Links between natural environments, learning and health: evidence briefing

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Contents

Purpose of briefing

This briefing note is one of a series that summarises evidence of the relationships between the natural environment and a range of outcomes. This briefing focuses on the impacts of learning in natural environments and the impacts of natural environments on learning processes and outcomes and health. The briefing updates the original evidence briefing (EIN017) published in 2016. The notes are aimed at: policy makers, practitioners, practice enablers (including Natural England), local decision makers, and the wider research community. They highlight some of the implications for future policy, service delivery and research. It is intended that they will inform practitioner planning, targeting and rationales, but not the identification of solutions or design of interventions. Barriers to access or use of natural environments are not considered in this note. The notes consider evidence of relevance to the UK and outcomes for both adults and children. Please see EIN016 for methodology, glossary and evaluation resources.

Summary statement

For some time, there has been a substantial body of evidence supporting a positive association between engagement with the natural environment and a diverse range of learning processes and outcomes, including educational, social, developmental and health outcomes. Over the last 10-15 years, the quality of the research in this area and the robustness of the findings have significantly improved. There is now more evidence available on individual outcomes, how these are enabled, and on whether these outcomes are more likely to be delivered through learning outdoors, or through a combination of learning indoors and outdoors, than solely in the classroom. Evidence continues to suggest that a greater quantity of natural environments in or around the living or educational setting is associated with positive learning, behavioural and emotional processes and outcomes as well as health benefits. Most of the evidence continues to relate to children of school age. While a significant number of high quality studies and reviews have been carried out, there are still too many studies which are short term and relatively small scale, and which do not adjust for confounders and sources of bias. There is still a need for more focused evidence for particular population subgroups, outcomes, and delivery approaches, although this has improved since the original briefing was published.

Review of the evidence

What is the impact of learning in the natural environments on educational, social and developmental outcomes?

There is a substantial body of evidence, including several systematic reviews, which demonstrates positive associations between a number of teaching approaches and learning opportunities in the natural environment (including in the school grounds, Forest Schools, award schemes and immersive nature experiences) and a range of learning processes and outcomes (including motivation, attendance and achievement), but also wider social and psychological outcomes that may be linked to these particularly in the short term [1-14]. The majority of evidence regarding teaching and learning in natural environments comes from studies involving school children and their teachers.

Much of the evidence is drawn from small-scale studies with, in the case of the quantitative studies, little use of control groups or accounting for the multiple sources of potential bias [5]. This is invariably because they are evaluations of particular interventions rather than primarily research studies. Nevertheless, many of these studies have a sound theoretical base and use robust research techniques resulting in findings that may, in similar circumstances be generalisable. Together evidence has shown that:

With respect to outcomes:

- School students engaged in learning in natural environments have been found to have **higher achievement** (in comparison to their peers or projected attainment) in reading, mathematics, science and social studies, exhibiting enhanced progress in Physical Education and drama, and a greater motivation for studying science [1-10]. Longer term and 'progressive' experiences appear to result in the greatest benefits and children with below average achievement have tended to make progress in learning outcomes to the greatest degree [4].

- Regular exposure to education outside the classroom has been found to be associated with improvement in intrinsic **motivation** [7]. The results were independent of gender and socio-economic status. A German study found that education outside the classroom can support improvements in school motivation which could contribute to an improvement in children's mental health because many young people find being in school is stressful [8].

- A school-based learning programme taking place in the natural environment was associated with some improvements in attendance rates [22]. Further studies have found improved behaviour amongst children at a special needs school, sustained over two months, following learning in the natural environment [4].

- In both adults and children there is evidence that learning in natural environments is associated with the **accumulation of social capital and with fostering pride, belonging and involvement in the community** [4, 15]. A review of evidence relating to structured sustainability education taking place in the natural environment found it resulted in the promotion of a sense of community within and beyond the school [1].

