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ARTICLE

Differential effects of digital mindfulness-based interventions on creative potential and responsibility among middle school students

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Abstract

Background: Creativity and responsibility are enhanced by meditation among adults, but such effects have not been studied in adolescents. Moreover, the determinants of the ethical effect (such as responsibility) of meditation are unclear.

Aims: To address this gap by investigating the impact of digital in-class meditation programmes in middle school, focusing on intentions (self-centred vs. responsibility-centred), on adolescents' creative potential and sense of responsibility. These intentions are operationalized by different purpose-based meditations.

Methods: We conducted a cluster randomized controlled trial involving 107 year 7 adolescents from six classes, assigning them to two experimental groups and an active control group. Pre- and post-intervention assessments were conducted over an 11-week period, including a creativity (EPoC) test comprising four exercises (graphic and verbal, divergent and convergent thinking), a responsibility and a mindfulness scale.

Results: Our findings revealed no discernible effects on divergent thinking or self-reported mindfulness. However, we observed significant differences in graphic and verbal convergent creative thinking, as well as impacting responsibility scores, between a responsibility-centred meditation group and a self-centred meditation group. Moreover, distinctions were noted between control and self-centred meditation groups and between some classes. Effect sizes indicated that the interventions had a moderate but significant impact on the variables measured.

Conclusion: Our study reveals the effectiveness of digital meditation interventions in enhancing convergent creative thinking and responsibility among middle-school students.

Notably, it shed new light on the importance of meditation intentions, which may be as significant as the form of meditation itself.

KEYWORDS
convergent thinking, creativity, digital, mindfulness, mind wandering, responsibility

INTRODUCTION

Well-being, meditation and mindfulness

Recognition of the increasing importance of enhancing well-being and alleviating mental distress has become more pronounced in contemporary discourse. Indeed, studies have widely documented that meditation can contribute to alleviating mental distress (Dahl et al., 2020). However, gaps in understanding remain regarding the specific effects of mindfulness-based interventions, most particularly in the secular context of schools, raising the question: How can secular meditation programmes contribute effectively to the development of key skills such as creativity and responsibility among students? This question underscores the necessity of an empirical investigation into the potential benefits of mindfulness practices in educational settings.

Dahl et al. (2020) proposed four fundamental dimensions of well-being as crucial for human flourishing: awareness, connection, insight and purpose, the latter being centred around personally significant aims. They further suggested that various forms of meditation can cultivate these dimensions. According to Nedelcu and Grégoire (2016), meditation is a method for training the mind, fostering attention, vigilance, calmness, compassion, benevolence and discernment. As a practice, meditation has its roots in diverse religious traditions.

One prevalent form of secular meditation today is mindfulness meditation, which has been described as an attentional state of consciousness (Rebecchi & Hagège, 2022), involving intentional, nonjudgmental awareness of the present moment (Kabat-Zinn, 1994). Mindfulness has been conceptualized in various ways, including as a trait, state, outcome, process or mode of awareness, achievable through different types of meditation practices. Its primary objective is often to enhance physical and mental well-being. The delivery of mindfulness meditation can occur through in-person sessions or digital platforms, each with its specific advantages and limitations. However, digital mindfulness training presents challenges, as outlined by Mrazek et al. (2019), such as low engagement, shallow learning and unaddressed obstacles or frustrations. The effectiveness of digital mindfulness interventions varies, with small to moderate effects on stress and mindfulness, which are contingent upon the delivery mode (Zhang et al., 2020). Lahtinen and Salmivalli (2020) suggested that concerns around disparities in the effects between digital and face-to-face mindfulness interventions may lack empirical support. Indeed, digital mindfulness programmes can yield at least some benefits of the benefits afforded by face-to-face interventions, such as anxiety reduction, even in brief interventions lasting only a week (Goetz et al., 2020).

Meditation also makes it possible to improve several executive functions, such as attention (Chiesa et al., 2010; Tang et al., 2007), working memory (Chiesa et al., 2011) and cognitive control (Fountain-Zaragoza et al., 2016). Meta-analyses of studies carried out among adults have shown that mindfulness meditation reduces stress (Zhang et al., 2020), improves general cognitive performance (Whitfield et al., 2021), has beneficial therapeutic effects (Klingbeil et al., 2017) and improves prosocial behaviours (Donald et al., 2019) and prosocial emotions (Luberto et al., 2018).

Mindfulness meditation in schools

Adolescence is a key stage in human development, during which time individuals develop new cognitive abilities (including the capacity for abstract thought), cultivate a more distinct sense of self and achieve a level of emotional, personal and financial autonomy from their parents (Christie & Viner, 2005). At this stage of life, cognitive development processes are often underpinned by a strong need for autonomy, which can generate an existential crisis characterized by the rejection of parental models and a new form of ill-being (Favre, 2007). For this reason, it seems necessary to accompany adolescents in the maturation of their cognitive functions and behaviours (Brookman-Byrne & Dumontheil, 2021) by seeking to design the curriculum to be as effective as possible in terms of the acquisition of skills and knowledge (Case, 1978; Wigfield et al., 2006), and the development of adolescents' well-being and psychosocial skills, including creativity (Kleibeuker et al., 2016) and responsibility. School is a key developmental context for adolescents to learn mindfulness (Eccles & Roeser, 2011).

Regarding the school setting, Malboeuf-Hurtubise et al. (2017) noted that mindfulness-based interventions showed positive effects on students' attention and on their social and emotional skills. More generally, prior studies have measured various beneficial effects of mindfulness meditation. In the absence of iatrogenic effects, increases in the social skills, well-being and attention of children under 18 have been reported, with a moderate to large effect size, while academic performance is improved with a small effect size (meta-analysis by Zoogman et al., 2015). Overall, numerous meditation programmes implemented with young people, often at school, have shown moderate improvements in well-being, emotion regulation, prosocial behaviour and social skills in general, along with reduced antisocial behaviour, stress, anxiety, emotional arousal and emotions which are deemed unpleasant (Britton et al., 2014; Waters et al., 2015). A meta-analysis notably showed a particularly marked effect of various interventions on resilience (Zenner et al., 2014). The increase in well-being at school among young adolescents was subsequently confirmed (McKeering & Hwang, 2018).

Creativity and responsibility: Towards responsible creativity

For the past 10 years or so, increasing attention has been paid to developing the skills deemed economically important in the upcoming century: critical thinking and responsibility, creativity and innovation and last but not least, problem resolution (OECD, 2018). In line with this, in September 2015, heads of state and government, senior United Nations (UN) officials and representatives of civil society gathered at the UN General Assembly and adopted 17 sustainable development goals (SDGs) to be achieved by 2030, among which are high quality education (to equip all individuals with the knowledge, skills and values necessary to enable them to live in dignity, to build a life and to contribute to their society), the reduction of inequalities, the fight against climate change and finally, boosting health and well-being. The present study will offer an avenue for promoting better education including creativity and responsibility through programmes designed to develop responsible creativity (Rebecchi et al., 2024).

Links between adults' creativity and states of consciousness (including mind wandering, flow and mindfulness) in professional, artistic and therapeutic contexts have recently been reviewed (Rebecchi & Hagège, 2022). Although a growing number of authors and researchers are continuing to question and study the effects of mindfulness in education (Felver et al., 2015), and the effects are regularly seen on well-being and mental health (McKeering & Hwang, 2018; Mettler et al., 2023; Phan et al., 2022), research focusing specifically on the effects of meditation on the development of creativity in the school context is still lacking. We do not know whether this absence is due to the very recent emergence of a new way of developing creativity, or to the ineffectiveness of this practice in the development of creativity in schools. Creativity refers to "the ability to produce a work that is both new and adapted to the context in which it occurs" (Lubart et al., 2015, p. 23). Thus, the creative act requires intentional work. It is generally considered that creativity involves the combination of different factors (e.g. intelligence, motivation, emotional factors, context). Moreover, in terms of creative thinking processes, Barbot and

Lubart (2012, p.301) defined convergent-integrative thinking as the ability to "synthesise heterogeneous elements, to integrate them into a single and coherent whole" and divergent-exploratory thinking as a "process of searching multi-directionally for many ideas or solutions, from a single starting point".

However, McLaren wrote that, in historical terms, "much of human creative effort has been in the service of devious and violent schemes" such as the first use of atomic energy in the bombing of Hiroshima (McLaren, 1993, p. 137), and it is, thus, necessary to consider the establishment of safeguards to avoid this and develop awareness of responsibility at the same time as creativity. The World Health Organization (WHO) proposed the development of life skills, defined as "capacities for adaptive and positive behaviour, which enable individuals to cope effectively with the demands and challenges of daily life" (WHO, 1994, p. 1). These life skills are also called psychosocial skills and they play an important role in a person's physical, mental and social well-being. Thus, the WHO originally proposed to integrate 10 skills into school programmes: decision-making, problem-solving, critical thinking, effective communication, interpersonal relationships skills, self-knowledge, empathy, the ability to regulate emotions, stress management and creative thinking. Also, in 2018, the Organization for Economic Cooperation and Development (OECD) launched a project on the future of education for 2030 and indicated that "creativity and the ability to solve problems presupposes considering the future consequences of one's actions, evaluating their risks and benefits, and to accept responsibility for the results of one's work" (OECD, 2018, p. 7).

