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Attending 12 weekly sessions of Forest School sessions improves mood and cooperation in 7–8-year-old children

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ABSTRACT

Being in nature improves wellbeing and health, but opportunities for children to spend time outside in a natural environment can be limited. Forest School programmes offer this opportunity. This study aimed to examine whether participation in a 12-week Forest School programme would improve mood, self-esteem, spatial cognition and collaborative behaviour. One hundred and seventy-nine UK school children aged 7–8 years took part, with a final sample comprising 151 children. A Forest School and classroom group were assessed at baseline and after 12 weeks. Children who attended the Forest School rated themselves as less tired, less bored, calmer and happier than children in the classroom. There were also greater improvements in cooperation in Forest School attendees. There were no differences in self-esteem, but some initial evidence of better competence-related self-esteem. Performance on the spatial cognition task was unchanged. Our findings suggest that Forest School participation is beneficial for children's mood and cooperation.

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Forest School; mood; cooperation; self-esteem; cognition

Introduction

The practice of spending time in nature as an educational experience has a long history, going back to at least Victorian times (Cree & McCree, 2012). This became a more formalised pedagogical practice in the 1950s in Scandinavian countries including Denmark, Finland, Sweden and Norway (Cree & McCree, 2012). In the UK, Forest School sessions began in a more formal way in the 1990s and the Forest School Association was established in 2012. While Forest Schools are an educational approach within the broader context of outdoor education (Waite & Goodenough, 2018), it is considered to be different from other outdoor learning activities as it allows more freedom for children to self-select activities and to explore, learn and take risks (Forest School Association, 2011).

The Forest School Association (UK) works from six good practice principles (Forest School Association, 2011). These six principles are as follows. Forest School involves long-term and regular sessions, with planning, adaptation, reviewing and observation an integral part of each session. Forest School takes place in a woodland or natural environment and supports learners to develop a relationship with the natural world. It promotes holistic development, in order to encourage independent, resilient, confident and creative learners. It offers individuals support to take managed and appropriate risks. Forest School is run by qualified Forest School practitioners, who develop and reflect on their own professional practice. Finally, Forest School applies a learner-centred pedagogical approach.

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In the UK, Forest Schools often takes place as an addition to formal early years or primary school education, rather than as the sole provider of early education (Waite & Goodenough, 2018). Forest Schools are located in woodland, or in a small outdoor area with some trees, depending on the locally available resources. Typically, children attend for a minimum of 6 weeks and are able to join in with loosely structured, practical activities, such as outdoor craft, constructing dens and learning to light fires (Cudworth & Lumber, 2021; Murray & O'Brien, 2005). Forest School offers a constructivist approach to learning (O'Brien, 2009), allowing children the opportunity to solve problems and learn from their mistakes. This more personalised learning compared to that available in mainstream classrooms, may lead to a positive and profound effect on participating children (Murray & O'Brien, 2005).

How does engaging with Forest School impact children?

While Forest Schools have grown in popularity in recent years (Cree & McCree, 2012; Forest School Association, 2012), there are relatively few studies evaluating its impact on children. Murray and O'Brien (2005) examined three case-study areas that tracked 24 children through Forest School in England over 8 months (Murray & O'Brien, 2005). They identified eight themes that describe the impact of Forest School on children. These include changes in the children's confidence and self-belief, social skills and cooperation, language and communication, motivation and concentration, physical skills and increased knowledge and understanding of the natural environment. They also found changes in how the teachers understood the children who they had observed in the Forest School setting. These themes are supported by two recent systematic reviews (Dabaja, 2022; Garden & Downes, 2021).

One recent systematic review identified 25 articles on Forest School and education, which took place in three contexts—Early Years, Special Educational Needs and Disability (SEND) and Formal Education. The majority of the studies were small in scale and qualitative in method; only three studies had over 100 participants (Garden & Downes, 2021). These authors identified a number of themes. In the Early Years, themes included natural play, development and risky play. Formal education included physical activity, mental health and environment awareness. SEND included dignity of risk and relationships. These themes overlapped contexts to some degree and there was one theme that fell into all contexts, which was space. There is some overlap with the themes identified by Murray and O'Brien (2005), but the Garden and Downes work extends this to map themes onto three specific educational contexts.

A second recent review examined the impact of Forest Schools more widely, that is not just educational impacts, and reported on 28 publications from 2000 to 2019 (Dabaja, 2022). Seven themes were identified—social and cooperative skills, physical skills, self-confidence and self-esteem, learning performance and cognitive skills, emotional and mental wellbeing, environmental awareness and sense of belonging and risk management skills. There is a overlap between the seven themes along which Forest School affects children that were identified by Murray and O'Brien from evaluation work, and Garden and Downe's nine themes and Dajaba's seven themes, both of which were identified from reviews of published papers. In the present study, we focus on four of these; self-esteem, cooperative skills, learning and cognition and emotional wellbeing, and here, we review the evidence for the impact of Forest Schools on each in more detail.

Effects on self-confidence and self-esteem

The Forest School Association states that participation in a Forest School leads to the development of confidence and self-esteem (Forest School Association, n.d.). Self-esteem and self-confidence are related to an individual's self-concept (Bailey, 2003) and the self-concept is an individual's perception of themselves, including qualities and attributes, and physical and psychological characteristics (Rogers, 1959). Self-esteem is the extent to which an individual views the characteristics and qualities

in their self-concept as positive. Self-confidence occurs when the individual trusts that they have the abilities to meet the demands of the task in hand. Thus, self-confidence and self-esteem are related, but distinct concepts, but they are often used in a fairly interchangeable way in the Forest School literature. The improvements in self-esteem and confidence after Forest School participation may occur after practical experience that allows children to master new tasks, which may not happen in a traditional classroom, and this helps them to increase in confidence, earn the respect of their peers (perhaps for the first time) and improve their view of themselves (self-esteem) (Swarbrick et al., 2004).