With respect to approach:

- **Structured and progressive approaches** to supporting schools in developing their outdoor learning provision have been found to result in more positive outcomes, including enhanced learning, increased creativity and imagination, positive affect and excitement for future sessions [9]. Such approaches might begin with short teaching sessions for children leading up to workshops for teachers. Regular school- and curriculum-based outdoor education programmes may impact positively on social, academic, physical and psychological dimensions [9].

- Substantial numbers of studies suggest that the **role of connectedness with nature in the development of pro-environmental behaviour is key** [10]. Increased participation in nature-based environmental education has been found to be related to improved ecological behaviour where opportunities to connect to nature are provided. In one study, whereas 69% of the variance in behavioural improvement was explained by connectedness to nature, only 2% was explained by environmental knowledge [10].

- **Early-childhood environmental education**, in which nature-rich settings and experiences are key, emphasises play and movement. A systematic review of early-childhood studies found that environmental education supports young children's affective and cognitive growth [12].

- Attending Forest Kindergarten or Forest School is associated with more advanced motor skills [16, 17], higher rates of physical activity [18], positive play behaviours [19], a range of observed developmental outcomes [20] and states of good mental health [21] in children, which is likely to lead to improved attainment.

- Evaluation of the health benefits of the John Muir Award found participants developed more positive attitudes to physical activity (in the short term) [23].

What is the impact of natural spaces in or around the learning environment on learning and associated outcomes?'

Substantial evidence indicates a positive association between children's engagement with local natural spaces and a range of social and educational

outcomes. These spaces might be within school grounds, or they might be local gardens and other green spaces. A greater amount of natural space in or around the learning environment (i.e., the school) is associated with better emotional, behavioural and learning processes and outcomes. One possible explanation is that connectedness with nature plays a significant part in moderating learning and behavioural outcomes [12].

Overall, the evidence is mixed in terms of quality, while some studies account for confounding factors (such as socio-economic status), many have not. However, on balance, the quality of the evidence for these links is significantly stronger than it was when the original note was produced in 2016.

While there has been no systematic assessment of the importance of the type of environment on learning outcomes, there is some evidence that certain environments (such as forests or other wild spaces) do appear to afford beneficial experiences and outcomes:

- A review found that the specific use of **woods or forests** as settings was associated with the acquisition of academic, social and personal skills, increases in confidence and self-esteem, and improvements in physical skills [6].

- **Greener school environments** (such as the presence of natural features in the playground) have been linked with better motor skills [14], psychological restoration [27], and rates of physical activity [28].

- Evidence from Spain suggests that greater access to green and blue public spaces was positively associated with a range of behavioural indicators [24] and with cognitive development [25] in school children.

- Children who moved to homes with better access to natural environments tended to have higher levels of cognitive functioning than others who moved to areas with less access [26].

- There is some evidence of an association between high levels of ‘connectedness to nature’ in children aged 10-11 years and higher achievement in English examinations (though not for mathematics) [29]. Nature connection is important for children’s healthy social-emotional development [12].

What are the impacts of the use of natural environments for learning on inequalities, socio-demographic, gender and other factors?

We know little about the impacts of engaging with or learning in the natural environment on social inequality. There is some evidence that the most deprived children would appear to stand to gain the most, in terms of cognitive functioning, from an improvement in their surroundings.

- Children whose homes improved the most in terms of greenness following relocation also tended to have the highest levels of cognitive functioning following the move [51]. This finding suggests that the most deprived children stand to gain the most from an improvement in their surroundings.

- There is a disparity in who participates in learning in natural environments, with individual studies suggesting that children from poorer families, ethnic minorities, and those with low incomes in adulthood are less likely to have the opportunity to engage in learning in natural environments, potentially widening inequalities [1, 30, 34].

- Evidence suggests that targeted opportunities such as the John Muir Award may provide a route to wider participation for such groups [23].

Reviews of the literature suggest that the relationship between learning in and around natural spaces and learning and health outcomes do seem to differ according to socio-demographic characteristics such as gender, socio-economic status, and age [2]. Learning in natural environments may be of particular benefit to specific groups such as children suffering mental distress, those with low self-perceived social and personal skills [30], children on the autistic spectrum [3] and those with other special needs [4].

