UNIVERSITY OF Southampton

Doctoral Programme in Educational Psychology

Academic critique of Paws b, a mindfulness based intervention for children

Lloyd Chilcott. Academic critique, submitted January 2021

Mindfulness based interventions (MBIs) are programs created to teach mindfulness: the awareness of paying attention to the present moment (Kabat-Zinn, 2003). While MBIs are often associated with a positive impact on children and adolescents' mental health and wellbeing, there is growing evidence of the effect of mindfulness on cognition and learning (Weare, 2019). There is increasing evidence that MBIs impact executive functioning (EF) (Dunning et al., 2019), attention (Klingbeil et al., 2017) and academic performance (Bakosh, Snow, Tobias, Houlihan, & Barbosa-Leiker, 2016; Waters, Barsky, Ridd, & Allen, 2014). Furthermore, children may be well placed to receive MBIs. Mindfulness techniques engage the prefrontal cortex, the brain region responsible for EFs (Tang, Yang, Leve, & Harold, 2012). A child's prefrontal cortex experiences considerable maturation as they enter adolescence (Tang et al., 2012) and mindfulness may aid the development and application of executive skills during the developmental period (Kaunhoven & Dorjee, 2017). Schools are increasingly adopting MBIs (Emerson, de Diaz, Sherwood, Waters, & Farrell, 2020) and, in recent years, an increasing range of MBIs are available for pre-adolescents (MiSP, 2019).

Paws b is a mindfulness curriculum for children aged 7 – 11 created by the Mindfulness in Schools Project (MiSP) (MiSP, 2020c). Paws b provides a primary curriculum alongside .b, a mindfulness programme for adolescents (MiSP, 2020a). Paws b is taught as either 12 short lessons, or six paired sessions, that introduce mindfulness activities and the science of mindfulness. Table 1, created by Thomas (2015), displays a simple overview of the Paws b programme. Trained professionals (those with previous mindfulness qualifications, personal mindfulness practice and who have passed the three day 'Teach Paws b' course) may deliver the curriculum (MiSP, 2020d).

Table 1. *Thomas' (2015) overview of the Paws b mindfulness programme*

Lesson	Description of content
1	• An introduction to the brain; • A discussion of our ability to make choices; • A breath counting mindfulness exercise.
2	• An introduction to the 'searchlight' of attention; • An introduction to the philosophy of mindfulness; • Two mindful breathing exercises.
3	• A grounding mindfulness exercise; • A discussion of 'wobbly' feelings.
4	• The 'count and add two' mindful breathing exercise; • A discussion of how to avoid reacting badly to situations.
5	• A discussion of worries; • A discussion of how worries can be supported by the previously learnt mindfulness exercises.
6	• A recap of learning; • Practise all learnt mindfulness exercises.

Paws b and .b is estimated to have reached over 540,000 children internationally (MiSP, 2019). However, there is a limited evidence base for Paws b, particularly regarding the impact on cognition and learning. To the best of the author's knowledge, this critique includes the first systematic literature review of Paws b. The

critique will first examine the theoretical base for Paws b, focusing on the impact on EF. Then, the critique will review the literature evidencing the impact and effectiveness of Paws b on cognition and learning. Finally, the critique will explore the implications for educational psychology practice.

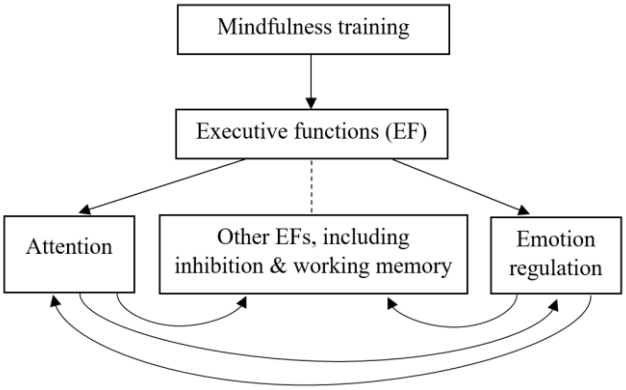
Theoretical Underpinnings

MiSP does not provide an overview of the theory informing Paws b on their website. Instead, MiSP explains on their 'Mindfulness. Why do it?' webpage that mindfulness can develop attention, working memory, planning, emotion regulation and self-regulation (MiSP, 2020b). MiSP also provides access to a range of publications supporting these claims (including Weare (2019) and Baer, Crane, Miller and Kuyken (2019)), which have findings in keeping with the wider literature. For example, Dunning et al. (2019) conducted a systematic literature search of random control trials of MBIs with children and found a small yet significant positive effect with EF and attention. Similar results were reported in Klingbeil et al.'s (2017) meta-analysis of MBIs with youth, with findings of a small but significant effect on meta-cognition and attention. In total, these findings indicate that mindfulness can impact a range of cognitive processes, many of which could impact thinking and learning (Cross & Paris, 1988).