Given that improvements in self-confidence and self-esteem are the stated outcomes of Forest School, it is perhaps surprising that there is not more research on how these might change after Forest School engagement. However, the few reported studies do support the argument that Forest School engagement increases self-confidence and self-esteem. For example, teachers report that 'hands-on' contact with nature improves children's self-esteem (Maller, 2009) and self-confidence, particularly for disadvantaged children or children with SEND (Rickinson et al., 2012). Furthermore, engagement with a Forest School has been reported to help primary and secondary school pupils with SEND experience a challenging environment and feel successful, which was argued to promote a more positive self-image (Tiplady & Menter, 2021). However, the quality of evidence could be better. Some of the evidence for improvements in self-esteem is anecdotal (Swarbrick et al., 2004) and the majority of studies interview teachers or other adults, rather than assessing the children themselves. There is just one study that has conducted interviews with children, which reported that 11–12-year-old children who had experience of engaging with outdoor activities increased in self-confidence in comparison to children with less or no experience of outdoor activities (Palmberg & Kuru, 2000). A more rigorous approach would be to use a standardised measure of self-esteem, which is the approach we took; in the present study, we asked children to rate their own self-esteem using a well-established rating scale (Rosenberg, 1965).

Impact on the development of social skills and cooperation

A further stated aim of the Forest School Association is that engagement with Forest Schools enhance social aspects of learning (Forest School Association, n.d.), encourages pro-social behaviour and awareness of others and helps develop cooperative learning skills (Cree & McCree, 2012; Dabaja, 2022; Garden & Downes, 2021). But how might we conceptualise social aspects of learning, pro-social behaviour and cooperative learning? These fall under the umbrella of social competence, the development of which happens across childhood (Howes, 1987). Social competence is comprised of many skills and behaviours that allow individuals to interact appropriately in their social environment. These include pro-social behaviours, where one acts to the benefit of other(s); cooperation, where two or more individuals work together to achieve a shared goal; collaboration, where individuals work towards a shared goal, while showing sensitivity towards the needs of the other; making friends, communicating with others; and coping in social situations that may be difficult (and perhaps even more so in the case of children with SEND). Cooperation and prosocial behaviour are important in the classroom and specific classroom activities are important to developing these skills (Green & Rechis, 2006).

Evidence collated via qualitative and interview studies suggests that engagement in a Forest School results in improvements in social and cooperative skills. For example, positive changes in children aged 3–11 years were reported over 8 months in being able to successfully work as part of a team, to share materials and tools, forge new friendships, negotiate with each other and become more aware of the impact of their behaviour on others (O'Brien, 2009). Similar behaviours were improved in primary-school aged children who were interviewed after a 6-week stint of Forest School (Pimlott-Wilson & Coates, 2019). Important aspects of collaboration that improved included working with children they had not worked with before and learning to deal with social conflict. A case study of an Australian Bush School, in which data were collected via focus groups with children and interviews with staff, found that there was more cooperation during play in the Bush

School compared to the school playground, possibly occurring as a result of limited resources in the latter leading to more competition (Cumming & Nash, 2015). There were also more opportunities for staff and students to talk to each other, which is likely to help to grow new social bonds and reinforce existing ones. Finally, one study reported on focus groups run with 6–7-year-old children both before and after their participation in six weekly Forest School sessions (Ridgers et al., 2012). The children mentioned social interactions as a positive aspect of Forest Schools and some children were showing leadership in the games as they increased in confidence across the 6 weeks.

A couple of studies have examined gender differences in the impacts of Forest School. For example, focus group findings from 7–9-year-old children taking part in 12 weekly Forest School sessions showed that girls more frequently mentioned the social aspects of the Forest School as positive compared to boys (Trapasso et al., 2018). Interviews with practitioners, parents and children aged 5–8 years who were engaging in Forest School described increases in social interaction and collaboration, including between children who would not work together in the classroom, and a particular impact on social interaction was observed in boys (Slade et al., 2013). These studies could suggest that girls may particularly enjoy the social aspects of Forest Schools, but boys may receive a greater benefit for positive aspects of social interaction, but we note that studies so far are limited.

Children with SEND, and those who were disadvantaged, have also been shown to have improvements in social and cooperative skills after engagement with Forest School. One study tracked disadvantaged children attending weekly Forest School sessions over 3 years, starting when they were 5–7 years old (McCree et al., 2018). The outcome of interviews with teachers and focus groups with children was that teachers reported that children's social skills improved with Forest School participation, and that children became more 'socially confident learners.' A further study found that 5–8-year-old children with SEND showed particular improvements in social interaction (Slade et al., 2013).

In summary, the consensus of these studies is that engagement in Forest School improves a broad range of social and cooperative skills in children. This is the case for children of varying ages and for different amounts of time spent in Forest School sessions. To date, much of the research is informed by observations, interviews with parents, teachers and children and focus groups. In the present study, we adopted a formal and quantitative measure of cooperation, in order to provide a more objective measure of collaboration in a large group of children.

Effects of Forest School on learning and cognition

Learning and cognition is another area that has been identified as showing improvement after engagement with Forest Schools (Dabaja, 2022; Garden & Downes, 2021; Murray & O'Brien, 2005). Before evaluating the evidence, first we will define what we mean by learning and cognition. Learning occurs when an individual acquires new information, abilities or behaviour and is shown by changes in knowledge, skill or behaviour. It requires attending to information, organising it and integrating it with existing knowledge. Learning can be evaluated by assessing the extent to which knowledge (or skill or behaviour), for example, has been attained. This could include quizzes, interviews, and case studies, to name but a few measures. Cognitive processes are those by which learning occurs, such as attention, memory, reasoning, and problem solving. Cognitive processes can be directly evaluated by assessing the component of interest. For example, working memory can be assessed by a task such as digit span. Much of the Forest School evaluation and research has focused on children's learning in the Forest School environment. Forest School learning is experiential and created through transformative experience (Kolb, 1984; Pimlott-Wilson & Coates, 2019). Studies to date have reported that children view the learning that takes place during Forest Schools are experiential and hands-on and different from that which takes place in the classroom (Pimlott-Wilson & Coates, 2019). We will focus on what is known about the effect of Forest School engagement, or other aspects of engaging with nature, on cognitive processes.

Most studies have used qualitative methods and analysis to consider the effect of Forest School engagement on cognition. For example, primary-school aged children attending 6 weeks of Forest School talked about how they use maths to calculate equipment necessary to build dens and how their decision-making evolved (Pimlott-Wilson & Coates, 2019). Teachers reported that children aged 3–11 years showed improvements in concentration over an observation period of 8 months of Forest School participation (O'Brien, 2009). For example, as children were able to pick activities that they wish to participate in, they had a greater focus that lasted longer than if they were being assigned to activities. This could be a consequence of the autonomy of picking activities and/or that it was outside in nature. Furthermore, children aged 5–8 years were reported by teachers as having higher levels of concentration after three Forest School sessions and that this was particularly improved in the case of boys and children with SEND (Slade et al., 2013).