- A study of the use of forest environments in educational settings for boys aged 10-12 years suffering extreme mental trauma found increased levels of trust, exploratory activity and social cohesion [31].

- Use of educational adventure activities in natural environments as a tool to develop resilience in university students was found to be beneficial only for female students [32].

- The use of the natural environment as a setting to deliver formal school lessons (for children aged 6-11 years) was associated with (weak) positive impacts to the mental health of the boys taking part, however no impacts were detected in the girls [33].

- A review found evidence of the potential for school-based learning in natural environments to support the delivery of the curriculum, for wider personal, social and health education, and the development of social skills and wellbeing amongst autistic children [3].

A review of risky play did not find any consistent gender patterns in outcomes where those analyses were conducted [41]. A Danish experimental study of the physical activity outcomes of education outside the classroom found gender differences, with significant differences in rates of moderate to vigorous physical activity found for boys but not girls [46].

- One review found more positive associations with socio-emotional development in urban populations and children with psychological disorders such as ADHD [35]. They also found some evidence that factors such as sex, socioeconomic status and cultural background mediated outcomes.

- The quasi-experimental study of the prosocial behavioural outcomes of Danish education out of the classroom found lower SES students benefitted to a greater degree [45].

- The same study found that “a higher number of shorter EOtC (Education Outside the Classroom) sessions decreased the positive impacts of EOtC” [45].

What is the cost effectiveness of learning in natural environments?

There is currently very little evidence regarding the cost-effectiveness of learning in the natural environment [1].

What are the impacts of learning in and around natural environments on health outcomes?

The stronger association between various health and wellbeing outcomes in experimental studies of learning activities and interventions, as compared to more general neighbourhood exposure studies, suggest that the context and motivation for activity in natural environments may drive benefits [35].

Physical health

There appear to be relatively few studies which have considered the physical health benefits of participation in education in the outdoors and associated activities, fewer still which have been conducted using the types, designs and methodologies which allow us to be confident about likely generalisable impacts.

- One review identified just five studies, these related to Body Mass Index (BMI; a measure of adiposity) and psychophysiological stress in their expansive study, all of which were at serious risk of bias [14].

- In relation to BMI, whilst there was a reduction for a group undertaking adventure education, it was not significant in comparison to that of the control group [14].

Physical activity

Systematic reviews have shown some evidence that total time spent in the outdoors (including that accrued through the school day) is positively associated with higher levels of physical activity, in comparison to other settings, during childhood [36, 37]. Outdoor time has also been linked to other outcomes such as improved cardio-respiratory health [37].

There is evidence that outdoor activity in educational settings [13, 38], and specifically that resulting from ‘nature based activities’ in settings ranging from

school grounds to forests, are also associated with **higher rates of activity** than that of other settings [13].

- A review of experimental studies of nature-based activities, which included those in educational contexts (ranging from Forest School to outdoor adventure programmes), found some evidence of higher intensities of physical activity following nature-based activities in comparison to control settings in a small number of studies [35].

- A review of 'regular compulsory school- and curriculum-based outdoor education programmes' found only a very small number of studies (two, of moderate to low quality) which considered physical activity outcomes, both of which indicated positive impacts [6].

- A review of rates of physical activity during 'outdoor play' in early years settings found mixed evidence; with some studies finding participants were highly active, while others finding the children were predominantly sedentary [38]. A further review of unstructured nature play in early years settings found some evidence of positive impacts on physical activity outcomes, though the evidence was weak [39].

- The majority of the studies considered in a review of 'green exercise' in childhood (activities ranging from orienteering to walking) found no evidence of benefit in psychosocial or physiological outcomes over activity undertaken in other settings [40].

- A review of 'risky outdoor play' (e.g., activities involving climbing, contact with water or fire) in supportive environments (such as in an educational context or setting) found some evidence of a link with greater amounts of, and more intensive, physical activity [41]. However, the evidence base is inconsistent with some studies finding no effect.

