What Works in school based natural environment interventions: A scoping review

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"I feel at peace, and because just being outside calms me down…. I feel calm and I feel relaxed because it's like you don't have to worry about upcoming tests. You don't have to worry about problems you are having. You can just be outside enjoying the time you have out there."

Marissa, age 10, talking about being out in her greener school grounds (Chawla et al., 2014)

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Executive summary

Introduction

Children and young people in the UK face a number of health and wellbeing challenges. A recent survey indicated that one in eight 5-19-year olds had at least one mental health disorder in 2017, with rates increasing in the past 20 years (from 9.7% in 1999 to 11.2% in 2017) (Sadler et al., 2018). In 2014/15 a third of 10- to 11-year olds and over a fifth of four- to five-year olds were overweight or obese (Department of Health, 2016) and it is projected that by 2030 approximately 23% of 11-year-old boys overall, and almost a third of boys in the most deprived groups, will be obese (Viner et al., 2018). Children living in the poorest households experience the poorest health.

The need to focus on equitably improving children and young people's mental and physical health is clear. The school is one of the most important settings and mechanisms through which we can address the health and wellbeing of children and young people (Fazel et al., 2014). As a result, there is considerable interest in identifying effective interventions and intervention points and in understanding how educational cultures, practices and environments can be modified or used to support the equitable physical, social, cognitive, and academic development of children and young people (Weare and Nind, 2011, Durlak et al., 2011, Fazel et al., 2014, Vander Ploeg et al., 2014).

One approach is to use the natural environment as a setting or resource through which the health and wellbeing and academic development of children and young people can be promoted and protected.

Aims and approach

This report details the outcomes of a brief scoping review (peer reviewed but non-systematic with no assessment of the quality or reliability of the evidence). It was intended to contribute to the process of identifying 'what works' in the design and delivery of schools-based natural environment activities used to promote health, wellbeing and a number of other academic and environmental outcomes in children and young people. The review has a particular focus on mental health outcomes and on disadvantaged children and settings. Examples of the types of interventions considered include modifications to the environment of the school and its surroundings, the use of school grounds and local natural environments, or residential trips to more distant natural environments.

The aim of the report is to provide an initial indication of 'what works' for those involved in designing, funding and commissioning schools-based natural environment health interventions. The report is aimed at decision makers primarily in the educational, environment, and planning sectors who may need to know more about if and how schools based natural environment interventions work and could be delivered.

Extent of Nature Friendly Schools interventions activity

There appears to be little available information about the extent of key types of school based natural environment delivery in the UK. There is no comprehensive or regular survey of provision and uptake in the UK (Fiennes et al., 2015). Whilst some forms of provision, such as field studies centres, appear to be declining, other forms, such as Forest School are expanding.

Multiple studies suggest that teachers and school leaders have generally positive perceptions of the value of school based natural environment strategies and feel that they could and should be used more extensively (Rickinson et al., 2012, Rickinson et al., 2004, Dillon et al., 2005, Dillon and Dickie, 2012).

Extent of school based natural environment interventions evidence

Although there are significant bodies of evidence relating to specific types of school based natural environment interventions, such as adventure education, and in relation to the barriers and facilitators of delivery (Rickinson et al., 2012, Dillon et al., 2005, Kendall and Rodger, 2015), evidence relating to what works is patchy. As of yet we do not have a comprehensive understanding of the processes or impacts of the various different approaches or actions (Fiennes et al., 2015). We also do not have a clear understanding of what activities or actions would be most effective in achieving the outcomes of interest. Many of the programmes and activities are inherently complex, involving many different components such as teaching styles, inter-personal relationships, types and spaces of delivery. There is very little research of the type or quality which helps identify key contributors to success (or lack of).

What works in school based natural environment programmes

1. General school based natural environment programmes outcomes (non-aggregated by activity type or location)

There is evidence that outdoor learning (activity type not specified) is associated with increased academic progress and positive impacts to outcomes such as self-confidence and rates of physical activity.