Models of Mindfulness

Different models explain how MBIs, such as Paws b, impact cognition. The School-Based Meditation Model (Waters et al., 2014) demonstrates that MBIs impact upon cognition and emotional regulation, which subsequently impact academic achievement, wellbeing and social competence, which in turn impact one another. This simple model provides an accessible overview of each process but does not indicate the most significant cognitive functions, or the interaction of cognitive skills. Holas and Jankowski (2013) offer a more complex, alternative cognitive model of mindfulness. Here, mindfulness impacts the metacognitive system, which impacts the general level of EFs and the attentional orientating processes. While Holas and Jankowski highlight attention as a significant cognitive skill, this model, as with the previous model, combines cognitive functions into an umbrella term. For the purposes of this critique, a new model has been formulated, drawing on the work of Waters et al., and Holas and Jankowski: Figure 1 presents a cognitive model of mindfulness which outlines the key cognitive skills impacted by mindfulness practice and the interaction between these cognitive abilities.

Figure 1. *Cognitive model of mindfulness*



Attention

Attention is the first EF skill within the model. Attention 'is the process by which certain information is selected for further processing, and other information is discarded' (Ward, 2006, p.130). During mindfulness practice, a pupil learns to bring their attention to the present moment, usually in the form of their breathing, and, over time, this practice can improve a pupil's attention. Felver, Tipsord, Morris, Racer and Dishion (2017) reported a significant, medium size effect on attention from randomised clinical trials of an MBI with children. While potential experimenter effects limited these findings, the results were in keeping with reviews showing improved attention from MBIs (Dunning et al., 2019; Klingbeil et al., 2017). Attention is also fundamental to the application and development of other EF (as indicated in figure 1). To instigate emotion regulation, planning, etc., first, a person must focus their attention, before the top-down instigation of the other EFs (Woolfolk, 2016). Therefore, MBIs develop attention, and improved attention supports the development of other EFs.

Emotion Regulation

Emotion regulation, the capacity to alter the experience and expression of emotions (Woolfolk, 2016), is the second central EF skill within the model. MBIs often include the opportunity to develop emotion regulation strategies via top-down, intentional regulation (Kaunhoven & Dorjee, 2017). These strategies, such as the reappraisal of negative emotions (Jensen, 2013), are reported to result in significant improvements in emotion regulation (Jensen, 2013; Schonert-Reichl et al., 2015). In Paws b, emotion regulation is developed by the 'discussion of wobbly feelings' and the session on 'how to avoid reacting badly to situations'. Furthermore, emotion regulation, much like attention, is not an isolated cognitive skill. It influences other domains and is fundamental to the instigation and development of other EFs (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). For example, while we are not able to improve working memory capacity, our emotional state can restrict working memory potential (Woolfolk, 2016). Subsequently, improved emotional regulation, achieved through mindfulness, can allow an optimal working memory (Quach, Jastrowski Mano, & Alexander, 2016).

Other Executive Functions

Figure 1 indicates that mindfulness practice may indirectly benefit additional cognitive skills. MBI research in children and adolescents has indicated improvements in inhibition (Thomas & Atkinson, 2016), planning (Dunning et al., 2019) and working memory (Quach et al., 2016). Attention and emotion regulation create the 'mental capital' to aid a range of cognitive functions (Mindfulness All-Party Parliamentary Group, 2015, p.6) through the processes discussed in the previous attention and working memory examples. Therefore, it is unsurprising that there is tentative evidence of MBIs aiding academic achievement (Waters et al., 2014).

Impact and Effectiveness

The limited evidence exploring the impact of Paws b on learning and cognition consists of five peer-reviewed journal articles and one thesis (see Appendix A for the search strategy). The evidence will be considered first through an overview of the findings and then through a discussion of the limitations across the studies.

Attention

Thomas and Atkinson (2016) conducted a randomised control trial to explore the impact of Paws b on attention. Thirty year four pupils, and their class teachers, were randomly assigned to an experimental group or a waitlist control group. Both groups completed attention measures at pre- and post-intervention, and in follow-ups in the following weeks. The first measure, a teacher reported attention checklist, showed attention scores for the experimental group to have consistently improved on follow-up. In contrast, the waitlist control group, even after receiving Paws b, showed no improvements. Similar promising, but mixed, results emerged from the second measure, a researcher-administered measure of attention. Pupils completed a naming task and inhibition task, and the experiment group, mostly, scored higher than the control group until the control group also experienced the intervention. However, the control group did not maintain the improvements. The authors concluded that the intervention effects were unexpectedly stronger in the experimental group, and that follow up effects on attention were stronger than immediate effects.