Responsibility is a core concept of education and ethics (Paturet, 2003) that has been the object of several theories in separate fields of research (see an overview in Hagège et al., 2023). It can be defined as a person's ability to respond adequately to situations, while considering him or herself, others, and the environment on an equal footing (Hagège, 2019). This ability relies on the establishment of a dialogical relationship between the inner and outer worlds of the subject (Henriot, 2015) that tends towards non-duality (Hagège, 2022). The development of responsibility, thus, involves the entire psychoaffective functioning of the individual (notably their decisions, behaviours, intentions and actions) as well as value congruence (Hagège, 2017a, 2017b). Creativity lies at the centre of responsibility, which requires creating new (non-dual) functioning (Hagège, 2019). The concept of responsible creativity (Rebecchi et al., 2024) could, thus, reconcile Western creative processes focused on problem-solving and products, and Eastern creative processes oriented on emotional, personal and intrapsychic elements (Lubart, 1990). The challenge is, therefore, to include this objective of responsibility in designing education for creativity, and mindfulness meditation is a promising practice forming part of such an education.

Relation between meditation and responsibility

The links between meditation and responsibility have only been recently investigated for perhaps the first time, in a quasi-experimental study where an ethically oriented meditation-based programme (Hagège, 2022) was shown to enhance the self-reported sense of one's own responsibility among university students (Hagège et al., 2023). As far as more generally ethics-related variables and meditation are concerned, there are several debates in the mindfulness literature and the studies have mostly used samples of adult subjects. To summarize very briefly, some researchers have argued that altruistic outcomes would be intrinsically favoured by mindfulness meditation (discussed by Purser, 2015). In line with this, it has indeed been shown that mindfulness practice can foster moral decision-making (Shapiro et al., 2012) and prosociality (meta-analysis by Berry et al., 2020).

However, the above behavioural view might be challenged. Other researchers have argued for the explicit inclusion of ethical content in mindfulness programmes (Condon, 2019; Lomas, 2017; Thupten, 2019), and some empirical data have shown that the prosocial effects of mindfulness practices with no explicit ethical content depend on individual differences: they can be restricted to individuals who are predisposed to them, and even have the opposite effect on other individuals (Chen & Jordan, 2020; Poulin et al., 2021). In contrast, mindfulness programmes containing

ethical instructions have not produced these unwanted effects (Chen & Jordan, 2020), and have tended to increase prosociality (Chen & Jordan, 2020), and self-reported ethical value congruence (Monteiro et al., 2019). The rare studies comparing meditation with or without ethical content (Bayot et al., 2020; Chen & Jordan, 2020) have based their ethics on Buddhist content and compared programmes that differ in relation to several variables, such as the types of meditations and philosophical teachings. Thus, it is not yet clear how best to promote ethics, including which pedagogical elements of the meditation programme are most beneficial. On this topic, we note two major gaps in the literature: the manipulation of single pedagogical independent variables in experimental designs, and the lack of use of secular ethical meditation, which would be needed to adapt practices to the public school context. Moreover, we found no study addressing meditation with an explicitly ethical aim (such as responsibility) in a school setting.

Relation between meditation and creativity

Mindfulness training has been shown to enhance creativity among adults (reviewed in Rebecchi & Hagège, 2022), for both divergent and convergent verbal productions (Hagège et al., 2023). Prior research has established that different types of meditation have different effects on creativity. Colzato et al. (2012) noted that open-monitoring meditation improves divergent thinking, and that focused attention meditation improves convergent thinking. Additionally, prior meditation experience has been shown to modulate both performance and strategy, particularly with respect to open-monitoring meditation and the insightful strategies used by people with meditation experience (Lippelt et al., 2014). This suggests that the type of meditation being practised matters, as two different types can have opposite effects, and that the effects of meditation on creativity vary depending on the length of the programme (Capurso et al., 2014; Lippelt et al., 2014). These results are consistent with Berkovich-Ohana et al. (2016), who noticed that people who practised more than 1000 h of meditation performed better in tests of divergent thinking (flexibility and fluency). Moreover, Ding et al. (2014) found that short-term (30 min per day for 7 days) integrative mind–body training improved divergent thinking scores, and that a short-term (5-h) meditation programme was more effective than simple relaxation to activate the eureka effect (suddenly understanding something that was previously incomprehensible) (Ding, Tang, Cao, et al., 2015). Ding, Tang, Deng, et al. (2015) also concluded that personality and mood predict individual variations in terms of the effects of meditation on creativity.

It should also be noted that listening to a pre-recorded open-monitoring meditation can improve divergent thinking, even if these types of meditations are not led by a live instructor (Poure, 2016). Drawing on the five facets of mindfulness developed by Baer et al. (2006) – describe, act with awareness, non-judgement of inner experience, non-reactivity to inner experience and observation – Baas et al. (2014) claimed that only having the ability to observe and to be attentive to various stimuli can enhance a person's creativity. Furthermore, Horan (2009) highlighted that meditation enhances creative incubation and enlightenment through transcendence and integration.

Lebuda et al. (2015) conducted a meta-analysis of the empirically informed mindfulness-creativity link, and reported that the link between creativity and mindfulness is at the level of little-c creativity ("everyday life creativity", see Kaufman & Beghetto, 2009) with a small to medium effect size. They noticed that the main link between creativity and mindfulness relates to open-monitoring meditation and divergent thinking by improving working memory, originality, cognitive flexibility and the ability to change perspective, and reducing the fear of judgement and responding in unusual ways. These relationships led Henriksen et al. (2020) to explore the implications for teaching and learning contexts and to make a call for further study, given the lack of pedagogical literature on the subject. It should also be noted that some teachers have begun to integrate mindfulness skills into new educational digital programmes, even if they do not always assess them (Butler et al., 2016).

Due to the results of other research on adults, even if they are still preliminary (Capurso et al., 2014; Henriksen et al., 2020), it seems plausible that meditation could help to develop divergent-exploratory

thinking and mindfulness traits in middle school students, but here again, to the best of our knowledge, the impact of meditation on children's creativity has not yet been explored.

The literature reviewed here underscores the potential of mindfulness meditation programmes to positively impact various aspects of well-being and cognitive functioning among both adults and adolescents. However, despite the wealth of research in this area, gaps in understanding how meditation interventions specifically influence the development of creativity and responsibility remain, particularly within the context of secondary education. Thus, a crucial question arises: How can mindfulness meditation programmes contribute effectively to the development of key skills such as creativity and responsibility among middle school students?

Intention, action and education for responsibility

In order to promote responsibility, education should aim to emancipate the individual, thereby influencing their conscious intentions. However, the origin of intentions remains a subject of inquiry. By definition, intention arises from causes that are not intentional (Brandtstädter, 2007). Neuroscience findings indicate that the determinants of intention largely reside in the unconscious mind, with neuronal activities detectable several seconds before action (Soon et al., 2013). Also, an intention can be the result of extrinsic or intrinsic motivation, and from an educational point of view, the development of individual autonomy is central (Ryan et al., 1997). Therefore, what is at stake here is that the individual *voluntarily* and *consciously* internalizes responsible intentions, even if they are initially proposed by the educational environment.

In the context of mindfulness learning, intention has been identified as "the link with ethics of making moral choices and acting on them" (Batchelor, 2019, p. 21). In intervention research, intention has been defined in a strict sense as "a conscious decision to perform a behavior or a resolve to act in a certain way" (Carey et al., 2019, p. 699). In a broader sense, it also refers to the orientation towards values or generic goals (e.g., helping others). It is considered in various models to be a primary and essential determinant of action, together with an individual's feeling of being capable of carrying out the targeted action (in the theory of planned behaviour; Ajzen, 1991). Indeed, intention and beliefs about capabilities are the most closely linked determinants that empirically explain the effect of behaviour change techniques (Carey et al., 2019). Intentionality "has to do with whether one is in control over the instigation or 'start up' of processes" "of one's own thought and behavior", and as such, it is antagonistic to the automaticity of behaviours that are triggered by the environment (Bargh, 1994, p. 16). It has also been well documented that intentions and goals can be unconscious and primed by the environment (such as via advertisements, or other factors) (Custers & Aarts, 2010).

Thus, the role of intention in meditation and in the causality of actions is widely recognized in the literature, including as an ethical determinant, but as far as we are aware, no experiment about meditation has attempted to manipulate intention per se as an independent variable.

Objective of the present study and hypotheses

We present here the results of such an experiment. In sum, we identified several gaps in the literature (vagueness about the ethical determinants of secular meditation, a lack of data on the specific experimental role of intention and in relation to children, no knowledge of the effects of meditation on creativity or of explicitly ethical meditation). This study, therefore, sought to explore them all. More specifically, our aim was to examine whether introducing a meditation practice with explicit guided intention in middle school could enhance the creative potential of middle-school students. We were particularly interested in exploring divergent-exploratory thinking at the individual level within the graphic and verbal domains, comparing the meditation groups to a control group. Additionally, we

aimed to investigate the impact on students' sense and awareness of responsibility, aligned with the triggered intention.

We conducted a pre-registered double-blind randomized controlled trial to compare the effects of 11-week digital mindfulness-based interventions (d-MBI) in class on three variables: creative potential, mindfulness and responsibility. We deployed three programmes in all. Two were meditation programmes which differed in their orientation (i.e. the intention that they aim at cultivating): self-centred (with the explicit aim of individual well-being or mental health) or responsibility-centred (with the explicit aim of enhanced common good that takes the self, others and the environment into account), and the last was a control programme that displays informative content about various topics (respectively, applied in groups S, R and C). The first two programmes contained meditations of different types (mainly awareness, insight and purpose).

We hypothesized that there would be a greater increase in the responsibility-centred group compared to the other meditation group. We also expected an increase in mindfulness in the meditation groups compared to the negative control group. One original contribution of this study was to associate digital mindfulness practice delivered in class (materialized as an "awareness" meditation) with the cultivation of specific intentions (materialized as a meditation with "purpose"), which explicitly guide or orient the intention of the subjects given a specific orientation (self- or responsibility-centred).

Through this research, we aimed to propose elements of answers to research questions about the way to trigger responsibility (or ethics) by meditation, and also to contribute to the current research on the integration of secular meditation practices in educational settings, and their potential role in promoting essential soft skills development.