2. Greener and greening of school grounds

The majority of the evidence regarding the benefits of greener school grounds relates to mental health and psychological, and to physical activity outcomes. The small body of evidence identified suggests that greenspaces in the school setting are associated with children and young people's psychological restoration and with some physical health and physical activity behaviours. The evidence relating to the effects of greening of the school grounds is mixed but with some positive impacts to physical activity behaviours.

3. School gardens and gardening

One systematic review was found relating to the health and wellbeing impacts of school gardens and gardening activities (Ohly et al., 2014). The limited available evidence suggests that there may be a number of positive impacts to mental health and psychological outcomes.

4. Greener community settings

The evidence of whether greener community settings relates to positive health, educational and environmental outcomes originates predominantly from the United States of America and, while it is mixed, does suggests that greater amounts of certain types of natural environment (typically trees) in the community setting of schools is associated with higher academic achievement.

5. Offsite experiences in local natural environments

The evidence suggests that regular use of local natural environments is associated with a number of positive mental health, wellbeing and psychological outcomes, and with increases in physical

activity. There is also evidence that activities such as Forest School may have positive impacts on behaviour, particularly for children with pre-existing behavioural difficulties.

6. Residential programmes

Although mixed, there is some limited evidence of a number of positive impacts to mental health and wellbeing associated with school based residential trips to natural environments including increases in resilience and capacity to face challenges, improved relationships and enhanced social skills. There is also some evidence of increases in student motivation to learn associated with residential experiences and connection to nature.

Perceptions and experiences

In general, children and young people appear to have positive perceptions of school based natural environment interventions:

"It feels like it is the only time I can be alone and at peace without anything to bother me. I just forget everything and relax and just think happy thoughts and rest for a while…. When I am inside and all that, it's like all the work is hitting me and I have a lot to worry about." Michael, age 9, discussing greener areas in his school's grounds (Chawla et al., 2014).

The impacts for disadvantaged and hard to reach groups

The current evidence suggests that Nature Friendly Schools activities can be of particular benefit to disadvantaged and hard to reach groups, as well as for children and young people with mental health or behavioural challenges.

Key pathways to benefit

While very little of the available research is able to provide evidence of cause and effect, some studies do provide some understanding of likely 'active ingredients' in school based natural environment strategies, some of which relate to more extensive and robust evidence of what works in schools based mental health promotion strategies (Fazel et al., 2014). Key pathways include:

- Forming positive peer and adult-child relationships (Richmond et al., 2018).
- The different environments and approaches to learning may help children and young people develop self-efficacy (Chawla et al., 2014), new and different skill sets (Richmond et al., 2018), and feelings of competence (Chawla et al., 2014). This additional skills development may impact wider academic achievement (Durlak et al., 2010).
- Giving children a 'break' from place based stresses and anxiety, from normal routines, from digital technology (Richmond et al., 2018).
- The development of non-cognitive skills such as resilience and perseverance.
- Facilitating increased opportunities for, higher intensities of, and more varied forms of physical activity which allow children to develop new physical competencies (Dyment et al., 2009, Fjortoft, 2001, Fjortoft, 2000).
- Allowing children to take part in 'risky play' (Brussoni et al., 2015).
- Providing opportunities to develop independence and leadership capabilities as a result of taking on new roles (Richmond et al., 2018).

- Contributing to development of supportive school cultures (Chowdry et al., 2010, Dyment et al., 2009) relating to the development of a sense of belonging and a supportive academic community (Richmond et al., 2018).
- Improved environmental quality of the school (Dadvand et al., 2015) and contributing to the children and young people's quality of life.

Using broader evidence to understand benefits and pathways

Although the evidence of effectiveness of school based natural environment strategies is limited, wider bodies of high-level evidence (systematic reviews, reviews of reviews, meta-analyses) can be used to help understand the evidential backing for some of the key pathways theoretically linking school based natural environment activities and approaches to the key outcomes. Such evidence suggests that many, but not all, of the key pathways identified are plausible.