In a subsequent publication, using the same study data, Thomas and Atkinson (2017) reported the findings from four focus groups, consisting of 16 pupils, on their experiences of Paws b. Some pupils discussed the usefulness of being less distracted and being able to reorientate their attention. In a more recent study, Hutchinson, Huws and Dorjee (2018) also completed focus groups on the experiences of Paws b, though with year six pupils with two years more experience of the intervention. The children reported being able to better focus on the present moment and their emotions, which allowed them to respond with mindfulness. In one focus group example, a child reflected on a previous peer disagreement, brought attention to their own anger, and reappraised their interpretation from the other child's perspective.

Emotion Regulation

The findings of Hutchinson, Huws and Dorjee (2018) appeared to evidence the link between attention and emotion regulation, another cognitive skill theoretically impacted by MBIs. Wimmer & Dorjee (2020) further explored the effect on emotion regulation in a comparison of results from the Emotion Regulation Checklist (Shields & Cicchetti, 1997) completed by the parents of 15 pupils attending a school with Paws b and nine pupils without MBI experience. The Paws b group received higher scores on the lability/negativity subscale (indicating fewer displays of negative emotions), while there was no group difference for the emotion regulation subscale (indicating 'appropriate affective displays, empathy, and emotional self-awareness'; Shields & Cicchetti, 1997, p.910). The authors suggest this may be due to the increased saliency of negative emotions to parents, as opposed to the subtly of emotion regulation. However, fewer incidents of negative emotion only goes so far as evidence of better regulation, since there may have been fewer arising emotions to regulate.

Other Executive Functions

Wimmer and Dorjee's (2020) study also explored the impact of paws b on executive functioning in the first mindfulness study using neuroscientific methods with children. The study compared the performance of the two groups (with larger sample sizes for the Paws b experienced (n=33) and non-experienced groups (n=20)). Pupils were tested using a portable electroencephalogram to measure event related potentials in the prefrontal cortex while completing cue-target trials. The mindfulness-experienced group displayed greater response inhibition (the cognitive ability to stop a response due to a new goal; Chiu, 2019). However, the same group displayed inferior cue processing (the cognitive ability to respond to a specific learnt target; Wimmer & Dorjee, 2020). These results suggest a complex relationship between MBIs and executive functioning skills.

Vickery and Dorjee (2016) explored meta-cognitive skills in pupils from three primary schools (two schools with Paws b experience and one without). The students' teachers and parents completed the Behavior Rating Inventory of Executive Function (Gioia, Isquith, Guy, & Kenworthy, 2000) at baseline and post-treatment. Despite an original sample of 71 pupils, only eight pupils in the experimental group, and ten pupils in the control group, had complete data sets. The teachers reported significant improvements of meta-cognition at follow-up for the experimental group and not for the control group. While the pupils' parents also reported no significant improvements for the control group, they reported a decrease in meta-cognition for the experimental group. The authors suggest the discrepency between the scores may be due to the teachers ability to idenitify meta-congitive skills, or that MBI learning is unable to generalise beyond the school. Unfortunately, the authors did not provide any details of the indivudal meta-congitive indicies and only presented meta-congition as a unified construct.

Engagement

Pupil engagement and enjoyment of Paws b will likely impact the potential effect on cognition, for greater engagement in an activity will likely result in increased learning (Woolfolk, 2016). In Vickery and Dorjee's (2016) study with 71 children, a self-report measure indicated 76% of the pupils liked the practice, and 61% wanted to continue mindfulness in school. In the focus groups conducted by Thomas and Atkinson (2017), 15 of the 16 pupils indicated that they liked the practice. Hutchinson et al.'s (2018) focus groups did not comment on engagement or enjoyment directly but did share the practice was quick and achievable irrespective of the location.

Academic Output

The only study to explore academic progress was conducted by Thomas (2015). Here, as part of the same study reported by Thomas and Atkinson (2016, 2017), teachers completed a questionnaire of the quality of work produced in class, and the researchers compared the pupils' literacy and numeracy national curriculum levels. The questionnaire demonstrated a lack of intervention effects, and while the literacy and numeracy

variables showed significant improvements, there was also evidence of maturation effects. Subsequently, the authors concluded no main findings to impact on academic progress.