Studies that use quantitative methods to formally assess cognitive abilities have tended to be conducted in outdoor-learning settings and examine exposure to nature, rather than specifically Forest School participation. For example, one study assessed a formal measure of attention in 4–6-year-old children and correlated this with the quality of their outdoor playing areas (Mårtensson et al., 2009). A better quality outdoor area was defined as being larger, having more trees and greenery, which were better integrated with play structures, and this was linked to less inattention in the children (Mårtensson et al., 2009). Walking in a natural environment, compared to an urban environment was found to improve adults' attention, assessed using the Attention Network Test and backwards digit span; even solely viewing nature photos can improve cognitive performance after task-induced fatigue, compared to photos of urban environments (Berman et al., 2008; Berto, 2005). Increased exposure to green spaces was found to enhance the working memory of 7–10-year-old children on the Attention Network Test, with working memory improvements over 12 months and a reduction in inattentiveness over the same timescale (Dadvand et al., 2015). The amount of time spent outdoors was related to a reduction in inattention-hyperactivity measured using the Strengths and Difficulties Questionnaire in pre-schoolers in nature-based day-care centres in Norway (aged 12–78 months—children start school at a later age in Norway compared to many countries) (Ulset et al., 2017). An increase in time spent outdoors was also related to improved digit span in 5–6- and 7-year-old children (Ulset et al., 2017). Finally, one study has assessed the impact of weekly Forest School sessions on children who were followed over 3 years and aged 5–7 years old at the start of the study (McCree et al., 2018). These children were defined as disadvantaged, for social, behavioural and/or economic reasons. Teachers reported on quantitative changes in formally measured academic attainment, which could be viewed as a proxy for cognitive performance. They found that reading improved by 27% in Forest School attendees compared to 22% in similarly disadvantaged peers; writing attainment improved by 18% compared to 7% in peers; and maths increased 27%, compared to 11% in peers (McCree et al., 2018). There are also studies that show that spending time in green outdoor activities resulted in an enhancement of attention (Faber Taylor & Kuo, 2009) and a reduction in Attention Deficit Hyperactivity Disorder (ADHD) symptoms (Kuo & Faber Taylor, 2004) in children with ADHD.

Thus, concentration, attention and memory are the cognitive processes so far suggested to be improved by increased exposure to nature. However, the evidence base is not very strong, and relies on cognitive processes being inferred from observation of children's behaviour, rather than formal measurement of cognition. For the present study, we focused on one aspect of memory. Memory is the ability to retain information or past experiences across time and to be able to retrieve this information. Spatial memory allows us to store and retrieve information about the location of objects and to plan routes (Arce & McMullen, 2021). This develops over childhood and is linked to motor development (Farran et al., 2019). Thus, it involves the same sorts of cognitive skills often used in the Forest School environment. For example, in order to forage and locate materials used in Forest School activities, children must plan their route around the environment and remember the locations at which they observed potentially useful material. In the present study, we objectively assessed the ability to remember spatial locations using the Corsi Blocks task (described in methods).

The impact on emotional wellbeing

The definition of wellbeing is variable and approached differently by many researchers (Pollard & Lee, 2002). The American Psychological Association defines emotional wellbeing as a state of contentment and/or happiness, that is accompanied by little distress. It is multi-component, often including good mental and physical health and good quality of life, and can also be characterised by good mood. UNICEF provides a regular index of child wellbeing in the most advanced economies of the world. In 2020, children in the UK were rated 16th for wellbeing in the 29 most advanced economies (Unicef, 2020). This is an improvement on the 2007 survey in which children in the UK were rated last (Unicef, 2007), but it is clear that wellbeing is not optimal for UK children. Here, we consider the evidence for whether general exposure to nature or engagement in Forest School can aid children's wellbeing.

Exposure to nature has been reported to positively affect children's emotional wellbeing. For example, a systematic review of nature activities reported positive effects on changes in children's affect, with studies showing increased positive and reduced negative mood, and changes in resilience (Roberts et al., 2020). Similar findings regarding resilience were reported by a systematic review of the impact of immersive nature experience on children's social health, but there was less evidence supporting a positive impact on mood (Mygind et al., 2019). Finally, a review of the impact of interactions with nature on the mental health and wellbeing of children reported that half of the reviewed studies showed a positive relationship and that the other half were not statistically significant (Tillmann et al., 2018), suggesting there is not much uniformity in the findings. Self-esteem and -confidence are often viewed as components of wellbeing (Mygind et al., 2019; Roberts et al., 2020; Tillmann et al., 2018), but as we have discussed these separately above, we have not included them here.

Few studies have specifically looked at the effect of Forest School participation on emotional wellbeing in children, and some of these have used objective measures of mood. For example, after a day either in a Forest School or in the classroom, the mood of children with an average age of 11-years old was assessed using the Mood Adjective Checklist. A greater, positive, change in mood (energy, stress, anger and hedonic tone) was observed in children who had been in Forest School (Roe & Aspinall, 2011). The greatest change was in the subset of children with poor behaviour (poor behaviour was rated by teachers) (Roe & Aspinall, 2011). Similar changes in mood were reported in a study of children aged 7–9 years who were taking part in weekly Forest School sessions over 3 months and showed improvements in mood, particularly happiness and wellbeing; this was related to more engagement in free and creative play (Trapasso et al., 2018). Other studies have examined resilience and ratings of wellbeing. For example, a measure of resilience increased over time in children aged 11–12 years who took part in Forest School programme 1 day a week for 5 weeks (measured using the Sense of Mastery scale from the Resiliency Scales for Children and Adolescents) (Roberts, 2017). However, mental wellbeing, as measured by the Warwick-Edinburgh Mental Wellbeing Scale, increased for the boys, but not for the girls (Roberts, 2017). A qualitative study showed that Forest Schools programmes (9–12 months) had positive impacts on children's resilience, confidence and wellbeing (Blackwell, 2015). Wellbeing has also been affected in disadvantaged 5–7-year-old children engaged in Forest School over 3 years, who were reported to have maintained high levels of wellbeing throughout the period (McCree et al., 2018). Furthermore, teachers reported that this was more present during Forest School sessions compared to the classroom (McCree et al., 2018). Finally, engagement with Forest School resulted in children and adolescents with SEND showing improvements in behaviours linked to emotional wellbeing (Tiplady & Menter, 2021).