Design and delivery of interventions

There are a number of design and delivery factors which are linked to positive outcomes. These include:

- Clarity in the approach and intentions of the school based natural environment intervention.
- Involving children and young people in the development and design of school based natural environment interventions (Foster, 2006, Dyment and Bell, 2007, Viner, 2017). Children and young people's involvement in the greening of school grounds, especially those intended for informal and play uses, appears to be of particular value.
- Progressive experiences where children and young people are able to take an active role appears to be an important approach to achieve sustained outcomes (Kendall and Rodger, 2015, Richmond et al., 2018).
- Building up to and then building on the natural environment activities through the school's wider educational delivery.
- Linking the 'offer' (i.e. the activities) and the anticipated outcomes to teacher and school leaders' priorities (Dillon et al., 2005).
- Mitigating the potential of natural environment activities on teacher's workloads is likely to be important in both embedding the practice and in achieving positive sustained outcomes (Dillon, 2010).
- Supporting teachers and leaders to develop the skills and competencies necessary to bring about the desired change (Durlak et al., 2010).
- Working with the wider community, including the families and carers of the children and young people.

Ensuring that the experience avoids unnecessary risk and is not detrimental to student's wellbeing, welfare or academic progress is fundamentally important (Dillon, 2010). Some studies have indicated that poor peer relationships can influence the outcomes of activities, some children resist the aims and processes of the programmes, and others may be fearful or feel unsafe (Sammet, 2010, Whittington and Budbill, 2013). Involving children in the design of the activities, or potentially giving them some choice in participation, may help to mitigate concerns (Christie et al., 2014).

Following best practice in the targeting of interventions and identification of populations of interest is crucial for mental health interventions. Furthermore, providers should be aware of the highly

complex ethical considerations of mental health and behavioural interventions in the school setting (Fazel et al., 2014).

School based natural environment intervention evidence needs

A more comprehensive set of synthesis studies which aim to critically examine the existing evidence and to help identify and un-pick the relative and contextual importance of the 'active ingredients' of school based natural environment programmes is needed. The collection of consistent data about the type, extent and reach of school based natural environment activity would help track progress of efforts to promote the approach and ensure equity of engagement (Dyment and Bell, 2008).

In addition, further primary studies using appropriate, robust and reliable methods are needed to explore the following questions:

1. How to best equip teachers with the knowledge and skills to undertake outdoor learning (Dillon, 2010).
2. Clarifying the 'dose' in terms of frequency, duration and intensity of school based natural environment activities that is needed to bring about positive outcomes.
3. The longer term impacts of school based natural environment activities, potentially achieved through greater use of longitudinal designs (Tillmann et al., 2018).
4. The potential for and ways in which school based natural environment activities and leaders may instigate pro-environmental behaviours and actions in young people (Prince, 2017).
5. How to ensure equity of experience and benefit (Mitchell and Shaw, undated).
6. The experiences of marginalised groups such as learning disabled children (von Benzon, 2011).

Conclusions

The evidence indicates that the key school based natural environment activities or exposures are linked to a range of positive outcomes, with particular benefits for disadvantaged children and young people, and for those suffering with health or behavioural issues. One of the strongest arguments for many forms of schools based natural environment activity is the potential for co-benefits. The greening of school grounds, for instance, has the potential to impact on the health and wellbeing and environmental attitudes of children and young people through several concurrent pathways.

Currently, however, our understanding of what works is limited by a patchy evidence base, a high percentage of lower quality studies with a reliance on self-reported or teacher assessed outcomes, and little understanding of how programmes do, or do not, work. The challenge now is how to use the existing evidence base to design robust interventions which are equitable in outcome and which complement and build on wider classroom-based learning so as to ensure sustained outcomes.

Schools have an increasingly important role in facilitating children and young people's knowledge of and contact with different natural environments. Similarly, schools are of crucial importance in promoting mental health in children and young people. Schools based natural environment activities, if well designed and ethically and fairly implemented, have the potential to meet both these aims.