Limitations of the Literature

The intervention fidelity ('the degree to which treatment is implemented as intended' Perepletchikova, 2005, p.365) was not measured or assessed in half of the studies. In Wimmer and Dorjee's (2020) study, different teachers delivered Paws b without observation or comment on whether these teachers consistently delivered the curriculum at the same standard. Hutchinson, Huws and Dorjee (2018) 'expected that the programme would have been delivered with a high degree of fidelity' (p.3938) but did not provide evidence. In contrast, Thomas (2015; the same paper provided the data for Thomas and Atkinson, 2016, 2017) conducted a fidelity observation of a systematic set of Paws b sessions. This observation allows for a more accurate interpretation of the intervention effects (Perepletchikova, 2005).

Each of the studies had a small sample size, some of which reduced further during their experiments. For example, Vickery and Dorjee (2016) started with a sample of 71 pupils, but only 18 students were applicable for their parent and teacher meta-cognition measure. A small sample can result in estimated intervention effects not representative of the true association (Pannucci & Wilkins, 2010). Additionally, the selected sample in each study may lack generalisability to a wider population. Each school in the six studies volunteered for involvement; these schools may have specific characteristics that alter their performance (such as having the provision available for MBIs) which is not present in a randomly selected school. In Hutchinson, Huws and Dorjee (2018), the lead teacher for mindfulness co-developed Paws b, which may have resulted in their sample receiving a greater quality programme compared to other schools. Moreover, Thomas (2015) and Thomas and Atkinson (2016, 2017) used data from the same experiments, and the three remaining papers each used samples from North Wales within a four year period. Other areas of the UK may provide different findings.

Within the Paws b curriculum are inherent confounding variables that could affect study outcomes. The curriculum includes encouragement for the pupils to practice at home, and to embed mindfulness practice into the wider school curriculum, both of which reduce a standardised Paws b experience between students. The Paws b studies discussed include additional confounding variables. For example, Thomas (2015) and Wimmer and Dorjee's (2020) sample consisted of mostly bilingual students. Bilingualism is positively associated with increased executive functioning (Carlson & Meltzoff, 2008), and may have influenced the pupils increased outcomes.

Five of the Paws b studies included self-report measures. Self-report measures allow researchers to gather the views of participants, but rely on an individual understanding their own and others' behaviour, which may change over time (Fadnes, Taube, & Tylleskär, 2012). Additionally, all six studies provided insufficient long-term follow-up measures. Four of the studies did not include a follow-up measure, and while Thomas and Atkinson (2016) and Vickery and Dorjee (2016) both included a follow-up measure months later, neither crossed Greenberg and Harris (2012) standard for a six-month follow up to ensure high-quality MBI research in children.

Summary and Implications for Practice

In summary, the limited Paws b literature provides promising findings, with considerable limitations. There is tentative evidence that Paws b can impact executive functioning, particularly in attention, emotion regulation and inhibition. There are also suggestions that Paws b is highly engaging, though it is unclear if there is any impact on academic output. Nonetheless, the significant limitations across each of the Paws b studies result in the need for caution when interpreting the results.

MBIs are a recent therapeutic intervention to be considered by Educational Psychologists (EPs) (Thomas & Atkinson, 2017). Paws b has the potential to become a highly recommended MBI, but, as demonstrated in this critique, there must be further research. The current role of the EP is in supporting schools to consider the

evidence for MBIs and aid the evaluation of MBIs within schools (Thomas & Atkinson, 2017). EPs are also required to support school staff to implement MBIs into their school, should the school staff decide to introduce an MBI. The EP may be able to support at a systems level to make staff aware that MBIs are most effective when staff have their own mindfulness practice (Weare, 2019), the school staff create a supportive, mindful community (Hutchinson et al., 2018) and embed mindfulness principles and practice across the school curriculum (Thomas & Atkinson, 2017). The EP is also able to support overcoming barriers to implementing MBIs in schools, such as the misconception that mindfulness practice is a reactive wellbeing intervention, rather than a tool that may benefit all learners' wellbeing, cognition and learning (Jones, 2011). At present, EPs are unlikely to deliver MBIs as most are without the relevant training (Thomas & Atkinson, 2016). However, there may be great value in mindfulness training as part of EP training to increase the awareness of MBIs within the profession and to support EP wellbeing (Thomas & Atkinson, 2017).