MATERIALS AND METHODS

Study design

The intervention took place in a middle school in a rural environment in France, from December 2020 to May 2021. The middle school hosts around 950 adolescents from the local region. The study comprised a randomized controlled trial (trial registration: anonymized) which used a double-blind design: the students and teachers did not know the treatment group to which they had been assigned and were not aware of the assigned interventions. This was a single-centre study where participants were randomly divided into a balanced cluster (1: 1). The relevance of using a randomized controlled trial by clusters is justified by the context of the research (a middle school where students are grouped by level class) and by the field of the research (an educational intervention).

Assessments were conducted at baseline and post-intervention (11 weeks). Participants randomized into three groups (Table 2) participated in an 11-week digital intervention of approximately 5 min four times a week. The recordings (available on request) consisted of explanations and exercises for the students to do. Among the recordings they listened to, those for 10 weeks (i.e. 40 recordings) were unique, and those for 1 week (i.e. four recordings) were replays due to sanitary conditions, organizational difficulties and the presence of pupils (we, therefore, had 44 recordings in total, with 40 unique and four repeats). The recordings lasted between 4 min 50 s and 6 min 10 s each, and were recorded by a nurse trained in mindfulness-based stress reduction. The weekly schedule was set according to the availability of teachers and to avoid the teacher effect by which the teacher's personality or behaviour has a direct influence on the results obtained by the pupils. They played the recordings in one or more groups and one to four times a week (Table 1). This design avoided bias due to a "teacher effect".

We drew up an information note for the teachers, who were all volunteers, telling them that they would be taking part in an educational innovation operation during which they would be listening to recordings with their pupils. This note also served as a document used for presenting the experiment to the students. Some points of caution were highlighted, in particular the fact that these practices could destabilize certain psychologically fragile people and that, accordingly, everyone was free to do or not to

TABLE 1 Listening schedule for recordings by class and teacher.

	Monday	Tuesday	Wednesday	Thursday	Friday
Class 1	Teacher 1	Teacher 1	Teacher 10		Teacher 4
Class 2	Teacher 10	Teacher 1		Teacher 9	Teacher 4
Class 3	Teacher 8	Teacher 11	Teacher 3	Teacher 11	
Class 4	Teacher 5	Teacher 7	Teacher 8		Teacher 2
Class 5	Teacher 6	Teacher 2		Teacher 5	Teacher 5
Class 6	Teacher 7	Teacher 9		Teacher 7	Teacher 6

do the exercises proposed, as long as they remained silent so as not to disrupt the class. We were always on hand to answer any questions (from the students or the teachers). We only received organizational questions from the teachers (not related to the practice itself). We also told them that if they had any doubts, or if the situation became obviously problematic (if a student expressed or showed discomfort), they should absolutely inform us, the school management or social services. No such case was reported.

Anonymization

To diminish social desirability biases, the pre-test and post-test were administered by a researcher following a robust anonymization procedure (available on request) and the school teachers were not aware of the condition assigned to their class or the research hypotheses.

Randomization

We used cluster randomization in which each class was randomly assigned to one of three predetermined blocks of equal size, taking into account that there are two classes with additional language options which, therefore, had to be in two different groups. If classes 5 and 6 from the R and S groups (which are European section classes in which the pupils deepen their knowledge of a modern foreign language and culture) were assigned to the same experimental group, then the draw would have been cancelled and repeated so as not to unbalance the groups. The list of random numbers used to create these three blocks was created using web applications available at http://random.org.

Sample size

A total of 152 students and six classes took part in the study, with approximately 25 students per class. Finally, because of the coronavirus disease (COVID-19) situation and all the student absences that this caused, the sample size was only 107 participants. When a student did not complete any of the subtests or subscales, he/she was not included in the analysis.

Recruitment and selection

Eligible participants were all adolescents in Year 7 (average age: 11 years old). All students from the selected classes participated in the study.

As the experiment took place within the framework of a project approved by the Academic Centre for Research–Development, Innovation and Experimentation (CARDIE) in collaboration with the regional Rectorat (the institution representing the French Ministry of Education at the local level),

TABLE 2 Experimental and control groups listening to digital programmes in class.

Experimental Group: self-centred meditation (S) Class 4 (16 students, 42% girls, all born in 2009 and 2010), and Class 6 (13 students, 58% girls, all born in 2009: average age: 11 years old)	Experimental Group: responsibility-centred meditation (R) Class 1 (18 students, 50% girls, all born in 2008 and 2009), and Class 5 (20 students, 54% girls, all born in 2009: average age: 11 years old)	Control Group: general knowledge (C): Class 2 (19 students, 50% girls, all born in 2009) and Class 3 (21 students, 52% girls, all born in 2008, 2009 and 2010: average age: 11 years old)
Week 1: Present mode *Ex*: "*We're going to try to focus our attention on our breathing*".		Week 1: Nutrition *Ex*: "*We can distinguish between two types of protein depending on their source*: *proteins of animal origin and proteins of plant origin*."
Week 2: Present mode, five senses and body *Ex*: "*Let the sensations be as they are, without evaluating them…*"		Week 2: Human qualities *Ex*: "*Critical thinking is an intellectual attitude that involves not accepting any statement or information as true or real without examining it carefully through reason*."
Week 3: Needs *Ex*: "*If we constantly seek to acquire more, or if we pursue only values such as popularity, beauty, wealth, it rather leads to stress and dissatisfaction*."		Week 3: Human body *Ex*: "*Your brain is composed of two parts*: *a right hemisphere and a left hemisphere that are strongly interconnected*."
Week 4: Physical sensations *Ex*: "*If we detect signals in our body very early, it leaves space in the mind to welcome and explore the physical sensations related to stress, learning to recognise when we feel stressed*."		Week 4: General perception *Ex*: "*You may not realise it, but we perceive the world through our senses in different ways*."
Week 5: Emotions *Ex*: "*What is an emotion? It's an energy that travels through the body. There are many different ones*."		Week 5: Cognition *Ex*: "*There is another misconception that some people use their left brain more and are stronger in mathematics, while others use their right brain more and are stronger in visual arts*."
Week 6: Attention and presence *Ex*: "*What prevents us from being present, for example, with a support, is the fact that our mind has the habit of grasping, almost constantly, thoughts, perceptions, without our wanting it, and often without us being aware of it*."		Week 6: Social cognition *Ex*: "*Why do we need to imagine what happens in the brains of others? Humans are among the species with highly developed social lives*."
Week 7: Benevolence *Ex*: "*Let come to your mind a mistake you made, something you said or did, or conversely, did not say or did not do, and with which you do not feel comfortable*."		Week 7: Ecology *Ex*: "*Like ants or termites, honeybees are social insects (not all bees are), and they can only live within a community of several thousand individuals*: *the colony, and their way of life is highly evolved*."
Week 8: Vision and attention *Ex*: "*This week, we use the sense of sight to train in being present, that is, not getting lost as we usually do by thinking about the past or worrying about the future*."		Week 8: Digital *Ex*: "*An internet social network is a site accessible through a web browser or a mobile application where users can communicate and express themselves*."
Week 9: Thoughts *Ex*: "*The goal of this training is to notice that thoughts can appear and evolve in different ways. And that we can't catch them, we don't really control them*."		Week 9: Society and social experiments *Ex*: "*In the mid-20th century, American psychologist Robert Rosenthal was convinced that categorising someone creates certain expectations about that individual's behavior*."
Week 10: Gratitude *Ex*: "*Gratitude is a pleasant emotion that we experience when we receive, for example, help or a gift from others, and it is an intentional and selfless gesture*."		Week 10: Discoveries and inventions *Ex*: "*Writing was invented to facilitate trade and communication, but it also serves counting. Moreover, in almost all civilisations, writing is connected to religions*."

Note: Each session of the meditation programmes contains short meditations (2–3 min) and explanations. The two experimental groups differ in the general purpose of the programme that is explained (self-health and well-being in group S vs. whole-health and well-being in group R), as well as in the corresponding very short purpose-based meditations they contain. In the control group, the programme is informative and does not include meditation. An example sentence from the recording is provided for each week.

accepted on 21 June 2019 by the Rector of the Bordeaux regional education authority, participants were, therefore, not remunerated, and were required to participate by the institution as a pedagogical innovation. Because this was an official experiment modifying the school's traditional and compulsory curriculum, parents were informed by the school principal, but their consent was not required.

Groups

Eleven teachers from one middle school participated in the study, of which two were male (18.18%) and nine were female (81.82%). Two teachers taught earth and life sciences, three taught French, two teachers taught English, two teachers taught history and geography, one teacher taught Spanish and one taught physical education. Each week, all the teachers received URLs by email. Each class listened to forty-four 5-min recordings over the 11 weeks. At the end of each recording, students were given a weekly challenge to do for the next week. Among the 11 teachers, four were trained in mindfulness with two training sessions and four others with one training session (these included courses at organizations such as Mind with Heart and others offering training in mindfulness-based stress reduction or Eline Snel's method), and we organized an online meeting to answer any questions before the experiment. The teachers were asked to write down how many students put their hand up from week 4 to week 11 and inform the researchers on a WhatsApp group after each session to measure student engagement. We observed that group R was strongly committed, group S was moderately committed and group C was weakly committed (see below on the nature of the groups).

The 152 students were divided into six classes (from the nine classes from this middle school) with 24–26 students per class. A summary of the different groups and classes (including the size and composition of the groups, the ages of the students and the types of recording) is provided in Table 2. There were three groups, each composed of two classes (Table 2), two experimental groups listening to recordings of meditation with an explicitly guided intention (one with a focus on the self and the other with a focus on the self, others and the non-human environment, i.e., focusing on responsibility) and a control group (whose recordings concerned various general knowledge topics). These groups were formed at random from among six classes of 6th-year pupils of the teachers who agreed to participate in the study. We decided to implement an active control group in order to eliminate the potential effects of relaxation (Noone & Hogan, 2016). Also, Berry et al. (2018, 2020) have previously noted that in the absence of an active control group, an effect of the programme was often observed, whatever the programme, compared with an inactive control group, for example. Our choice, which reduced the possibility of obtaining significant results, thus potentially reinforced the robustness of the results obtained.