- It has been suggested that outdoor play and activities, including those in educational settings, are linked with higher total amounts and intensities of activity through a number of pathways [42]. These include the greater affordances of more complex environments, children's motivation and interest to use the setting, and higher levels of reported 'fun' and enjoyment when taking part [42].

Mental health

There is some, though mixed, evidence that exposure to nature, including through various different pathways including educational activities, is positively associated with better mental health outcomes in children and teenagers [43, 44]. A review found that the most consistent relationships were found for resilience, stress and overall mental health [44]. However, findings were, on the whole, non-significant for other outcomes such as emotional well-being, self-esteem, and depression [44].

- A systemic review and synthesis of 'immersive nature experiences', which includes activities such as adventure therapy, outdoor residential experiences and education outside the classroom, found some evidence (typically of low quality) of improved participant self-esteem in comparison to control groups or conditions [14]. Similarly, immersive experiences were linked to increased self-efficacy, though again the quality of the evidence

was low. For all outcomes reported in one review, the studies included found no effect or change that was not significantly greater than that seen in a control group [14].

- The same review found mixed evidence of impacts to mood following participation in nature-based activities, with some positive outcomes following Forest School, but no evidence of effect for physical activity in nature [14].

- A further review concluded that there is 'emerging' evidence of positive impacts of nature-based learning on a range of mental health, wellbeing and social outcomes [13]. Currently there are few studies which have investigated mental health, wellbeing and social outcomes, and the existing evidence is heterogenous. This means there is low certainty in terms of the outcomes of specific activities and for specific populations [13].

- A review of regular compulsory school- and curriculum-based outdoor education programmes found just one study which had investigated mental health outcomes (parental reporting of psychiatric symptoms) resulting from participation [6]. A positive impact to primary aged boys' mental health, but not girls, was found.

- A non-randomised experimental study found significant increases in motivational regulation following a semester of education outside of the classroom [8].

Social, behavioural and developmental

There is some evidence that regular compulsory school- and curriculum-based outdoor education programmes, such as Forest School, are linked with more positive social competencies such as self-esteem, self-confidence, trusting relationships, and sense of belonging [6]. However, again, the evidence is mixed and subject to various sources of bias.

- A review of immersive nature experiences found some evidence of positive impacts to a range of social and behavioural outcomes, however, again, the evidence was considered to be weak [14].

- A review of experimental and exposure studies indicated that time spent in natural environments often as part of educational programmes is associated with some evidence of benefits to socio-emotional development [35]. The authors note, however, that the evidence is inconsistent and the quality of studies is poor.

- A quasi-experimental study found that, following education out of the classroom over a school year (Danish children aged 9-13 years), demonstrated greater improvements to pro-social behaviours over controls [45]. It also found no significant associations with alteration of emotional problems, hyperactivity-inattention, or peer problems [45].

Strengths and limitations of the evidence base

Unlike the research into learning outside the classroom and educational outcomes, the evidence base for health impacts is still relatively weak, with few study designs used that can identify causal relationships between education in the outdoors and relevant health outcomes [13, 37, 47]. Many studies are cross-sectional [14, 44]. There are wider methodological issues including small sample sizes, poor description of the activity and limited use of reliable and robust outcomes measures [13, 35]. Many of the studies that use experimental designs are at risk of some or serious sources of bias, such as not randomising allocation or inappropriate statistical tests (e.g., ones which do not take account of the potential for non-independence of the data) [14, 35]. The potential for publication bias in the literature has been noted by some reviewers [12, 35]. The potential for detection bias in relation to outcomes such as mood, physical wellbeing and stress has been noted [35]. This factor may partially account for the lack of clarity in the evidence base. Currently, the evidence is not of a scale to indicate the most effective nature based educational setting or activity for health outcomes [13, 44]. We do not have enough evidence to fully understand factors affecting outcomes for different populations including adults [6], people with disabilities, without employment or not in education [4].