References

Baer, R., Crane, C., Miller, E., & Kuyken, W. (2019). Doing no harm in mindfulness-based programs: Conceptual issues and empirical findings. *Clinical Psychology Review*, *71*, 101–114. https://doi.org/10.1016/j.cpr.2019.01.001

Bakosh, L. S., Snow, R. M., Tobias, J. M., Houlihan, J. L., & Barbosa-Leiker, C. (2016). Maximizing mindful learning: Mindful awareness intervention improves elementary school students' quarterly grades. *Mindfulness*, *7*(1), 59–67. https://doi.org/10.1007/s12671-015-0387-6

Carlson, S. M., & Meltzoff, A. N. (2008). Bilingual experience and executive functioning in young children. *Developmental Science*, *11*(2), 282–298. https://doi.org/10.1111/j.1467-7687.2008.00675.x

Chiu, Y. C. (2019). Automating adaptive control with item-specific learning. *Psychology of Learning and Motivation - Advances in Research and Theory*, *71*, 1–37. https://doi.org/10.1016/bs.plm.2019.05.002

Cross, D. R., & Paris, S. G. (1988). Developmental and instructional analyses of children's metacognition and reading comprehension. *Journal of Educational Psychology*, *80*(2), 131–142. https://doi.org/10.1037//0022-0663.80.2.131

Downs, S. H., & Black, N. (1998). The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *Journal of Epidemiology and Community Health*, *52*(6), 377–384. https://doi.org/10.1136/jech.52.6.377

Dunning, D. L., Griffiths, K., Kuyken, W., Crane, C., Foulkes, L., Parker, J., & Dalgleish, T. (2019). 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 and Allied Disciplines*, *60*(3), 244–258. https://doi.org/10.1111/jcpp.12980

Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child Development*, *82*(1), 405–432. https://doi.org/10.1111/j.1467-8624.2010.01564.x

Emerson, L. M., de Diaz, N. N., Sherwood, A., Waters, A., & Farrell, L. (2020). Mindfulness interventions in schools: Integrity and feasibility of implementation. *International Journal of Behavioral Development*, *44*(1), 62–75. https://doi.org/10.1177/0165025419866906

Fadnes, L. T., Taube, A., & Tylleskär, T. (2012). How to identify information bias due to self-reporting in epidemiological research. *The Internet Journal of Epidemiology*, *7*(2). https://doi.org/10.5580/1818

Felver, J. C., Tipsord, J. M., Morris, M. J., Racer, K. H., & Dishion, T. J. (2017). The effects of mindfulness-based intervention on children's attention regulation. *Journal of Attention Disorders*, *21*(10), 872–881. https://doi.org/10.1177/1087054714548032

Gioia, G. A., Isquith, P. K., Guy, S. C., & Kenworthy, L. (2000). Behavior rating inventory of executive function. *Child Neuropsychology*, *6*(3), 235–238. https://doi.org/10.1076/chin.6.3.235.3152

Greenberg, M. T., & Harris, A. R. (2012). Nurturing mindfulness in children and youth: Current state of research. *Child Development Perspectives*, *6*(2), 161–166. https://doi.org/10.1111/j.1750-8606.2011.00215.x

Holas, P., & Jankowski, T. (2013). A cognitive perspective on mindfulness. *International Journal of Psychology*, *48*(3), 232–243. https://doi.org/10.1080/00207594.2012.658056

Hong, Q., Pluye, P., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., … Vedel, I. (2018). Mixed Methods Appraisal Tool (MMAT) version 2018: user guide.

Hutchinson, J. K., Huws, J. C., & Dorjee, D. (2018). Exploring experiences of children in applying a school-based mindfulness programme to their lives. *Journal of Child and Family Studies*, *27*(12), 3935–3951. https://doi.org/10.1007/s10826-018-1221-2

Jensen, J. (2013). *Mindfulness and school-age children: An integrative literature review exploring developmental considerations* [Doctoral thesis, California Institute of Integral Studies]. ProQuest. https://search.proquest.com/docview/1492986219?pq-origsite=gscholar&fromopenview=true

Jones, D. (2011). Mindfulness in schools. *The Psychologist*, *24*, 736–739.

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

Kaunhoven, R. J., & Dorjee, D. (2017). How does mindfulness modulate self-regulation in pre-adolescent children? An integrative neurocognitive review. *Neuroscience and Biobehavioral Reviews*, *74*, 163–184. https://doi.org/10.1016/j.neubiorev.2017.01.007

Klingbeil, D. A., Renshaw, T. L., Willenbrink, J. B., Copek, R. A., Chan, K. T., Haddock, A., … Clifton, J. (2017). Mindfulness-based interventions with youth: A comprehensive meta-analysis of group-design studies. *Journal of School Psychology*, *63*, 77–103. https://doi.org/10.1016/j.jsp.2017.03.006

Mindfulness All-Party Parliamentary Group. (2015). *Mindful Nation UK*. London.