The meditations of groups S and R differed in particular at the level of the purpose-based meditations that framed each recording. The different intentions were elicited by the beginning of sentences like this:

> "To start, you are invited to say to yourself the following wish: 'I wish that this session will be good for me'" (Self-centred meditation group) versus "To start, you are invited to say to yourself the following wish: 'I wish this session to be good for me, humanity, and the universe'" (Responsibility-centred meditation group).
> "To end this session, you are invited to say to yourself the following wish: 'if there was something good for me in this session, I wish that it continues to develop for me'" (Self-centred group) versus "To end this session, you are invited to say inwardly the following wish: 'if there was something good in this session, I wish that it will grow for the sake of myself, humanity, and the universe'" (Responsibility-centred group).

Also, when explanations were given about the efficiency of the practice, in programme S, they focused on personal health and in programme R they emphasized the benefits for the whole (oneself,

others and the non-human environment). During the trial, at the end of each recording, the students were asked if they would take up a kind of challenge (e.g. a small exercise focusing on something from their daily life), and if they had taken up the challenge from the last recording. Also, each challenge was adapted to the type of recording listened to in each of the groups. The control group only contained information and was also invited to take some challenges, in order to give it a similar structure and incentive effect to the meditation programme groups.

Measures

First, we calibrated the tests in December 2020 on a sixth-grade class not participating in the experiment to make sure they were appropriate. All participants in the three conditions were administered tests at baseline (week 0) and post-intervention (11 + 4 weeks of holidays) by one researcher to assess their creative potential, mindfulness and sense and awareness of their own responsibility.

Creative potential

The EPoC (creative potential assessment) is a creative thinking assessment (Lubart et al., 2011). It helps to determine the creative profile and explore the potential of children aged 4–12. It was designed to measure children's creative abilities in two application domains (verbal and graphic) and contains four subtests (graphic divergent-exploratory thinking, verbal divergent-exploratory thinking, verbal convergent-integrative thinking and graphic convergent-integrative thinking). All reliability coefficients and the inter-subtests correlation matrix are reported in table 2 in Barbot et al. (2016).

The EPoC enables the assessment of creative skills, detects children with high creative potential and determines a creative profile in order to orient their development in a relevant way. Two forms are proposed (form A and form B) in order to allow two successive evaluations with different but comparable tasks. For each form, the examination takes place in two sessions, each lasting 30–45 min. Students get multiple ratings – a fluency score corresponding to the number of drawings produced by the child in the graphic divergent-exploratory thinking test; a fluency score for the number of story endings and beginnings proposed; an elaboration score corresponding to the number of words for all story endings and beginnings in the verbal divergent-exploratory thinking test; and finally, a mark obtained via an evaluation by four judges graded between 1 and 7 for the realization of the graphic convergent-integrative thinking test and the verbal convergent-integrative thinking. The four judges were doctoral students in Training and Educational Sciences. The tests were presented to the pupils as games. They included challenges such as: "make as many drawings as possible using one object", "try to invent different possible beginnings for the end of a story", "invent a drawing using at least four different objects chosen from ten or so" and "invent a story with three prescribed characters".

Mindfulness

Mindfulness was measured using the Five Facet Mindfulness Questionnaire (FFMQ), which is a self-report assessment method designed to explore the facets of mindfulness created by Baer et al. (2006). The five facets are acting with awareness, describing, non-reactivity to inner experience, observing and non-judging of inner experience. We used the French version validated by Heeren et al. (2011) which is based on a 5-point Likert-type scale (1 = never or very rarely true; 5 = very often or always true). The French version of the FFMQ showed good internal consistency (for all factors Cronbach's alpha was higher than .75) and good test–retest reliability (r (40) = .64, $p < .001$). For the observation dimension, one question was, for example, "When I walk, I deliberately become aware of the sensations of my body

in movement". For the description of experience dimension, a question was, for example, "I am good at finding words to describe my feelings". For the mindful action dimension, one of the questions was "When I'm doing something, my mind wanders and I'm easily distracted". For the non-reactivity to private events dimension, an exemplar question was "I observe my feelings without letting myself get carried away by them". For the non-judgement dimension, one of the questions was "I criticise myself when I have irrational or inappropriate emotions." It should be noted that in the initial design, this variable was included mainly to study its statistical relationships (and those of its subconstructs) with creativity, which will be presented in another study. For this reason, it is not detailed in the statistical analyses here, even though it appeared in the trial registration.

Responsibility

The indicators of self-reported responsibility were measured using the Awareness and Sense of One's Own Responsibility Scale created by Hagège et al. (2023). We adapted it to use it with middle-school students. It contains two subscales: Sense of One's Own Responsibility (SOOR) (seven items), and Awareness of One's Own Responsibility (AOOR) (3 items). It is based on a 6-point Likert-type scale (1 = totally disagree; 5 = totally agree). For the first dimension, one of the items is "Whatever I do has no effect on the world". For the second dimension, one of the items is "I am aware of the consequences of my limits and errors in my environment".

Statistical analyses

We used two types of analyses (analysis of covariance, ANCOVA, and multivariate analysis of variance, MANOVA) to examine the differences in means between groups and classes before the intervention and after 11 weeks of d-MBI in class among the three groups for creative potential, mindfulness and responsibility. IBM SPSS v.26 and Microsoft Excel v.16 were used to create the databases and perform the statistical analyses and G*Power v.3.1.9.6 to calculate the power of the analyses. For the MANOVA, preliminary assumption tests were conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance–covariance matrices and multicollinearity, with no serious violations noted. For the ANCOVA, preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes and the reliable measurement of the covariate. Based on Cohen (1988) and Miles & Shevlin (2001), a partial eta squared of .06 indicates a medium effect and .14 indicates a large effect in ANCOVA and MANOVA. Effect size is a quantitative index of the strength of the relationship between the variables that allow us to conclude whether or not the relationship observed in the data actually exists in reality.

RESULTS

Summary and descriptive statistics

Summaries of the descriptive statistics are given in Table 3, and Tables 4 and 5 present all the results (absence of results, positive effects and negative effects). In brief, when all three groups were compared using MANOVA analyses, we found differences only in the creativity scores (which were decreased in group S and increased in groups C and R, respectively, for graphic or verbal creativity). When classes were compared using ANCOVA analyses, we found that the SOOR (responsibility) score increased in class 1 of the R group and decreased in class 6 of the S group.

TABLE 3 Descriptive statistics (mean and std. deviation).

	Group responsibility centred (R)						Group self-centred (S)						Group control (C)					
	T0			T1			T0			T1			T0			T1		
	Class 1	Class 2	Group R	Class 1	Class 2	Group R	Class 5	Class 6	Group S	Class 5	Class 6	Group S	Class 3	Class 4	Group C	Class 3	Class 4	Group C
Responsibility (ASOOR)	3.56 (0.53)	3.83 (0.69)	3.70 (0.61)	3.82 (0.80)	3.76 (0.44)	3.79 (0.63)	3.92 (0.54)	3.90 (0.71)	3.91 (0.61)	3.64 (0.67)	3.20 (0.63)	3.44 (0.68)	3.74 (0.52)	3.58 (0.73)	3.66 (0.63)	3.62 (0.63)	3.32 (0.68)	3.46 (0.67)
Divergent thinking	7.83 (2.55)	7.70 (1.72)	7.76 (2.12)	7.38 (2.74)	8.50 (2.09)	7.97 (2.45)	7.31 (2.35)	6.84 (2.64)	7.10 (2.45)	7.75 (2.84)	7.23 (3.44)	7.51 (3.07)	8.78 (2.55)	7.14 (2.12)	7.92 (2.45)	7.73 (2.70)	6.66 (2.17)	7.17 (2.46)
Convergent thinking	6.61 (1.68)	7.25 (1.58)	6.94 (1.64)	6.11 (0.96)	6.55 (1.14)	6.34 (1.07)	5.50 (1.31)	6.30 (2.01)	5.86 (1.68)	5.75 (1.80)	5.30 (1.84)	5.55 (1.80)	6.68 (2.11)	7.4 (1.83)	7.075 (1.97)	7.15 (3.35)	6.47 (1.36)	6.80 (2.50)
Sense of responsibility (SOOR)	2.37 (0.34)	2.40 (0.44)	2.38 (0.39)	2.59 (0.56)	2.41 (0.36)	2.50 (0.47)	2.54 (0.47)	2.62 (0.49)	2.57 (0.47)	2.35 (0.49)	2.02 (0.56)	2.20 (0.54)	2.35 (0.44)	2.29 (0.49)	2.32 (0.46)	2.39 (0.43)	2.13 (0.55)	2.26 (0.50)
Knowledge of one's responsibility (AOOR)	1.18 (0.41)	1.43 (0.31)	1.31 (0.38)	1.22 (0.38)	1.35 (0.28)	1.29 (0.33)	1.38 (0.29)	1.27 (0.31)	1.33 (0.36)	1.28 (0.30)	1.18 (0.37)	1.24 (0.33)	1.39 (0.25)	1.29 (0.36)	1.34 (0.31)	1.23 (0.41)	1.18 (0.29)	1.20 (0.35)
Graphic divergent-exploratory thinking	4.00 (1.64)	3.60 (1.18)	3.78 (1.41)	3.72 (1.77)	3.80 (1.28)	3.76 (1.51)	3.50 (1.26)	3.15 (1.40)	3.34 (1.31)	4.06 (1.76)	3.46 (1.98)	3.79 (1.85)	3.52 (1.38)	3.42 (1.43)	3.47 (1.39)	3.52 (1.61)	3.23 (1.48)	3.37 (1.53)
Verbal divergent-exploratory thinking	3.83 (1.24)	4.10 (1.41)	3.97 (1.32)	3.66 (1.32)	4.70 (1.41)	4.21 (1.45)	3.81 (1.51)	3.69 (1.60)	3.75 (1.52)	3.68 (1.70)	3.76 (1.64)	3.72 (1.64)	5.26 (1.66)	3.71 (1.48)	4.45 (1.73)	4.21 (1.51)	3.42 (1.72)	3.80 (1.65)
Verbal convergent-integrative thinking	3.22 (0.80)	3.30 (0.57)	3.26 (0.68)	3.16 (0.85)	3.60 (0.94)	3.39 (0.91)	3.12 (0.88)	2.84 (0.68)	3.00 (0.80)	2.56 (1.03)	2.92 (1.18)	2.72 (1.09)	3.36 (1.06)	3.47 (1.12)	3.42 (1.08)	3.15 (1.34)	2.90 (0.88)	3.02 (1.12)
Graphic convergent-integrative thinking	3.38 (1.53)	3.95 (3.95)	3.68 (1.54)	2.94 (0.99)	2.95 (1.05)	2.94 (1.01)	2.37 (0.95)	3.46 (1.71)	2.86 (1.43)	3.18 (1.16)	2.38 (1.26)	2.82 (1.25)	3.31 (1.49)	3.95 (1.56)	3.65 (1.54)	4.00 (2.28)	3.57 (1.43)	3.77 (1.87)