In summary, these studies suggest that various components of emotional wellbeing, such as mood, resilience and mental health, may be positively impacted by engagement with Forest Schools. However, the evidence is rather limited and not all studies have used objective measures (Tillmann et al., 2018), and stringent study design, such as the use of control groups (Roberts et al., 2020),

should be employed. In the present study, we assessed children's mood using a well established, self-rated mood scale.

The present study

Our literature review reports that there is rather limited evidence that suggests that Forest School engagement leads children to show improvements in self-esteem and self-confidence, social and cooperative skills, learning and cognition, and emotional wellbeing. Much of the literature includes small-scale studies, often using practitioner or parent ratings of children's behaviour, rather than direct measurement. This is problematic because teacher and/or parent report may introduce bias relating to expectations about how Forest School may impact on children's behaviour, which in turn could affect ratings. Many studies are qualitative (Dabaja, 2022) and as such, do not offer a comparison with a control group of children who do not attend Forest School. Thus, it is difficult to argue that the changes in behaviour are directly related to Forest School engagement. In addition, studies do not compare children's behaviour and/or cognition both before and after engagement with Forest School, which also results in it being hard to attribute changes directly to time spent in Forest School.

In the present study, we adopted a study design with five components that result in greater rigour than found in previous studies. First, we tested a large sample of children helping to make the results more reliable and generalisable. Second, we used standardised and replicable measures of mood, self-esteem and spatial cognition, along with a structured observation of collaborative behaviour. Third, we also assessed a control group matched for age, gender and socio-economic status, who did not attend Forest School sessions. Fourthly, we assessed children both before and after they engaged with Forest School—or in the case of the control group, 12 weeks apart. Fifth, the same qualified Forest School leader ran all of the sessions in the schools across the 12-week programme and offered the same child-led activities. These five components allow the rigour of objective measurement, direct comparison of the impact of engaging with Forest School with the impact of not attending Forest School, uniformity of Forest School planned session from the same leader, and the pre- and post-intervention design allows assessment of whether any changes in behaviour were related to Forest School engagement.

In the present study, we assessed a large sample of primary school-aged children who attended 12 weeks of weekly Forest School sessions, compared with a control group of children who did not. Performance was assessed at both baseline before attending Forest School, and at test, after the 12 weeks of Forest School sessions. We hypothesized that children who attended Forest School sessions would show improved self-esteem, collaboration skills, spatial memory span and mood, compared to their peers who did not attend a Forest School.

Methods

Design

Children were assigned to either a Forest School or classroom group. Children in the Forest School group attended Forest School sessions for 12 weeks in the Autumn term between September and December 2018. The classroom group was a wait list control, with these children being offered Forest School sessions in the following school term (January to March 2019). Participation in the study preceded, and was not impacted by, the COVID-19 lockdowns and restrictions. Children were assessed on outcome measures at baseline and then at test (12 weeks later). There were measured on tests of self-esteem, self-rated mood, Corsi blocks and performance in a collaborative task.

Table 1. Information about the schools from which the sample was drawn.

School	Location	Proportion of school pupils eligible for free school meals*+	Students requiring additional help	Where did Forest School sessions take place?	Participants
School 1	Rural commuter village	12.8%	In line with national average	In a small wooded area on the school grounds	Forest School $n = 15$ (6 girls and 9 boys) Classroom $n = 18$ (12 girls and 6 boys)
School 2	Rural commuter village	13.1%	In line with national average	In a small wooded area that was a short walk behind the school	Forest School $n = 17$ (10 girls and 7 boys) Classroom $n = 14$ control (4 girls and 10 boys)
School 3	Small town	12.2%	In line with national average	In a small wooded area on the school grounds	Forest School $n = 22$ (10 girls and 12 boys) Classroom $n = 34$ (18 girls and 16 boys)
School 4	Small town	4.6%	Below national average	In a small wooded area that was a short walk behind the school.	Forest School $n = 14$ (3 girls and 11 boys) *Classroom* $n = 17$ control (9 girls and 8 boys)

*Data obtained from each school's Ofsted report.
+ Contemporaneous national average of pupils eligible for free school meals = 13.7.

Participants

Participants were 7–8-year-old school children recruited from four primary schools in Essex, UK (Table 1). In total, 179 children took part, but some did not complete both baseline and test assessments, and the final sample comprised 151 children. The Forest School group comprised 68 children (mean age 7 years 9 months; 27 girls, 41 boys) and the classroom group comprised 83 children (mean age 7 years 6 months; 44 girls, 39 boys).

Forest School or classroom setting

Forest School sessions took place once each week for 12 weeks (one school term) and lasted for either a whole morning or afternoon. The session included changing into appropriate clothes, followed by a short walk to the Forest School site. Each session followed a standard Forest School session, which began with introductory circle time, then a series of free choice activities. Following a snack, a supervised activity took place, such as a making dens, craft activities or activities exploring nature. At the end of the session, children were encouraged to reflect on and share their experiences of the session. This could include talking about the session, pointing to emotion charts, or providing a thumbs up (good) or down (bad).

Each Forest School session was led by the same qualified Forest School leader at all four schools across the 12-week programme. The planning for each session for each school was the same for each week, with the same child-led activities were offered at each school. These included activities such as playing in a mud kitchen, nature observation activities such as leaf or minibeast identification, and hiding style games. In line with the principles of Forest School, students could choose the activities in which they participated, so they did not all choose the same activities.

The classroom group that were not participating in Forest School sessions had a normal morning or afternoon of classroom learning and other activities.

Materials

Mood scales

Mood was assessed by a Visual Analogue Mood Scale (Stern, et al., 1997). Children marked a 10 cm horizontal line with anchors to represent the positive and neutral face emoji at each end. The emojis were accompanied by the emotion word. They were asked to rate how tired, happy, bored, calm and excited they were feeling. Scores were calculated by measuring from the neutral to the emotion emoji and this was expressed as a percentage; higher scores represented a higher amount of that emotion.

Rosenberg self-esteem scale

Self-esteem was assessed using the Rosenberg Self-Esteem Scale (Rosenberg, 1965). Children were asked to select one option on a 4-point Likert scheme as a response to a given statement of self-esteem. The options were 'all of the time' (scored as 4), 'most of the time' (scored as 3), 'sometimes' (scored as 2) and 'never' (scored as 1). Five of the statements were positively worded, for example 'I have lots of good ideas. Three questions were negatively worded, for example 'I'm not always proud of myself. These questions were scored, then all eight scores were summed, and a total score was created with a higher score indicating higher self-esteem.