MiSP. (2019). *Impact Report 18/19*. https://mindfulnessinschools.org/wp-content/uploads/2020/01/MiSP-Impact-Report-2019-crop.pdf

MiSP. (2020a). .b Curriculum (ages 11 – 18). https://mindfulnessinschools.org/teach-dot-b/dot-b-curriculum/

MiSP. (2020b). Mindfulness. Why do it? https://mindfulnessinschools.org/mindfulness-in-education/why-do-it/

MiSP. (2020c). Paws b Curriculum (ages 7 – 11). https://mindfulnessinschools.org/teach-paws-b/paws-b-curriculum/

MiSP. (2020d). Prerequisites for Teach Paws b Training. Retrieved from https://mindfulnessinschools.org/prerequisites/paws-b/

MiSP. (2020e). Research. https://mindfulnessinschools.org/research-papers/

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine*, *151*, 264–269.

Pannucci, C. J., & Wilkins, E. G. (2010). Identifying and avoiding bias in research. *Plastic and Reconstructive Surgery*, *126*(2), 619–625. https://doi.org/10.1097/PRS.0b013e3181de24bc

Perepletchikova, F. (2005). Treatment integrity and therapeutic change: Issues and research recommendations. *Clinical Psychology: Science and Practice*, *12*(4), 365–383. https://doi.org/10.1093/clipsy/bpi045

Quach, D., Jastrowski Mano, K. E., & Alexander, K. (2016). A randomized controlled trial examining the effect of mindfulness meditation on working memory capacity in adolescents. *Journal of Adolescent Health*, *58*(5), 489–496. https://doi.org/10.1016/j.jadohealth.2015.09.024

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), 52–66. https://doi.org/10.1037/a0038454

Shields, A., & Cicchetti, D. (1997). Emotion regulation among school-age children: the

development and validation of a new criterion Q-sort scale. *Developmental Psychology*, *33*(6), 906–916. https://doi.org/10.1037/0012-1649.33.6.906

Tang, Y. Y., Yang, L., Leve, L. D., & Harold, G. T. (2012). Improving executive function and its neurobiological mechanisms through a mindfulness-based intervention: Advances within the field of developmental neuroscience. *Child Development Perspectives*, *6*(4), 361–366. https://doi.org/10.1111/j.1750-8606.2012.00250.x

Thomas, G., & Atkinson, C. (2016). Measuring the effectiveness of a mindfulness-based intervention for children's attentional functioning. *Educational and Child Psychology*, *33*(1), 51–64.

Thomas, G., & Atkinson, C. (2017). Perspectives on a whole class mindfulness programme. *Educational Psychology in Practice*, *33*(3), 231–248. https://doi.org/10.1080/02667363.2017.1292396

Thomas, G. L. (2015). *Evaluating the impact of the paws .B mindfulness programme on mainstream primary school aged pupils' suppressing and sustaining attention skills, and their academic proxy measures* [Doctoral thesis, The University of Manchester]. University of Manchester Research Explorer. https://www.research.manchester.ac.uk/portal/en/theses/evaluating-the-impact-of-the-paws-b-mindfulness-programme-on-mainstream-primary-school-aged-pupils-suppressing-and-sustaining-attention-skills-and-their-academic-proxy-measures%281712d5dd-3e0d-4ce7-bcb0-66026081b98f%29.html

Vickery, C. E., & Dorjee, D. (2016). Mindfulness training in primary schools decreases negative affect and increases meta-cognition in children. *Frontiers in Psychology*, *6*, 1–13. https://doi.org/10.3389/fpsyg.2015.02025

Ward, J. (2006). *The student's guide to cognitive neuroscience*. Hove: Psychology Press.

Waters, L., Barsky, A., Ridd, A., & Allen, K. (2014). Contemplative education: A systematic, evidence-based review of the effect of meditation interventions in schools. *Educational Psychology Review*, *27*(1), 103–134. https://doi.org/10.1007/s10648-014-9258-2

Weare, K. (2019). Mindfulness and contemplative approaches in education. *Current Opinion in Psychology*, *28*, 321–326. https://doi.org/10.1016/j.copsyc.2019.06.001

Wimmer, L., & Dorjee, D. (2020). Toward determinants and effects of long-term mindfulness training in pre-adolescence: A cross-sectional study using event-related potentials. *Journal of Cognitive Education and Psychology*, *19*(1), 65–83. https://doi.org/10.1891/JCEP-D-19-00029

Woolfolk, A. (2016). *Educational psychology* (13th ed.). Harlow: Pearson Education Limited.