TABLE 4 Summary of results (MANOVA).

	Knowledge of one's responsibility (AOOR)	Graphic convergent thinking	Verbal convergent thinking	Sense of responsibility (SOOR)	Graphic divergent thinking	Verbal divergent thinking
Self-centred (S) group	In comparison to R: $\eta 2 = .129$ $p = 1.000$	In comparison to R: $\eta 2 = .129$ $p = .434$	In comparison to R: $\eta 2 = .129$ $p = 1.000$	In comparison to R: $\eta 2 = .129$ $p = .222$	In comparison to R: $\eta 2 = .129$ $p = .684$	In comparison to R: $\eta 2 = .129$ $p = 1.000$
	In comparison to C: $\eta 2 = .129$ $p = 1.000$	**In comparison to C:** $\boldsymbol{\eta 2 = .129}$* $\boldsymbol{p = .011}$	In comparison to C: $\eta 2 = .129$ $p = .162$	In comparison to C: $\eta 2 = .129$ $p = .794$	In comparison to C: $\eta 2 = .129$ $p = 1.000$	In comparison to C: $\eta 2 = .129$ $p = .712$
Responsibility-centred (R) group	In comparison to S: $\eta 2 = .129$ $p = 1.000$	In comparison to S: $\eta 2 = .129$ $p = .434$	In comparison to S: $\eta 2 = .129$ $p = 1.000$	In comparison to S: $\eta 2 = .129$ $p = .222$	In comparison to S: $\eta 2 = .129$ $p = .684$	In comparison to S: $\eta 2 = .129$ $p = 1.000$
	In comparison to C: $\eta 2 = .129$ $p = 1.000$	In comparison to C: $\eta 2 = .129$ $p = .336$	**In comparison to C:** $\boldsymbol{\eta 2 = .129}$* $\boldsymbol{p = .044}$	In comparison to C: $\eta 2 = .129$ $p = 1.000$	In comparison to C: $\eta 2 = .129$ $p = 1.000$	In comparison to C: $\eta 2 = .129$ $p = .855$
Control (C) group	In comparison to R: $\eta 2 = .129$ $p = 1.000$	In comparison to R: $\eta 2 = .129$ $p = .336$	**In comparison to R:** $\boldsymbol{\eta 2 = .129}$* $\boldsymbol{p = .044}$	In comparison to R: $\eta 2 = .129$ $p = 1.000$	In comparison to R: $\eta 2 = .129$ $p = 1.000$	In comparison to R: $\eta 2 = .129$ $p = .855$
	In comparison to S: $\eta 2 = .129$ $p = 1.000$	**In comparison to S:** $\boldsymbol{\eta 2 = .129}$* $\boldsymbol{p = .011}$	In comparison to S: $\eta 2 = .129$ $p = .162$	In comparison to S: $\eta 2 = .129$ $p = .794$	In comparison to S: $\eta 2 = .129$ $p = 1.000$	In comparison to S: $\eta 2 = .129$ $p = .712$

Note: *p*-Values of 1.000 indicate Bonferroni-adjusted values derived from our analyses. *p*-Value in bold denotes significant at .05.

*A little better than the effect size expected according to Lebuda et al. (2015) reporting a small-to-medium effect size between mindfulness and creativity.

TABLE 5 Summary of results (ANCOVA).

	Knowledge of one's responsibility (AOOR)	Graphic convergent thinking	Verbal convergent thinking	Sense of responsibility (SOOR)	Graphic divergent thinking	Verbal divergent thinking
Class 1 (R)	In comparison to 2: $\eta 2 = .020$ $p = 1.000$ In comparison to 3: $\eta 2 = .020$ $p = 1.000$ In comparison to 4: $\eta 2 = .020$ $p = 1.000$ In comparison to 5: $\eta 2 = .020$ $p = 1.000$ In comparison to 6: $\eta 2 = .020$ $p = 1.000$	In comparison to 2: $\eta 2 = .135$ $p = .273$ In comparison to 3: $\eta 2 = .135$ $p = 1.000$ In comparison to 4: $\eta 2 = .135$ $p = 1.000$ In comparison to 5: $\eta 2 = .135$ $p = 1.000$ In comparison to 6: $\eta 2 = .135$ $p = 1.000$	In comparison to 2: $\eta 2 = .090$ $p = 1.000$ In comparison to 3: $\eta 2 = .090$ $p = 1.000$ In comparison to 4: $\eta 2 = .090$ $p = 1.000$ In comparison to 5: $\eta 2 = .090$ $p = 1.000$ In comparison to 6: $\eta 2 = .090$ $p = 1.000$	In comparison to 2: $\eta 2 = .139$ $p = 1.000$ In comparison to 3: $\eta 2 = .139$ $p = .095$ In comparison to 4: $\eta 2 = .139$ $p = 1.000$ In comparison to 5: $\eta 2 = .139$ $p = 1.000$ **In comparison to 6:** **$\eta 2 = .139$**** **$p = .009$**	In comparison to 2: $\eta 2 = .030$ $p = 1.000$ In comparison to 3: $\eta 2 = .030$ $p = 1.000$ In comparison to 4: $\eta 2 = .030$ $p = 1.000$ In comparison to 5: $\eta 2 = .030$ $p = 1.000$ In comparison to 6: $\eta 2 = .030$ $p = 1.000$	In comparison to 2: $\eta 2 = .072$ $p = 1.000$ In comparison to 3: $\eta 2 = .072$ $p = 1.000$ In comparison to 4: $\eta 2 = .072$ $p = 1.000$ In comparison to 5: $\eta 2 = .072$ $p = .756$ In comparison to 6: $\eta 2 = .072$ $p = 1.000$
Class 2 (C)	In comparison to 1: $\eta 2 = .020$ $p = 1.000$ In comparison to 3: $\eta 2 = .020$ $p = 1.000$ In comparison to 4: $\eta 2 = .020$ $p = 1.000$ In comparison to 5: $\eta 2 = .020$ $p = 1.000$ In comparison to 6: $\eta 2 = .020$ $p = 1.000$	In comparison to 1: $\eta 2 = .135$ $p = .273$ In comparison to 3: $\eta 2 = .135$ $p = 1.000$ In comparison to 4: $\eta 2 = .135$ $p = 1.000$ In comparison to 5: $\eta 2 = .135$ $p = .077$ **In comparison to 6:** **$\eta 2 = .135$** **$p = .015$***	In comparison to 1: $\eta 2 = .090$ $p = 1.000$ In comparison to 3: $\eta 2 = .090$ $p = 1.000$ In comparison to 4: $\eta 2 = .090$ $p = 1.000$ In comparison to 5: $\eta 2 = .090$ $p = 1.000$ In comparison to 6: $\eta 2 = .090$ $p = 1.000$	In comparison to 1: $\eta 2 = .139$ $p = 1.000$ In comparison to 3: $\eta 2 = .139$ $p = 1.000$ In comparison to 4: $\eta 2 = .139$ $p = 1.000$ In comparison to 5: $\eta 2 = .139$ $p = 1.000$ In comparison to 6: $\eta 2 = .139$ $p = .225$	In comparison to 1: $\eta 2 = .030$ $p = 1.000$ In comparison to 3: $\eta 2 = .030$ $p = 1.000$ In comparison to 4: $\eta 2 = .030$ $p = 1.000$ In comparison to 5: $\eta 2 = .030$ $p = 1.000$ In comparison to 6: $\eta 2 = .030$ $p = 1.000$	In comparison to 1: $\eta 2 = .072$ $p = 1.000$ In comparison to 3: $\eta 2 = .072$ $p = 1.000$ In comparison to 4: $\eta 2 = .072$ $p = 1.000$ In comparison to 5: $\eta 2 = .072$ $p = .581$ In comparison to 6: $\eta 2 = .072$ $p = 1.000$

(Continues)

TABLE 5 (Continued)

