveness of Mindfulness Interventions for Adolescents?. *Mindfulness, 8*, 495–504. <https://doi.org/10.1007/s12671-016-0624-7>
- Rebecchi, K., Lubart, T., Shankland, R., & Hagège, H. (2024). Differential effects of digital mindfulness-based interventions on creative potential and responsibility among middle school students. *British Journal of Educational Psychology, 94*(3), 919–946.
- Roeser, R. W., Galla, B. M., & Baelen, R. N. (2022). *Mindfulness in schools: Evidence on the impacts of school-based mindfulness programs on student outcomes in P–12 educational settings*. The Pennsylvania State University.
- Roeser, R. W., Mashburn, A. J., Skinner, E. A., Choles, J. R., Taylor, C., Rickert, N. P., ... & Sorenson, J. (2022b). Mindfulness training improves middle school teachers' occupational health, well-being, and interactions with students in their most stressful classrooms. *Journal of Educational Psychology, 114*(2), 408.
- Roeser, R. W., Skinner, E., Beers, J., & Jennings, P. A. (2012). Mindfulness training and teachers' professional development: An emerging area of research and practice. *Child Development Perspectives, 6*(2), 167–173.
- 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.
- Semple, R. J., Lee, J., Rosa, D., & Miller, L. F. (2010). A randomized trial of mindfulness-based cognitive therapy for children: Promoting mindful attention to enhance social-emotional resiliency in children. *Journal of Child and Family Studies, 19*, 218-229.
- Skinner, E. A., Kindermann, T. A., & Furrer, C. J. (2009). A motivational perspective on engagement and disaffection: Conceptualization and assessment of children's behavioral and emotional participation in academic activities in the classroom. *Educational and psychological measurement, 69*(3), 493-525.
- Tang, Y. Y., Hölzel, B. K., & Posner, M. I. (2015). The neuroscience of mindfulness meditation. *Nature Reviews Neuroscience, 16*(4), 213–225.

- United Nations Children’s Fund (2021). *The state of the world’s children 2021: On my mind – Promoting, protecting and caring for children’s mental health*. UNICEF.
- Zarate, K., Maggin, D. M., & Passmore, A. (2019). Meta-analysis of mindfulness training on teacher well-being. *Psychology in the Schools*, 56(10), 1700–1715.
- Zelazo, P. D., & Lyons, K. E. (2012). The potential benefits of mindfulness training in early childhood: A developmental social cognitive neuroscience perspective. *Child development perspectives*, 6(2), 154-160.
- Zhang, Y., Chen, S., Wu, H., & Guo, C. (2022). Effect of mindfulness on psychological distress and well-being of children and adolescents: A meta-analysis. *Mindfulness*, 13(2), 285-300.
- Zoogman, S., Goldberg, S. B., Hoyt, W. T., & Miller, L. (2015). Mindfulness interventions with youth: A meta-analysis. *Mindfulness*, 6(2), 290–302. <https://doi.org/10.1007/s12671-013-0260-4>