Appendix A – Systematic search strategy

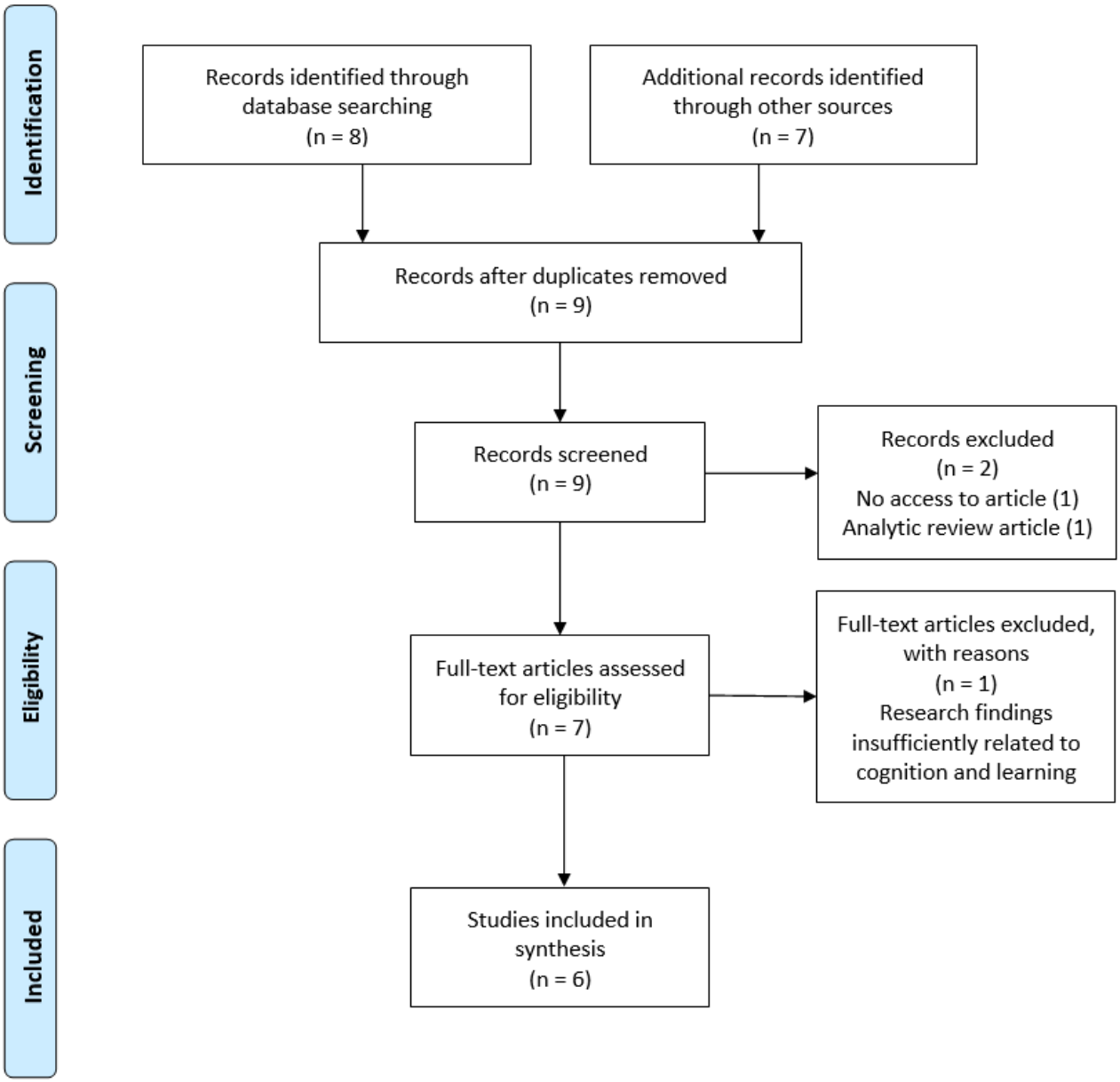
An initial scoping search was carried out using Delphis (a search portal available at the University of Southampton) and Google Scholar. This informed the selection of key terms, which were applied to the 'PICOS' framework (see Table 2). Search terms were then applied to the PsychInfo, Education Resources Information Centre (ERIC), Scopus and ProQuest databases. The PsychInfo search resulted in two applicable articles, the Scopus search resulted in four articles, the ERIC search resulted in one article, and ProQuest contained no applicable articles. During the scoping process, I discovered the MiSP research page (MiSP, 2020e), a repository of published Paws b research. This collection contained six applicable papers. Finally, in a reference search of an applicable paper, a further paper was identified and included for review. The resulting 15 papers were screened and assessed. Six duplicates were removed and three excluded (see Figure 2, the PRISMA Flow Diagram).