	Knowledge of one's responsibility (AOOR)	Graphic convergent thinking	Verbal convergent thinking	Sense of responsibility (SOOR)	Graphic divergent thinking	Verbal divergent thinking
Class 3 (C)	In comparison to 1: $\eta 2 = .020$ $p = 1.000$ In comparison to 2: $\eta 2 = .020$ $p = 1.000$ In comparison to 4: $\eta 2 = .020$ $p = 1.000$ In comparison to 5: $\eta 2 = .020$ $p = 1.000$ In comparison to 6: $\eta 2 = .020$ $p = 1.000$	In comparison to 1: $\eta 2 = .135$ $p = 1.000$ In comparison to 2: $\eta 2 = .135$ $p = 1.000$ In comparison to 4: $\eta 2 = .135$ $p = 1.000$ In comparison to 5: $\eta 2 = .135$ $p = 1.000$ In comparison to 6: $\eta 2 = .135$ $p = .565$	In comparison to 1: $\eta 2 = .090$ $p = 1.000$ In comparison to 2: $\eta 2 = .090$ $p = 1.000$ In comparison to 4: $\eta 2 = .090$ $p = 1.000$ In comparison to 5: $\eta 2 = .090$ $p = .308$ In comparison to 6: $\eta 2 = .090$ $p = 1.000$	In comparison to 1: $\eta 2 = .139$ $p = .095$ In comparison to 2: $\eta 2 = .139$ $p = 1.000$ In comparison to 4: $\eta 2 = .139$ $p = 1.000$ In comparison to 5: $\eta 2 = .139$ $p = 1.000$ In comparison to 6: $\eta 2 = .139$ $p = 1.000$	In comparison to 1: $\eta 2 = .030$ $p = 1.000$ In comparison to 2: $\eta 2 = .030$ $p = 1.000$ In comparison to 4: $\eta 2 = .030$ $p = 1.000$ In comparison to 5: $\eta 2 = .030$ $p = 1.000$ In comparison to 6: $\eta 2 = .030$ $p = 1.000$	In comparison to 1: $\eta 2 = .072$ $p = 1.000$ In comparison to 2: $\eta 2 = .072$ $p = 1.000$ In comparison to 4: $\eta 2 = .072$ $p = 1.000$ In comparison to 5: $\eta 2 = .072$ $p = .225$ In comparison to 6: $\eta 2 = .072$ $p = 1.000$
Class 4 (S)	In comparison to 1: $\eta 2 = .020$ $p = 1.000$ In comparison to 2: $\eta 2 = .020$ $p = 1.000$ In comparison to 3: $\eta 2 = .020$ $p = 1.000$ In comparison to 5: $\eta 2 = .020$ $p = 1.000$ In comparison to 6: $\eta 2 = .020$ $p = 1.000$	In comparison to 1: $\eta 2 = .135$ $p = 1.000$ In comparison to 2: $\eta 2 = .135$ $p = 1.000$ In comparison to 3: $\eta 2 = .135$ $p = 1.000$ In comparison to 5: $\eta 2 = .135$ $p = 1.000$ In comparison to 6: $\eta 2 = .135$ $p = .400$	In comparison to 1: $\eta 2 = .090$ $p = 1.000$ In comparison to 2: $\eta 2 = .090$ $p = 1.000$ In comparison to 3: $\eta 2 = .090$ $p = 1.000$ In comparison to 5: $\eta 2 = .090$ $p = .072$ In comparison to 6: $\eta 2 = .090$ $p = 1.000$	In comparison to 1: $\eta 2 = .139$ $p = 1.000$ In comparison to 2: $\eta 2 = .139$ $p = 1.000$ In comparison to 3: $\eta 2 = .139$ $p = 1.000$ In comparison to 5: $\eta 2 = .139$ $p = 1.000$ In comparison to 6: $\eta 2 = .139$ $p = .829$	In comparison to 1: $\eta 2 = .030$ $p = 1.000$ In comparison to 2: $\eta 2 = .030$ $p = 1.000$ In comparison to 3: $\eta 2 = .030$ $p = 1.000$ In comparison to 5: $\eta 2 = .030$ $p = 1.000$ In comparison to 6: $\eta 2 = .030$ $p = 1.000$	In comparison to 1: $\eta 2 = .072$ $p = 1.000$ In comparison to 2: $\eta 2 = .072$ $p = 1.000$ In comparison to 3: $\eta 2 = .072$ $p = 1.000$ In comparison to 5: $\eta 2 = .072$ $p = .995$ In comparison to 6: $\eta 2 = .072$ $p = 1.000$

TABLE 5 (Continued)

	Knowledge of one's responsibility (AOOR)	Graphic convergent thinking	Verbal convergent thinking	Sense of responsibility (SOOR)	Graphic divergent thinking	Verbal divergent thinking
Class 5 (R)	In comparison to 1: $\eta 2 = .020$ $p = 1.000$ In comparison to 2: $\eta 2 = .020$ $p = 1.000$ In comparison to 3: $\eta 2 = .020$ $p = 1.000$ In comparison to 4: $\eta 2 = .020$ $p = 1.000$ In comparison to 6: $\eta 2 = .020$ $p = 1.000$	In comparison to 1: $\eta 2 = .135$ $p = 1.000$ In comparison to 2: $\eta 2 = .135$ $p = .077$ In comparison to 3: $\eta 2 = .135$ $p = 1.000$ In comparison to 4: $\eta 2 = .135$ $p = 1.000$ In comparison to 6: $\eta 2 = .135$ $p = 1.000$	In comparison to 1: $\eta 2 = .090$ $p = 1.000$ In comparison to 2: $\eta 2 = .090$ $p = 1.000$ In comparison to 3: $\eta 2 = .090$ $p = .308$ In comparison to 4: $\eta 2 = .090$ $p = .072$ In comparison to 6: $\eta 2 = .090$ $p = 1.000$	In comparison to 1: $\eta 2 = .139$ $p = 1.000$ In comparison to 2: $\eta 2 = .139$ $p = 1.000$ In comparison to 3: $\eta 2 = .139$ $p = 1.000$ In comparison to 4: $\eta 2 = .139$ $p = 1.000$ In comparison to 6: $\eta 2 = .139$ $p = .180$	In comparison to 1: $\eta 2 = .030$ $p = 1.000$ In comparison to 2: $\eta\eta 2 = .030$ $p = 1.000$ In comparison to 3: $\eta 2 = .030$ $p = 1.000$ In comparison to 4: $\eta 2 = .030$ $p = 1.000$ In comparison to 6: $\eta 2 = .030$ $p = 1.000$	In comparison to 1: $\eta 2 = .072$ $p = .756$ In comparison to 2: $\eta 2 = .072$ $p = .581$ In comparison to 3: $\eta 2 = .072$ $p = .225$ In comparison to 4: $\eta 2 = .072$ $p = .995$ In comparison to 6: $\eta 2 = .072$ $p = 1.000$
Class 6 (S)	In comparison to 1: $\eta 2 = .020$ $p = 1.000$ In comparison to 2: $\eta 2 = .020$ $p = 1.000$ In comparison to 3: $\eta 2 = .020$ $p = 1.000$ In comparison to 4: $\eta 2 = .020$ $p = 1.000$ In comparison to 5: $\eta 2 = .020$ $p = 1.000$	In comparison to 1: $\eta 2 = .135$ $p = 1.000$ **In comparison to 2:** **$\eta 2 = .135$** **$p = .015$*** In comparison to 3: $\eta 2 = .135$ $p = .565$ In comparison to 4: $\eta 2 = .135$ $p = .400$ In comparison to 5: $\eta 2 = .135$ $p = 1.000$	In comparison to 1: $\eta 2 = .090$ $p = 1.000$ In comparison to 2: $\eta 2 = .090$ $p = 1.000$ In comparison to 3: $\eta 2 = .090$ $p = 1.000$ In comparison to 4: $\eta 2 = .090$ $p = 1.000$ In comparison to 5: $\eta 2 = .090$ $p = 1.000$	**In comparison to 1:** **$\eta 2 = .139$**** **$p = .009$** In comparison to 2: $\eta 2 = .139$ $p = .225$ In comparison to 3: $\eta 2 = .139$ $p = 1.000$ In comparison to 4: $\eta 2 = .139$ $p = .829$ In comparison to 5: $\eta 2 = .139$ $p = .180$	In comparison to 1: $\eta 2 = .030$ $p = 1.000$ In comparison to 2: $\eta 2 = .030$ $p = 1.000$ In comparison to 3: $\eta 2 = .030$ $p = 1.000$ In comparison to 4: $\eta 2 = .030$ $p = 1.000$ In comparison to 5: $\eta 2 = .030$ $p = 1.000$	In comparison to 1: $\eta 2 = .072$ $p = 1.000$ In comparison to 2: $\eta 2 = .072$ $p = 1.000$ In comparison to 3: $\eta 2 = .072$ $p = 1.000$ In comparison to 4: $\eta 2 = .072$ $p = 1.000$ In comparison to 5: $\eta 2 = .072$ $p = 1.000$

Note: *p*-Values of 1.000 indicate Bonferroni-adjusted values derived from our analyses. *p*-Value in bold denotes significant at .05.

*A little better than the effect size expected according to Lebuda et al. (2015) reporting a small-to-medium effect size between mindfulness and creativity. **A little better than the effect size according to Berry et al. (2020), Donald et al. (2019), Luberto et al. (2018), Malin (2023), Zoogman et al. (2015) reporting a small-to-medium effect size between mindfulness and prosociality.