Corsi blocks

The Corsi blocks test was used to assess children's spatial working memory span. Previous research has found that memory span for verbally presented items—in the form of a digit span test—is improved after increased time spent in or exposure to pictures of natural environments (Berman et al., 2008; Berto, 2005; Ulset et al., 2017). The Corsi blocks test is a spatial corollary of digit span, chosen because it was considered to be a better match to the real-life experience of Forest School. Rather than remembering lists of items, children may remember the spatial locations of natural items in the Forest School environment for creative play and outdoor exploration.

The Corsi blocks test uses a wooden board (20 × 25 cm) with nine 2-cm square wooden blocks glued on top (De Renzi & Nichelli, 1975). Numbers were positioned on the back of the blocks only visible to the experimenter. The pre-determined sequences were 'tapped' out on top of the blocks at a rate of one block per second and the child was asked to repeat the tapping sequence. The task starts with a sequence of two blocks and sequence length increased successively by one block, up to a maximum of nine blocks. Children were assessed individually. There were two attempts at each sequence length, and after two incorrect attempts at a given sequence length, the task was stopped. The longest correct sequence was recorded as the child's spatial span.

Collaboration task

This was a collaborative craft activity completed in small groups of six children. Group size for collaborative tasks is most commonly four to six children (Kutnick et al., 2002). Different craft activities were used at baseline and test, in order to avoid developing task familiarity over time, which would impact on the need for cooperation. The tasks used provided a similar level of challenge for the children. Both required the same skill sets to complete, collecting appropriate resources, group discussion about the choice of resources, group discussion of how the final creation should look, the use of string to bind the materials used. Observation of the children suggested that they did not find one task more difficult.

At baseline, children were shown a completed sample dream catcher and then were asked to work as a team to collect natural material to create their own as a group. In the Forest School, they foraged for natural materials and in the classroom setting they were provided with a selection of natural materials from which they could select items. At week 12, the task was to make a small den for a toy mouse. Similarly to baseline, the Forest School group foraged for items and the classroom group were provided with materials to choose from.

In order to provide a measure of collaborative behaviour, while the children completed the task, the researcher observed how the group worked together collaboratively and a chart was used to assess changes in cooperation within the group, awareness of others and motivation. This was assessed during the baseline and the test session. The observation focused on a number of behaviours, including how the children spoke to one another, listened to one another, divided tasks up among themselves, decided who would complete each part of the task, completed the task together, encouraged one another, and criticised or made recommendations of things could be improved to one another. These behaviours were recorded on assessment sheets recommended by the Forest School Association for collecting collaborative data. These changes were scored in a hierarchical manner: (1) no change in ability to work collaboratively during the session, (2) slight level of change (e.g. participants would occasionally work independently and occasionally work cooperatively with each other), (3) dramatic change (e.g. participants would initiate continual cooperative behaviour with other members of the group). This measurement procedure was adopted for each group in each school. Each group of six children was given a score at both baseline and test, and then the group scores were entered into the analysis (17 groups for Forest School and 19 groups for the classroom).

Testing day procedure

Children were tested at the start (baseline) and at the end (test) of the 12-week block. In the case of rating scales and Corsi blocks, each testing session took place in a quiet classroom in the children's school and lasted approximately 35 min. Participants were invited into the classroom in groups of six. The researcher then read through the task instructions to the group and then the children completed the self-esteem and mood rating scales individually. The Corsi blocks task was administered individually in a quiet area outside of the classroom so that the other children could not see the task. Children in the classroom completed a colouring activity under the supervision of their class teaching assistant. In the case of the collaboration task, Forest School participants did the task in the Forest School setting, and the other group did the task in their classroom.

Ethics

The study was approved by the School of Psychology, UEL's ethics committee. Following this, parents or carers were invited to a meeting at their child's school to explain what the Forest School sessions would entail. The rationale and details of the present study were also explained, and there was ample opportunity to ask questions either in the session or afterwards. Parents or carers were given an information sheet about the study to read and, if they wished their child to participate, signed the consent form. At the start of the study, children for whom parental or carer consent had been given, were given their own, child-appropriate information sheet. They were given the opportunity to ask questions and, if they wished to participate, signed the assent form. After participating in the study, children were thanked and read a short debriefing statement; their parents or carers were given a debriefing letter.

Statistical analysis

For the rating scales and Corsi blocks data, analysis of covariance was conducted on each outcome measure, comparing Forest School to classroom participants on test scores, covarying baseline scores. In the case of the Rosenberg self-esteem scale, these analyses were conducted on the total score and the individual items; the individual items were analysed in a more exploratory manner to help future research. The cooperation task was analysed by a series of Mann Whitney U tests as the data were not normally distributed. These assessed cooperative changes, changes in awareness of others, and changes in motivation, which occurred within the group sessions that took place at

baseline and at test, comparing scores from groups of children who were either Forest School or classroom attendees.

Results

Rating scales and Corsi blocks

Means, standard deviations, and inferential statistics for rating scales and Corsi blocks are presented in Table 2. Baseline score was a significant covariate for all outcome measures. There were significant group differences, taking into account baseline scores, on four ratings of mood. Children who attended the Forest School rated themselves as less tired, less bored, calmer and happier than children in the classroom, but there were no differences in how excited they rated themselves.

The self-esteem total score was not significantly different in Forest School and classroom attendees. There was a significant difference on one sub-scale; children who attended Forest School rated themselves as lower scoring on the competence-related measure of self-esteem, 'Sometimes I don't think I'm very good', compared to children in the classroom.

Children's performance on the Corsi blocks spatial memory task was not affected by the Forest School intervention.

Collaboration task

Table 3 shows medians, ranges for Forest School and regular school attendees for all three behaviour change measures at baseline and test and inferential statistics. There were no differences between groups on these measures at baseline. At test, children who attended Forest School showing a significantly greater change in cooperation than children who did not attend Forest School. There was also a trend towards greater change in motivation at test in Forest School attendees, but this did not reach significance. There were no statistically significant differences in awareness of others at test.