After screening the articles, the resulting six papers were appraised using either the Downs and Black (1998) checklist for measuring quantitative study quality (Appendix C), or the Critical Appraisal Skills Programme (CASP; Hong et al., 2018) Checklist for measuring qualitative study quality (Appendix D). One study (Thomas, 2015) was assessed using the quantitative checklist, despite containing quantitative and qualitative experiments. The study included three experiments, two of which were discussed in two other included papers (Thomas & Atkinson, 2016, 2017). Subsequently, the remaining quantitative experiment was individually appraised.

Table 2. *Inclusion search terms*

	Search Terms
Population (P)	children OR adolescents OR youth OR child OR teenager OR "young people" OR young-people OR school-age OR "school age" OR pupil* OR student*
Intervention (I)	"Paws b"
Comparison (C)	N/A
Outcome (O)	
Setting (S)	"Mindfulness based intervention" OR MBI OR Mindfulness OR Meditation OR "Mindfulness-based intervention" OR "Mindfulness Intervention" OR "Mindfulness-based" OR "Mindfulness meditation"

Figure 2. *PRISMA 2009 Flow Diagram (Moher, Liberati, Tetzlaff, & Altman, 2009) of the systematic search process*



Appendix B

Table 3. *Quality appraisal of research sources using an amended Downs and Black (1998) checklist for measuring quantitative study quality*

Study	Hypotheses clearly described	Outcome measures clearly described	Sample clearly described	Interventions clearly described	Findings clearly described	Distribution of data and estimates of random variability	Potential adverse effects of intervention reported	Lost participants described	Probability values reported
Wimmer & Dorjee (2020)	Yes	Yes	No*	Yes	Yes	Yes	No	Yes	Yes
Thomas & Atkinson (2016)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Vickery & Dorjee (2016)	Yes	Yes	No*	Yes	Yes	Yes	No	Yes	Yes
Thomas (2015)*	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes

Study (cont.)	Representative sample	Intervention within representative context	Participants blind to intervention	Attempts to blind those measuring outcomes	All unplanned analyses reported	Time periods between intervention and tests appropriate	Appropriate statistical tests	Intervention fidelity (reliability and validity)	Accurate outcome measures
Wimmer & Dorjee (2020)	Yes	Yes	No	No	Yes	Unknown	Yes	Unknown**	Yes
Thomas & Atkinson (2016)	Yes	Yes	No	No	Yes	Yes	Yes	Unknown*	Yes
Vickery & Dorjee (2016)	Yes	Yes	No	No	Yes	Yes	Yes	Unknown**	Yes
Thomas (2015)	Yes	Yes	No	No	Yes	Yes	Yes	Unknown**	Yes

Study (cont.)	Participants from same population at same time	Random allocation of participants	Adequate adjustment for confounding variables	Lost participants taken into account	Total score out of 22	Source Type	Notes
Wimmer & Dorjee (2020)	No	No	No	Yes	13	Peer-reviewed journal	*Sample characteristics overly simplistic. **Insufficient account of intervention application
Thomas & Atkinson (2016)	Yes**	Yes***	No	Yes	17	Peer-reviewed journal	*Insufficient account of intervention application **Participants were from the same school, but different classes ***Participant groups (their class) were randomly assigned.
Vickery & Dorjee (2016)	Yes***	No	No	Yes	15	Peer-reviewed journal	*Sample characteristics overly simplistic. **Insufficient account of intervention application ***Participants were from the same school, but different classes
Thomas (2015)	Yes***	Yes****	No	Yes	17	Thesis	*Appraisal only of RQ2: see search strategy for further detail. **Insufficient account of intervention application ***Participants were from the same school, but different classes ****Participant groups (their class) were randomly assigned.

Appendix C

Table 4. *Quality appraisal of research sources using an amended CASP Checklist (Hong et al., 2018) for measuring qualitative study quality*

Study	Aims clearly described	Appropriate methodology	Appropriate recruitment	Data collection addressed the aims	Considered relationship between researcher & participant	Considered ethical issues	Sufficient data analysis	Statement of findings
Hutchinson, Huws, & Dorjee, (2018)	Yes	Yes	Yes	Yes	No	Yes*	Yes	Yes
Thomas & Atkinson (2017)	Yes	Yes	Yes	Yes	No	No*	Yes	Yes

Study	Valuable research	Total score out of 9	Source Type	Notes
Hutchinson, Huws, & Dorjee (2018)	Yes	8	Peer-reviewed journal	*The authors did not explain the acknowledged risk with participation.
Thomas & Atkinson (2017)	Yes	7	Peer-reviewed journal	*While there was some acknowledgment of ethical issues, these were insufficiently discussed.