Comparison between groups

A one-way between-groups multivariate analysis of variance was performed to investigate the effects of the different programmes on creativity, responsibility and mindfulness skills. Seven dependent variables were used: graphic divergent-exploratory thinking, verbal exploratory divergent thinking, graphic convergent-integrative thinking, verbal convergent-integrative thinking, awareness of one's own responsibility (AOOR), sense of one's own responsibility (SOOR) and a single variable of mindfulness. The results showed a statistically significant difference among the three groups on the combined dependent variables, $F(12, 198) = 2.436$, $p = .006$; Wilks' Lambda = .759; partial eta squared = .129. When the results for the dependent variables were considered separately with post-hoc comparisons using the Bonferroni correction, the only difference to reach statistical significance was verbal convergent-integrative thinking between groups R and S, with a mean difference of 0.47 ($p = .044$), and graphic convergent-integrative thinking between groups C and S, with a mean difference of 0.87 ($p = .011$). Thus, we observed that:

Verbal convergent-integrative thinking scores between groups R and S with $p = .044$ where we observed that whereas group R's score improved in post-test (mean from 3.26 in T0 to 3.39 in T1), the score for group S decreased (mean from 3.00 in T0 to 2.72 in T1).
Graphic convergent-integrative thinking scores between groups C and S with $p = .011$ where we observed that whereas group C's score improved in post-test (mean from 3.65 in T0 to 3.78 in T1), the score of group S decreased (2.86 in T0 to 2.83 in T1).

Due to the presence of two classes including a European section (as explained in the Materials and Methods section) in the two experimental groups, it was essential to carry out analyses at the class level in addition to the group level. So, in order to examine further the results, we also carried out ANCOVA class-level analysis.

Comparison between classes

A one-way between-groups analysis of covariance was conducted to compare the effectiveness of the three different interventions designed to increase participants' creativity and responsibility. Seven dependent variables were analysed one by one with the post-intervention scores: graphic divergent-exploratory thinking, verbal exploratory divergent thinking, graphic convergent-integrative thinking, verbal convergent-integrative thinking, AOOR, SOOR and a single variable of mindfulness. The pre-intervention scores were used as covariates and the classes as fixed factors in this analysis.

After adjusting for pre-intervention scores, a significant difference was found between two classes (class 1 of group R and class 6 of group S) in post-intervention scores on the SOOR score, $F(5, 100) = 3.231$, $p = .010$, partial eta squared = .139 and between two other classes (class 6 of group S and class 2 of group C) in the graphic convergent-integrative thinking score $F(5, 100) = 3.118$, $p = .012$, partial eta squared = .135. When analysing the post-hoc comparisons using the Bonferroni correction, the first difference (class 1 vs. 6) had a mean of 6.348 ($p = 0.009$) and the second (class 6 vs. 2) had a mean difference of 1.665 ($p = 0.15$). Thus, we observed that:

SOOR scores were significantly higher in class 1 of group R at the post-test (mean from 2.37 in T0 to 2.59 in T1), when compared to the score for class 6 of group S (mean from 2.62 in T0 to 2.02 in T1).
Graphic convergent-integrative thinking scores were significantly improved in post-test in class 2 of group C (mean from 3.31 in T0 to 4.00 in T1), when compared to class 6 of group S (3.46 in T0 to 2.38 in T1).

The active engagement of the students in the challenges was analysed through hands raised in class, and we observed an average of 5.8 and 7.7 (classes 4 and 6) hands raised at the end of each listening session in the self-centred group, an average of 3.38 and 6.3 (from classes 1 and 5) hands raised at the end of each listening session in the responsibility-centred group, and finally an average of 1.2 and 1.8 (from classes 2 and 3) hands raised at the end of each listening session in the control group.

DISCUSSION

Main findings

The purpose of this study was to test the effects of both 11-week d-MBI in classes delivered in a French rural middle school through 5-min recordings to improve mindfulness, creative potential and responsibility in Year 7 students (average age: 11 years). To our knowledge, this experiment was the first to study the efficacy of d-MBI in class on creativity and responsibility in middle-school students. Our findings showed significant differences between groups with regard to creative potential (graphic and verbal convergent-integrative thinking), and also between classes for responsibility (SOOR). Moreover, the verbal and graphic convergent-integrative thinking scores, respectively, improved in the R and C groups, whereas both scores decreased in the S group. Furthermore, the SOOR score improved in class 1 (group R) and decreased in class 6 (group S). Effect sizes ranged from .129 to .139 for all the variables, which can be interpreted as a small to medium effect. We also observed the statistical power of the MANOVA to be .73 while the statistical power of the ANCOVA was .79.

These findings (summarized in Tables 4 and 5) highlight the relevance of using d-MBI centred on responsibility to develop creativity and responsibility, but also the absence of effects on several variables, at least in the context of our study (during the COVID-19 pandemic which was characterized by absenteeism): these were graphic divergent thinking; verbal divergent thinking; awareness of one's own responsibility; mindfulness. To the best of our knowledge, this study is the first to test meditations that differ in intentions and to examine their effects on graphic and verbal creativity and responsibility. Therefore, no comparison with existing studies can be made, but because they are distinct measures and both important, both (graphic and verbal) should be included in future creativity assessment (Woolley et al., 2020).

Creative potential

Our results are partly contradictory with prior research on creativity. They differ from the results reported in Lebuda et al.'s (2015) meta-analysis, which noted no effect of mindfulness meditation on convergent thinking, and from Colzato et al. (2012), who showed no statistically significant effects. Henriksen et al. (2020) explained that the meditation effects on mood (specifically the relaxing aspects) may interfere with the potential benefits of focused-attention meditation on convergent thinking.

However, the improvements in verbal convergent-integrative thinking in groups R and C in our study can be explained by both programmes focusing on various subjects and leading students to adopt a global and ecological view of society. Thus, the effect on convergent-integrative thinking (which can be defined as 'synthesising heterogeneous elements, to integrate them into a single and coherent whole') is because this thinking is at the core of sciences such as ecology (Reche & Perfectti, 2020), and it was the purpose of the recordings. Also, prior research has shown that meditation tends to neurologically inhibit automatic reactions (Lutz et al., 2008), which could explain why it enhances creative potential in some studies. We are interested in how self-centred intentions might decrease certain types of creativity; this may be because they cultivate a natural and already habitual tendency of the mind: that of thinking about oneself and being oriented towards one's own interests. This may have a negative effect on creativity, which instead requires a break with habits. On the other hand, the programme centred on

responsibility found the opposite effect, perhaps precisely because it instils a way of thinking that is, if not new, at least more open-minded, and therefore more creative.

Moreover, we observed different levels of engagement between group R with a strong commitment and group C with a weak commitment. Thus, the students in group R probably experienced greater attention and focus on the recordings (the words used, the exercises and the request) than the other groups, which could explain the verbal part of convergent thinking. This finding is consistent with Bellosta-Batalla et al.'s (2021) results on mindfulness and compassion-based interventions' effects on verbal creativity. We also suggest that for students in the control group, feelings of boredom and lack of involvement may have caused mind-wandering, therefore strengthening a link to visual imagination and enhancing graphic creativity (Woolley et al., 2020), which is consistent with Lorca Garrido et al.'s (2021) results about latent inhibition and graphic creativity in inattentive 12-year-old students, the literature on creativity and mind-wandering (reviewed in Rebecchi & Hagège, 2022), and the fact that this promotes creative incubation, even if it is usually associated with divergent thinking (Baird et al., 2012; Murray et al., 2021; Russ, 2020; Yamaoka & Yukawa, 2020).

Intention and meditation

As far as we are aware, this study is the first cluster randomized controlled trial to have tested the effects of meditations (that differ in explicit intentions but not in forms) on responsibility. The hypothesis about meditation's effects on responsibility was based on the theoretical model constructed and empirically argued by Hagège (2019) about the development of several types of skills (emotional, attentional, relational, axiological and epistemic). Intentions are among axiological skills (which means "related to values").

In meditation, as in any action, intention has been theorized to be a primary and primordial factor (Dahl et al., 2020; Grossenbacher & Quaglia, 2017; Shapiro & Schwartz, 2000). In this vein, we modelled the differential quality of intention in different attentional states of consciousness, including mindfulness and mind-wandering, which are two antagonistic states (Rebecchi & Hagège, 2022). It has also been argued that mindfulness practice cultivates the power of intention by training our minds to perceive phenomena more lucidly (Batchelor, 2019). More specifically, intention plays at least two distinct roles in meditation: as a factor eliciting attention (intended attention), and as an object of attention (attention to intention) (Grossenbacher & Quaglia, 2017). This second role was of special interest to us here, as we used as the object of meditation verbal intentions either linked to responsibility or centred on oneself, through the intermediary of wishes. Indeed, in loving kindness meditations (connection-based according to Dahl et al., 2020), wishes have been characterized as a component of an intentional nature (Jazaieri et al., 2013).

At least two other studies have compared meditation programmes that differ in their (ethical vs. more personal) intention, but they were conducted among adults and also differed in their form. First, a waiting list control group was compared to a standard MBI and to an ethical MBI that explicitly included Buddhist teaching (about interdependency, common humanity, etc.). Whereas neither meditation programme was found to have any measured effect on empathy when compared with the control, the standard programme increased mindfulness and the ethical one enhanced self-compassion and subjective well-being (Bayot et al., 2020). Second, two d-MBIs differing mainly in their form were compared: an "ethical" programme promoting understanding and reflection on interdependence and the commonalities between beings (who all suffer), and in which only one session out of six seemed to specifically include work on intention through wishes (that all beings be happy) and a more classical mindfulness-based programme (Chen & Jordan, 2020). Both programmes were reported to have positive effects on stress reduction, life satisfaction and self-awareness when compared to an active control group (doing semantic analyses). Ethical mindfulness also particularly enhanced personal growth and prosocial behaviour. In both latter studies, we suppose that the different theoretical and practical content may have influenced the intentions of the participants, but the work on intention was mainly

implicit. Our design, therefore, seems to be the first to systematically include wishes, thus explicitly and repeatedly focusing on training verbal intentions.