Implications for policy, service delivery and research

Policy and service delivery

The weight of available evidence suggests that learning that takes place in the natural environment results in or is associated with a range of positive outcomes for school children, and should, therefore, be supported [1, 2, 4]. In some cases, the evidence suggests that learning in the natural environment is more effective than learning inside school [4] at least in the short term. The evidence for a positive impact on learning outcomes for adults is not as strong and this is a gap in the evidence base.

Embedding outdoor learning into teachers' practices has been facilitated when delivery was tailored to meet individual school needs, had senior leadership support, and was regularly monitored and evaluated [9]. Evidence from the Natural Connections project confirms that teachers' knowledge, confidence and skills are critical enablers of students' engagement with the natural environment [53].

Extra attention should be paid to supporting participation of those children from families with low incomes [30, 34] to ensure parity in opportunity to participate [3]. Natural environment learning providers and commissioners should continue to improve the participation of underrepresented groups, those with experience of

trauma, children who need less conventional learning settings and those who have greater developmental needs [23].

Planners and developers could further consider the role of greener living and educational settings on learning related outcomes. However, it should not be assumed that green spaces, including in school grounds, will be used unless appropriate to user needs and people are confident in their use [48]. The involvement of end-users in a design or modification phase would increase the likelihood that the space is appropriate for use as a learning context.

In the development of policies or delivery strategies, greater attention should be paid to clarifying and articulating how the use of the natural environment as a setting for learning is likely to be beneficial as this would help define the activity, anticipated outcomes and guide evaluative work [4, 49].

- In a Dutch study, teachers identified a number of barriers to integrating learning in the natural environment into their schools, including the lack of any formal status for learning outside the classroom in their teaching practice and their levels of confidence in teaching outdoors [50].

- In a Canadian study into teachers' experiences of barriers and supports for outdoor learning. Four interrelated themes were identified: 1) *Teacher characteristics*: interest/motivation to teach outdoors, preparedness, confidence in handling risks; 2) *Systemic factors*: principal support, school/district policies, funding/resources, curriculum, school schedule; 3) *Culture*: school culture, societal beliefs about education, family backgrounds; 4) *Environmental factors*: weather, built/natural environment, hazards [38].

- Continued engagement within the sector through strategic policy, practice and research hubs, focusing on learning in the natural environment, will facilitate the collation and sharing of existing research, the prioritisation of future research needs, and improvement in the alignment between policy, service delivery, practice and emerging research [30].

Research

COVID-19, and the measures brought in to minimise its spread, have increased our awareness of the value of engaging with the natural world. This realisation comes at a time when there is a growing consensus that education about the environment and sustainability is increasingly important for our future. The Government's strategy for sustainability and climate change education is likely to lead to a focus on improving school grounds supported by a climate leaders award. These initiatives will provide an opportunity for longitudinal research into the impact of national policy on environmental behaviours and improvements in the school estate and beyond.

While there is substantial evidence of the beneficial impact of learning and engaging with the natural environment on learning and health, there are still gaps in our knowledge. Some of these gaps reflect the challenges faced by researchers in identifying causality in complex educational situations.

Developing our understanding of structured and progressive support for change in schools would seem to be a priority for further research. The relative impacts of

leadership support, developing teachers' confidence and knowledge in terms of engaging with the natural environment appear to be critical in the efficacy of interventions.

The idea of connection with nature is increasingly being used as a tool to inform school based learning in natural environments. For more detail on the evidence around nature connection, please see the Natural England evidence note on Connection to Nature.

Not all engagement with the natural environment leads to more positive attitudes or pro-environment behaviours and we need to increase our understanding of why some people are more affected than others [52]. We also need to understand factors affecting outcomes for different populations including adults [6], people with disabilities, without employment or not in education [4].

Although much is known about short-term impacts, far less is known about longer term outcomes and this is an area that needs support from funders.

There is still a lack of research that looks at the impact of engagement with the natural environment on educational and health outcomes in the same study and the links between the two. At the moment, the two are treated as being independent whereas this is unlikely to be the case as it is widely accepted that education and health are intimately linked.

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