1. Introduction

This report details the outcomes of brief scoping review (non-systematic with no assessment of the quality or reliability of the evidence) which is intended to contribute to the process of identifying 'what works' regarding the design and delivery of schools-based activities which facilitate contact with the natural environment and which are used to promote health, wellbeing and a number of other academic and environmental outcomes in children and young people. The review has a particular focus on mental health outcomes and on disadvantaged children and settings. Examples of the types of interventions considered include modifications to the environment of the school and its surroundings, or the use of school grounds, local natural environments, or residential trips to natural environments to deliver interventions.

The aims of the report are to provide an initial indication of 'what works' for those involved in designing, funding and commissioning schools-based natural environment health interventions. The report is aimed at decision makers primarily in the educational, environment, and planning sectors who may need to know more about if and how schools based natural environment interventions work.

1.1. Children and young people's health and wellbeing

Children and young people in the UK face a number of health and wellbeing challenges. The English *Mental Health of Children and Young People* survey highlighted the prevalence of mental health disorders amongst children and young people aged 5 to 19 (Sadler et al., 2018). The survey found that:

- One in eight 5-19-year olds had at least one mental health disorder in 2017, with rates increasing in the past 20 years (from 9.7% in 1999 to 11.2% in 2017).
- The number of children with emotional disorders has increased from 4.3% in 1999 to 5.8% in 2017.
- Older children and young people are more likely to suffer from poor mental health than younger children (however, comparisons are limited in that data was collected differently between the age groups): 5.5% of 2-4 year old children had poor mental health, 9.5% of 5-10-year olds, 14.4% of 11-16-year olds and 16.9% of 17-19-year olds. Nearly a quarter (23.9%) of girls aged 17-19 had a mental disorder in 2017.
- In primary and secondary aged children behavioural and emotional disorders were most common (primary ages 5.0% and 4.1% respectively, and secondary 9.0% and 6.2% respectively). In adolescence emotional disorders are still most prevalent (14.9%) but anxiety disorders are also common (13.1%).
- There are gender differences in prevalence of poor mental health. At primary school age boys are more likely to suffer from emotional disorders (4.6%, 3.6%), by secondary school girls were more likely to suffer from emotional disorders (10.9%, 7.1%).
- Young people who identify as lesbian, gay, bisexual or as another sexual identity are more likely to have poor mental health; 34.9% in comparison to 13.2% who identified as heterosexual.
- Rates of poor mental health also vary according to ethnicity, with those who identified as white having the poorest mental health, and according to socio-economic status, with children living in the poorest households having the poorest mental health.

- Poor mental health is associated with parent's mental health and family functioning, adverse life events, and with levels of social support.
- Children and young people with poor mental health are also more likely to suffer from a physical health condition (71.7%).
- Children and young people with poor mental health are more likely to be excluded from school (6.8%) in comparison to children without a disorder (0.8%).

Mental health is, as Fazel et al (2014) noted, related to a number of other health challenges faced by children and young people. In 2014/15 a third of 10- to 11-year olds and over a fifth of four- to five-year olds were overweight or obese (Department of Health and Social Care, 2016). It is projected that by 2030 approximately 23% of 11-year-old boys overall, and almost a third of boys in the most deprived groups, will be obese (Viner et al., 2018). Development of obesity in childhood is associated with an increased risk of cardio-vascular disease, cancer and poor mental health in adulthood (Viner et al., 2018). Approximately 28% of children and young people in England have a long-term condition that is serious enough to require medical intervention and approximately six percent have a recognised disability (Viner et al., 2018). The wellbeing and life satisfaction of children in England is, according to one of the few comparable data sources, consistently lower than the average for European nations (Viner et al., 2018).

The burden of poor health in children and young people falls disproportionality on more socio-economically deprived groups (Viner, 2017). The *State of Child Health Report 2017* found that across every health indicator considered, bar one, deprived children and young people had significantly worse outcomes than less deprived children and young people (Viner, 2017). There are also significant inequalities in educational outcomes according to socio-economic status, with the most deprived group, at key stage four[1], being around 19.2 months behind their peers (Andrews et al., 2017).