Responsibility

We show a specific impact of the responsibility-centred programme on self-reported responsibility in one class, but only on the Sense of One's Own Responsibility (SOOR) subscale. A similar result was obtained in a quasi-experimental study that compared a responsibility-centred MBI with an active control group among adults, where we explained the contrasting absence of a significant result for the AOOR subvariable with reference to an inadequacy in the items' formulation in the corresponding subscale: meditation could paradoxically enhance awareness of our lack of awareness, which would counterbalance the enhancement of the self-reported awareness (Hagège et al., 2023).

Further, if we consider responsibility as linked to ethics and prosociality, there has been a current debate in the literature on the difference between responsibility (or, more accurately ethics) and self-centred (or without any explicit goal) MBI. MBIs without explicit ethical goals increase compassionate helping and reduce behaviours related to prejudice or retaliation, but not instrumental or generous helping (meta-analysis by Berry et al., 2020). However, this prosocial effect might be restricted to people who already have some ethical predispositions such as interdependent self-construal (Poulin et al., 2021) or high levels of dispositional empathy (Chen & Jordan, 2020). Moreover, these MBIs seem to decrease prosocial behaviour among people with independent self-construal (Poulin et al., 2021) and among less empathetic subjects (Chen & Jordan, 2020). In the present study, descriptive analyses showed that the mean of the results of one responsibility-centred class in the pre-test for responsibility was the lowest of all the classes, whereas one self-centred class had the two best results for responsibility in T0 (Table 3). Thus, one responsibility-centred class (class 1) had the lowest responsibility scores at the beginning and was the only class to improve between the two tests. This reinforces the convergence with prior studies which show that those who need it most, in terms of openness to others, benefit most from a programme containing explicit ethics. Moreover, a programme focusing on health at school similarly showed that it is the children who need it most in terms of their health (the most stressed at the outset) who benefit in terms of their health (Michel et al., 2019). However, research is still needed to establish whether it might also reduce openness to others and responsibility (as the above-mentioned studies of Chen & Jordan, 2020 and Poulin et al., 2021 tend to suggest).

This argumentation highlights the importance of teaching an explicit ethical goal in interventions to favour an ethical outcome, an approach which has been theoretically argued before (Condon, 2019; Hagège, 2019), especially as this open perspective seems to be more motivating for the children, as suggested by the average rates of commitment to training in our study, which are higher in group R than in the others. Thus, although altruism could be reinforced by mindfulness meditation (Purser, 2015) and it could develop prosociality (Berry et al., 2020) and moral decision-making (Shapiro et al., 2012), further studies are required to better understand the interactions between subjects' predispositions, explicit guided intention and type of meditation, all of which impact meditation interventions on responsibility.

Limits of our study and implications regarding fostering psycho-education for responsible creativity in schools

The findings of this study are encouraging, but some limitations should be highlighted. First, due to the COVID-19 pandemic, the final sample was not as large as we had planned at the beginning of the study. Many students were ill during the 11 weeks of experimentation, and others were unable to attend either the listening sessions or the post-tests. This could explain the absence of measured effect in the majority of our variables of interest. Future studies should consider using a large sample from the beginning. Second, the responsibility scale used here had not been previously validated, but no other responsibility

scale was available in French at the time of the study. It has now been published (in a version for adults; Hagège et al., 2023). Third, we deleted the five mindfulness variables from the analyses because their inclusion could have diminished the statistical power, and because there was no effect on this scale.

Fourth, studies have shown that the effects of meditation programmes in school tend to be stronger when they are taught by the class's regular teachers than when taught by an outside educator (reviewed by Waters et al., 2015). So, in our study, the effect of the training was undoubtedly impacted by the external origin of the audio and by the lack of interactions with an educator in a position to discuss ideas, ask questions, listen to a response and suggest answers to support the development of responsibility. In the audio sessions, questions were put to the pupil; for example: "What are your values at the moment in your life? You can ask yourself the following question: 'What is important to me?' and then remain open to the thoughts that appear spontaneously in your mind, without forcing them…". But right after the audios, the teachers simply continued with their lessons without any subsequent discussion, which did not allow feedback support for the person's progress. This could explain the absence of measured effect in the majority of our variables of interest.

Fifth, the effects of meditation programmes in school are measurable even with short interventions, although they are stronger with longer programmes and where young people meditate more frequently (Waters et al., 2015). In line with this, the ethical power of intention in meditation has been argued to be reliant on "what moves us repeatedly and might become ingrained as habitual responses" (Batchelor, 2019, p.21). The context of frequent absenteeism due to the pandemic might have decreased opportunities to repeat the practice and the integration of new attitudes or intentions. Moreover, as far as the development of coherence between intention and actions (thus the value-congruence component of responsibility, Hagège, 2017a, 2017b) is concerned, unconscious biases such as those stemming from cultural stereotypes can lead subjects to act unconsciously against their conscious intentions (Pearson et al., 2009), which raises problems from the point of view of responsibility (Faucher, 2012; Levy, 2014): how can we become responsible for inconsistencies of which we are unaware? Therefore, the process of developing responsibility involves identifying our own inconsistencies (value incongruence) and working to align our actions with our intentions (value congruence). As prior research into goals has shown that when a goal is implemented (even unconsciously), it tends to be achieved when the conditions are right (Custers & Aarts, 2010), reinforcing intentions can potentially encourage the realization of corresponding goals. Therefore, a teacher trained to teach meditation who accompanies the students in seeking to put the teachings and intentions into practice, and in freeing themselves from any implicit conditioning (such as unconscious biases) is likely to be more efficient. A programme like this which aimed to structure this kind of educational activity has been described before (Hagège, 2022), and has proved to be efficient in enhancing a sense of personal responsibility and different kinds of creative potential with great effect size among adults (Hagège et al., 2023).

In order to take advantage of the results obtained in the control group and the group focused on responsibility, we propose that responsible creativity could be taught through the following five practices: board games, video games, philosophy workshops, wisdom education and mindfulness meditation. Studies on the relationship between board games and creativity are not new (Butler, 1988), and more recent work has focused on the creative potential of individuals (Mercier & Lubart, 2021), the relationship between games, empathy and creativity (Rosa et al., 2021), and the development of problem-solving skills (Chen et al., 2021). Many studies have investigated the effects of video games on creativity (Čábelková et al., 2020; Gackenbach & Dopko, 2012; Green & Kaufman, 2015; Hamlen, 2009; Shute & Rahimi, 2021; Yeh, 2015), and video games are also known to be effective ways to support the development of certain perceptual, attentional and cognitive skills (Bediou et al., 2018), along with certain social and emotional skills (Kovess-Masfety et al., 2016; Villani et al., 2018).

A number of studies have also examined the effects of teaching philosophy on creativity, although this is a fairly new area of research (Hejazi & Pourtaghi, 2014; Kanani Harandi et al., 2021; Matthews, 2021; Momeni & Parvaresh, 2016; Nosrati Heshi et al., 2022; París-Albert, 2017). Wisdom can be defined as "the power to judge correctly and to follow the soundest course of action, based on knowledge, experience, understanding, etc." (Sternberg, 2003a, p. 147). Furthermore, it is "the result of applying

successful intelligence and creativity to the common good, through a balance of short- and long-term intrapersonal, interpersonal, and extrapersonal interests" (2003b, p. 188). Sternberg (2003b) stresses the importance of including wisdom in the curriculum (as it allows for the integration of thoughtful and deliberate values into important judgements, it is a means to create a better and more harmonious world, and it is important for children to learn to judge correctly as they will later serve the community and face challenges and conflicts as adults) even though this may raise several issues (as many people may not see the point of teaching something that does not promise to improve outcomes, and wisdom is much more difficult to develop than the kind of achievement that can be developed and easily tested through multiple choice questionnaires).

Finally, mindfulness meditations train several executive functions and improve attention test scores (Chiesa et al., 2010; Tang et al., 2007), working memory (Chiesa et al., 2011) and cognitive control (Fountain-Zaragoza et al., 2016). Mindfulness meditation also develops socio-emotional abilities (Malboeuf-Hurtubise et al., 2017), creativity (Capurso et al., 2014; Colzato et al., 2012, 2014; Ding et al., 2015a, 2015b; Lebuda et al., 2015; Lippelt et al., 2014), prosocial emotions (Luberto et al., 2018) and prosocial behaviours (Berry et al., 2020; Donald et al., 2019; Malin, 2023; Schindler & Friese, 2022), but this process is not necessarily automatic, hence the importance of including ethical instructions during mindfulness meditation (Berry et al., 2020; Chen & Jordan, 2020). These five practices, whether combined or not, could help to develop creativity and responsibility in pupils.

CONCLUSION

The findings of this study show the efficacy and relevance of varying the intentions of mindfulness meditations, and of analysing digital mindfulness-based interventions (d-MBI) in class effects on the responsibility and creativity of middle-school students. These results are innovative and encouraging, but more research is still needed about d-MBI in classroom contexts, as well as further studies on the relationships between mindfulness meditations and verbal convergent-integrative thinking with larger samples. It would be useful to replicate this experiment to compare the effects in different settings (for example, in urban areas or in primary schools), and with different meditation objectives (e.g. creativity and altruism). Finally, because our study has produced promising results, it would also be very interesting to more thoroughly explore the impact of responsibility-centred meditation programmes on school-age individuals' motivation to meditate, value congruence and well-being.

AUTHOR CONTRIBUTIONS

RK: Conceptualization, Data curation, Formal analysis, Investigation, Conceptualization, Validation, Visualization, Writing original draft, review and editing. LT and SR: Supervision. LT, SR and HH: Conceptualization, Validation, Writing: review and editing.

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CONFLICT OF INTEREST STATEMENT

No potential competing interest was reported by the authors.

DATA AVAILABILITY STATEMENT

The data are not yet available; the authors are still accumulating data for further analyses.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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