Discussion

Our results show that children who participated in 12 weekly Forest School sessions rated their mood more favourably than their peers who did not; Forest School attendees were less tired, less bored, calmer and happier than children in the classroom. Neither the overall self-esteem score nor most of the individual items did not differ between groups, but children who attended the Forest School had lower ratings on 'Sometimes I don't think I'm very good', providing some suggestion that attending the sessions may improve their competence-related self-esteem. Performance on a spatial memory task was not changed by Forest School participation. On a collaboration task, there were no group differences at baseline, but children who attended the Forest School were rated as showing an improvement in cooperation compared to the classroom group. There was a trend towards greater motivation in Forest School attendees, but no difference on measures of awareness of others.

Self-confidence and self-esteem

We found no difference in the total self-esteem score and interpret with caution the improved competence-related self-esteem as measured by the individual scale item. Thus, our findings in our large scale, rigorously designed study, do not support the literature, most of which have questioned teachers about changes in children's self-esteem (Rickinson et al., 2012; Swarbrick et al., 2004; Tiplady & Menter, 2021). Potential changes in competence-related self-esteem, which need confirming by follow-up work, fit with previous findings showing that children attending Forest Schools value the

Table 2. Means, standard deviations and inferential statistics comparing Forest School and classroom attendees for mood and self-esteem rating scales and Corsi blocks scores, covarying baseline scores.

		Forest School					Classroom					
			Baseline		Test			Baseline		Test		
	Measure	*n*	*M*	*SD*	*M*	*SD*	*n*	*M*	*SD*	*M*	*SD*	ANCOVA Testing group difference at test while covarying baseline.
Mood	**Tired**	**68**	**50.13**	**30.10**	**32.22**	**23.95**	**83**	**56.30**	**22.16**	**58.36**	**19.49**	Covariate F(1,148) = 56.62, $p < 0.001$ **Group F(1,148) = 59.61, $p < 0.001$**
	Happy	**68**	**77.07**	**20.54**	**84.04**	**17.71**	**83**	**62.13**	**16.79**	**64.22**	**16.11**	Covariate F(1,148) = 38.06, $p < 0.001$ **Group F(1,148) = 26.53, $p < 0.001$**
	Bored	**68**	**45.78**	**28.57**	**33.04**	**26.01**	**83**	**52.52**	**17.61**	**55.76**	**16.17**	Covariate F(1,148) = 26.90, $p < 0.001$ **Group F(1,148) = 39.40, $p < 0.001$**
	Calm	**68**	**75.31**	**23.35**	**81.10**	**22.19**	**83**	**61.00**	**17.96**	**62.39**	**16.96**	Covariate F(1,148) = 65.11, $p < 0.001$ **Group F(1,148) = 15.82, $p < 0.001$**
	Excited	68	83.06	12.47	83.46	21.32	83	70.51	15.89	83.46	21.32	Covariate F(1,148) = 58.04, $p < 0.001$ Group F(1,148) = 0.60, $p = 0.441$
Self-esteem	Proud of self	68	3.22	1.01	3.21	0.97	83	2.94	0.85	3.18	0.77	Covariate F(1,148) = 24.62, $p < 0.001$ Group F(1,148) = 0.313, $p = 0.576$
	Don't think I'm very good	**68**	**2.54**	**1.22**	**2.78**	**1.09**	**83**	**2.96**	**1.03**	**3.29**	**0.82**	Covariate F(1,148) = 18.73, $p < 0.001$ **Group F(1,148) = 6.79, $p = 0.010$**
	Lots of good ideas	68	2.69	1.15	2.96	0.97	83	2.86	1.00	3.05	0.87	Covariate F(1,148) = 40.52, $p < 0.001$ Group F(1,148) = 0.04, $p = 0.838$
	As well as my friends	68	2.88	1.17	3.06	0.90	83	3.00	0.96	3.00	0.92	Covariate F(1,148) = 46.79, $p < 0.001$ Group F(1,148) = .69, $p = 0.408$
	Not always proud of myself	68	2.59	1.11	2.93	1.07	83	2.80	0.84	2.94	0.89	Covariate F(1,148) = 9.72, $p = 0.002$ Group F(1,148) = 0.06, $p = 0.806$
	Can't do things	68	2.53	1.06	2.79	1.17	83	2.78	0.99	2.81	0.97	Covariate F(1,148) = 66.66, $p < 0.001$ Group F(1,148) = 0.85, $p = 0.359$
	On top of the world	68	3.26	1.06	3.49	0.97	83	3.35	0.97	3.37	0.95	Covariate F(1,148) = 140.03, $p < 0.001$ Group F(1,148) = 2.22, $p = 0.139$
	Pleased with self	68	3.34	0.89	3.37	.090	83	3.02	0.95	3.25	0.84	Covariate F(1,148) = 78.28, $p < 0.001$ Group F (1,148) = 0.25, $p = 0.617$
	Self-esteem total score	68	23.10	4.03	24.51	4.28	83	23.73	4.14	24.90	4.10	Covariate F(1,148) = 138.64, $p < 0.001$ Group F(1,148) = 0.015, $p = 0.904$
Corsi blocks		68	3.57	0.85	3.97	0.90	83	3.82	0.89	4.19	0.67	Covariate F(1,148) = 38.54, $p < 0.001$ Group F(1,148) = 1.12, $p = 0.292$

Note. Statistically significant differences are in bold.

Table 3. Median, minimum, maximum and inferential statistics comparing Forest School and classroom attendees for the collaboration task.

		Forest School			Classroom			Mann–Whitney		
		Med	*Min*	*Max*	*Med*	*Min*	*Max*	*U*	*Z*	*p*
Baseline	Cooperative change score	2	1	2	2	1	2	160	−0.056	0.975
	Awareness of others change score	1	1	2	1	1	2	160	−0.056	0.956
	Motivation change score	1	1	2	1	1	2	132.5	−1.09	0.363
Test	**Cooperative change score**	**3**	**2**	**3**	**2**	**1**	**3**	**42.5**	**−4.249**	**0.001**
	Awareness of others change score	3	2	3	2	1	2	119	−1.524	0.186
	Motivation change score	3	1	3	2	1	3	108	−1.902	0.093

acquisition of practical skills and experiences (Waite & Goodenough, 2018) and that this is borne out in measures of mastery (Roberts, 2017). This could be explored in future research.