The causes of poor health and wellbeing, and delayed educational development, in children and young people are complex and relate to the socio-economic, structural, cultural and physical environments and conditions in which they and their families and carers live, as well as to behaviours, attitudes and activities (Kelly and Russo, 2018). Factors such as low levels of physical activity are risk factors for poor health outcomes in children and young people. A recent systematic review found that children under the age of 12 years were sedentary for between 41% and 51% of their time outside of school, rising to 57% amongst adolescents (Arundell et al., 2016). Inequalities in health outcomes for children and young people are a result of poverty and multiple socio-economic and environmental disadvantage. Poor mental health is linked to shifts in the patterns of children's lives as well as to their relationships with peers, families and communities, and has been linked to social media and screen time. The pressure to achieve academically has also been linked to the increasing rates of stress.

1.2. Improving children and young people's health and wellbeing

The need to focus on equitably improving children and young people's mental and physical health is clear. As a result, there is considerable interest in identifying effective interventions and intervention points. The school is one of the most important settings and mechanisms through which we can address the health and wellbeing of children and young people.

[1] See Appendix 2 for details on school age and grade systems

Children spend more time in school than in any other formal institutional structure. As such, schools play a key part in children's development, from peer relationships and social interactions to academic attainment and cognitive progress, emotional control and behavioural expectations, and physical and moral development. All these areas are reciprocally affected by mental health. (Fazel et al., 2014).

Recognition of the school as a fundamentally important context and mechanism through which to address children and young people's mental and physical health goes back as far as Plato (Fazel et al., 2014). More recently we have sought to understand how educational cultures, practices and environments can be modified or used to promote health and wellbeing and to support the social, cognitive, and academic development of children and young people (Weare and Nind, 2011, Durlak et al., 2011, Fazel et al., 2014), as well as the development of important health behaviours (Hills et al., 2015, Telama et al., 2014) and the reduction of inequalities in health (Vander Ploeg et al., 2014).

Poor mental and physical health in children and young people places a significant cost burden on the education system (Snell et al., 2013), conversely the benefits of improving health and wellbeing and educational outcomes are multiple. Children and young people with higher levels of wellbeing tend to achieve better outcomes including their exam results, have better attendance and are less likely to drop out (Weare, 2015). Social and emotional skills are a better predictor of exam success than IQ scores and school effectiveness is positively correlated with the attention paid by the school to promoting mental, social and emotional health (Weare, 2015). Children's wellbeing is strongly associated with educational achievement. Children with the highest levels of emotional, behavioural, social and school wellbeing have, on average, higher levels of academic achievement (Gutman and Vorhaus, 2012). Poor mental health, including depression, is associated with lower levels of school attendance (Finning et al., 2019).

There is now an extensive body of literature which has sought to identify effective school based health interventions (Fazel et al., 2014). One approach is to use the natural environment as a setting or resource through which the health and wellbeing of children and young people can be promoted and protected.

1.3. Promoting children and young people's health and wellbeing in schools using the natural environment

Key strategies in which the natural environment is used to promote and protect children and young people's physical and mental health, engagement with school and the natural environment may be direct and specific (i.e. interventions may be designed and delivered with the explicit intention of addressing these outcomes) or indirect (i.e. the outcomes may be a co-benefit of an intervention or activity delivered for another reason). Examples of key overarching school-based strategies using the natural environment include:

- Modifying the school setting to encourage or facilitate changes to behaviour, physical activities and so on.
- Using the natural environment (campus, local or more distant) as a setting for educational delivery with co-beneficial outcomes (e.g. mental health).
- Using the natural environment (campus, local or more distant) as a setting for delivery of specific targeted interventions (e.g. for mental health outcomes) delivered through the school.

- Modifying school culture, practices, attitudes and so on to encourage or facilitate use of natural environments for educational delivery or for specific targeted interventions.