It is unlikely that our study did not show improvements in self-esteem as a result of lack of sensitivity in the self-rating measure. Rating scales are well-established for use in children, in many domains including self-esteem (Corcoran & Fischer, 2000). Children of 11–12 years have both the language and comprehension skills to self-report internal feelings such as mood and self-esteem (Chambers & Johnston, 2002). The use of self-rating in younger children should be considered carefully because much younger children (around 5 years old) may make more use of the extremes on a rating scale of emotions or psychological states when compared to older children but not when rating physical characteristics (Chambers & Johnston, 2002). Rating by pointing at smiley faces or similar images may work better with younger children (Betts & Hartley, 2012) and these different approaches should be considered in future studies. It is possible that adult observers may recognise a change in children's self-esteem before children are able to perceive this themselves. Future work could directly assess this by using child self-reports alongside other forms of measurement, such as teacher and parent reports and observations.

Social skills and cooperation—collaboration

Improvements in collaboration in our study support those reported in qualitative and interview studies (Cumming & Nash, 2015; McCree et al., 2018; O'Brien, 2009; Pimlott-Wilson & Coates, 2019; Slade et al., 2013; Trapasso et al., 2018). Part of the reason why cooperation might be observed more frequently in a Forest School than in the classroom may be due to the environment and types of activities that are offered at Forest School (O'Brien, 2009). The greater physical space allows for large, collaborative tasks and activities that require working with peers are more common in the Forest School than in the classroom (Pimlott-Wilson & Coates, 2019). Alongside this, certain characteristics of children are enhanced, or come to the fore, in the Forest School environment. For example, children are reported to show more empathy in a Forest School compared to the classroom (Cumming & Nash, 2015), which may result in less conflict and greater collaboration. There may also be less conflict because there is less competition for resources (Cumming & Nash, 2015). Furthermore, being in a different environment has been argued to allow different bonds and working relationships to evolve (Cumming & Nash, 2015). Increased cooperative behaviour is not only good as an end in itself, but can have an impact after the cooperative interaction. For example, cooperative interactions can aid cognitive development, including problem-solving, rule-based thinking and tasks measuring visual perception (Sills et al., 2016). Collaborative interactions are key skills that education policy makers think are important for children's development (Department for Education, 2013) and Forest Schools offer a good environment in which children can enhance these skills.

Learning and cognition

The literature provides little evidence that Forest School improves learning, and our study is the first to evaluate the impact on an objective measure of cognition, rather than academic achievement (McCree et al., 2018). Our large, robustly designed study did not find that weekly engagement in Forest School sessions improved spatial memory performance. We suggest that this is not a function of task sensitivity because children were not performing at ceiling. It has been suggested that the main focus of the impact of Forest School on children should not be solely evaluated in terms of impacts on outcomes related to classroom-based competencies (Garden & Downes, 2021), which are a proxy for, or at least rely on cognition. However, policy-makers have often been interested in an assessment-based approach that views Forest Schools as a vehicle for developing the capacity to learn and to improve academic achievement (Department for Education and Skills, 2006; Ofsted, 2022). As the impact of Forest School engagement on cognitive performance is currently under-researched, there is much that could be explored in future studies.

Emotional wellbeing

Our study provides support for the argument that engaging with Forest School improves children's mood and is similar to those previously reported (Roberts et al., 2020; Roe & Aspinall, 2011; Trapasso et al., 2018). It is perhaps to be expected that children in the Forest School rated themselves as less bored and happier than children in the classroom; Forest School provides a novel environment, which is likely to be larger than both the classroom and the playground, and with more room for innovation. The lower ratings of tiredness in those who attended Forest School may be due to changes in both physical and mental fatigue (Lieberman, 2011). While physical tiredness results from lack of sleep, physical exertion, or periods of stress and anxiety; mental fatigue can be caused by engaging in monotonous or intense cognitive tasks (Caldwell et al., 2019). A combination of the novelty of the Forest School environment, contrasted with the familiarity of the classroom, may contribute to lower ratings of fatigue and boredom in Forest School attendees. There were no group differences in excitement, which may be simply because feelings of excitement did not change, but could also be an artefact of either children in the control group being excited to start Forest School sessions in the following term, or excitement for the upcoming school holidays. Improved ratings of calmness in the Forest School group are likely related to the calm atmosphere in Forest School, which is one of the key features (O'Brien, 2009), providing both a calming environment and space to find a calm spot away from others (Harris, 2018).

What is the mechanism underlying the benefits of Forest School engagement?

Two theories are considered to be dominant in explaining the restorative benefits of spending time in nature, which may lead to improvements in mood and behaviour reported in our and other studies (Sella et al., 2023). Stress Reduction Theory (SRT) (Ulrich et al., 1991) focuses on the physiological processes underlying the reduction of stress, such as improved cardiac responses and reduced muscle tension. Attention Restoration Theory (ART) (Kaplan, 1995) suggests that attention fatigue occurs because the brain has limited attentional capacity to focus on a task; this mental fatigue can be lessened by exposure to nature. Forest School provides an environment that is rich in the elements that are fundamental to both Stress Reduction Theory and Attention Restoration Theory. However, in the present study, measures of stress reduction were not included, so we are not able to determine whether this is the means by which improvements in children's mood and cooperation came about. Furthermore, many studies in the literature, including ours, do not provide a direct test of ARR because they do not assess the impact of natural environments on attention (Stevenson et al., 2018). Some have reported little support for ART being able to explain the impact of nature on cognition and thinking via the restoration of attention (Ohly et al., 2016), but others

have suggested that exposure to natural environments could improve working memory, cognitive flexibility and attentional control and suggested a framework for future exploration (Stevenson et al., 2018).

Strengths and limitations

The strengths of this study include the large sample size and the rigorous study design. Having a control group and assessing children both before and after the 12 weeks of engagement with a Forest School allows us to directly compare both how children's self-esteem, cooperation, spatial memory and mood change after their engagement with Forest School, and how they change relative to a control group who were their school classmates, but did not attend the Forest School. Thus, we have more confidence in arguing that the reported changes in the children in our study are due to participation in the Forest School, rather than showing developmental progression. Our schools were broadly comparable for factors related to socio-economic status. Three out of the four schools that children attended were very similar in terms of the proportion of pupils eligible for free school meals and those requiring additional help in the classroom. The fourth had a slightly different profile, with fewer children eligible for free school meals and additional help. However, children were recruited to the Forest School and control groups evenly over all schools, thus minimising the impact of any potential differences across schools. This could be more carefully controlled in future. We also used well-established and objective measures to quantify mood, self-esteem and spatial memory; all of which have good psychometric properties (Chiu, 1989).

Our study also faced some limitations. The structured observation measurement of cooperation could be improved in future by assessing changes in individuals in the collaboration task, rather than within the groups. This may require filming the observations and coding them afterwards, which would be more demanding in terms of time and may impact on children's behaviour, so would require careful consideration. While the schools in the study were broadly comparable to each other in terms of the type of location, results from our study may not be generalisable to children in more urban areas and this could be formally assessed in future. Children who attend schools in inner city areas may particularly benefit from Forest School as their access to green spaces may be more limited, but there are likely to be practical issues, such as lack of space, and the logistic and financial pressure of having to drive children to a Forest School area. Regardless, the wellbeing of children living in the inner city has been shown to benefit from access to green spaces (McEachan et al., 2018). The timing of Forest School, including the length of individual sessions and the whole number of sessions, can vary between schools, and are considered to be an activity that should take place regularly and over several months (O'Brien, 2009). Studies have neither evaluated the impact of shorter or longer time periods, nor have they explored both the duration of any positive impact, nor whether these translate into changes in the classroom. This could form future work. Finally, we did not measure how frequently children engage with nature outside of school, which could impact on their engagement with Forest School and affect our findings; this should be controlled in future.

Practical implications for future practice

While the children who participated in our study attended mainstream schools, research suggests that engaging with outdoor learning is particularly beneficial for children who are underachieving academically and can increase motivation and close the attainment gap (Hamilton, 2017). The number of children who are underachieving academically is currently larger than usual as a consequence of the COVID-19 pandemic and lockdowns. A recent systematic review across 15 countries found learning deficits, particularly in maths and particularly in children from lower socio-economic backgrounds (Betthäuser et al., 2023). There is some early research evidence that participation in Forest Schools and outdoor learning can help children and adolescents recover from the effects of the COVID-19 lockdowns. For example, children who participated in more than 6 months of

Forest School prior to the pandemic spent more time learning independently than those who had not attended Forest School previously (Content, 2021). Forest School provision has been suggested for aiding children in Early Years settings (aged up to 5 years) for catching up on learning missed during COVID-19 lockdowns (Ofsted, 2022).

There was also a large pandemic-related increase in child and adolescent mental health symptoms (Deng et al., 2023), which could similarly be ameliorated by increased availability and engagement with outdoor learning, including Forest School. Early evidence suggests that adolescents who spent more time in outdoor activities during the COVID-19 pandemic had lower declines in measures of wellbeing (Jackson et al., 2021). Thus, evidence evaluating the impact of Forest School is currently of particular importance.

However, it should be noted that there are challenges that may be faced when incorporating regular Forest School sessions into the traditional school curriculum. Some of these results from ideological tensions related to educational policies that are based on measurement and accountability, which may conflict with the underlying principles of Forest School (Kemp, 2020). National curriculum rules or guidelines are common world-wide. For example, the UK national curriculum provides standards for what children must learn at different key stages (associated with age ranges), along with measures of pupil and school performance. The child-led philosophy of Forest School is not designed to directly feed into meeting these demands, in comparison to the teacher-driven pedagogy of the traditional indoor classroom that is more focused on delivering the educational content and child assessment required by a national curriculum (Pimlott-Wilson & Coates, 2019; Waite & Goodenough, 2018; Whincup et al., 2023). This tension could result in school leaders, and also possibly parents, perceiving Forest School participation in a negative light, because it may be difficult to see how it directly contributes to pupil progression and school performance ratings (Kemp & Pagden, 2018). Furthermore, a focus on meeting targets may feed into inequalities in Forest School provision, with schools that are rated by government inspection as performing well finding it easier to justify the inclusion of Forest School, compared to schools that have been rated as performing less well, which may choose to focus on traditional classroom teaching (Pimlott-Wilson & Coates, 2019).

A second challenge is faced by schools when trying to incorporate the costs of Forest School into a school budget (Whincup et al., 2023). These costs can include highly trained Forest School practitioners, equipment, travel to a Forest School site (if necessary) and appropriate clothing. In order to try to reduce some of these expenses, some schools offer Forest School-style sessions that may not be led by fully qualified Forest School practitioners (Whincup et al., 2023). Alternatively, some schools may support staff, such as teachers and teaching assistants, to train as Forest School leaders (Whincup et al., 2023). Some schools find training costs prohibitive (Kemp, 2020) and this approach can be challenging for teachers as they try to work in a setting with very different pedagogy and values from their usual working environment (Waite & Goodenough, 2018; Whincup et al., 2023). There may also be tensions around engaging with risk, as the culture of risk management and risk reduction in the traditional indoor classroom clashes with the approach in Forest School where taking measured risks is valued and encouraged (Whincup et al., 2023). Notwithstanding these difficulties, it has been suggested that teacher Forest School leaders, with support, are able to overcome these issues (Whincup et al., 2023), although this does not solve the issue of costs associated with training and other expenses.

Conclusion

Our study is the first to combine the methodological rigour of a large sample size, with standardised and replicable assessments, a matched control group who did not attend Forest School sessions, and assessment both before and after the Forest School sessions. It provides rigorous evidence that regular engagement with Forest School changed children's feelings and behaviour, in comparison to children who did not attend Forest School. We found that after 12 weeks of weekly Forest School

sessions, children who attended the Forest School rated themselves as feeling less tired, less bored, calmer and happier than children who remained in the traditional, indoor classroom. In addition, children's behaviour in our collaborative task showed increased cooperation in those who attended regular Forest School, in comparison to those who did not. In the case of self-esteem, there was some indication of improvement in competence-related self-esteem, which needs confirmation, but no change in our overall measure. We speculate that changes to mood are likely to have resulted from the novel and stimulating environment, coupled with the calm atmosphere of Forest School; future work could explore these explanations further. With regard to improvement in cooperative behaviour, Forest Schools offer children unique opportunities to work together, because they can choose with whom they play and learn, and make links with different children to whom they might normally socialise and study. This study, therefore, adds to the wide body of literature detailing the many ways in which attending regular Forest School can aid children's development and improve their lives. It particularly supports the added value for children who attend Forest School sessions while spending the majority of their school week in a traditional, mainstream classroom. We note that it can be challenging for school leaders to find space and funds to enable Forest School provision and suggest that addressing these issues will be important to create the provision of regular Forest School sessions for all children.

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