Some school based natural environment strategies integrate established and well evidenced mental health promotion approaches such as cognitive behavioural therapy or social and emotional learning. However, beyond those formal and direct intervention approaches there are a number of ways in which school based natural environment strategies may influence the health and wellbeing of children and young people:

- Provision of opportunities for increased, or different forms of physical activity. Physical activity may be integrated into the wider learning process or a result of other actions.
- Opportunity to develop new and improved relationships with teachers and peers.
- Educational experiences away from the institutional setting of the school and the inherent norms and cultures of the classroom.
- Opportunity to learn about, develop and demonstrate different skills.
- Developing resilience and self-confidence through taking on challenging tasks.
- Hands on 'real-world' learning, grounding theoretical, abstract concepts.
- A fun, enjoyable experience.

There are few explicit models which have sought to clarify the theoretical or evidence pathways between school based natural environment strategies and anticipated benefits, particularly those relating to health. One useful example is Nielsen et al.'s (2016) models of impacts of education outside the classroom on pupils' physical activity, wellbeing and learning (Figure 1).

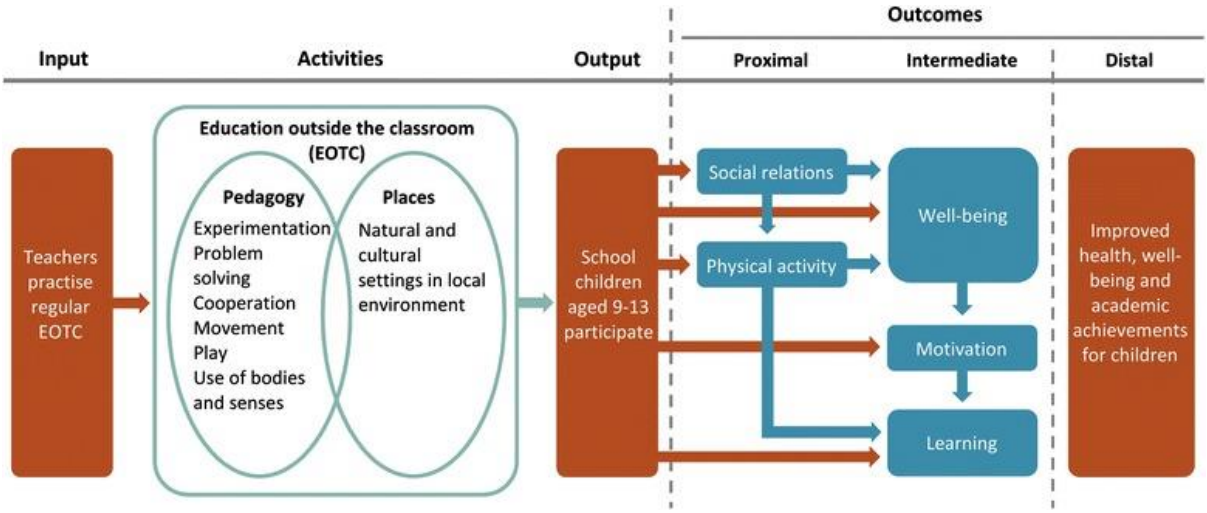

Figure 1. Nielsen et al.'s (2016) programme theory of potential effects of education outside of the classroom (EOTC), programme elements and potential outcomes

One of the key pathways is the role the school has in facilitating regular equitable access to and use of natural environments for children and young people. A growing body of disparate and heterogeneous evidence indicates that the natural environment is an important determinant of children and young people's health, wellbeing, development and quality of life (Tillmann et al., 2018, Chawla, 2015, Christian et al., 2015, Twohig-Bennett and Jones, 2018, Kabisch et al., 2016, McCracken et al., 2016, Markevych et al., 2014). A systematic review of recent research (2012-2017) found consistent evidence that exposure and access to greenspace is positively associated with children's (aged 0-18 years) mental and physical health and with their cognitive development (McCormick, 2017). Specifically, access to higher quality spaces (usually assessed by distance from

home residence) are associated with greater general wellbeing, fewer emotional and behavioural difficulties, and more positive peer-relationships, while poor access (e.g. greater distance to greenspace from the home residence) is associated with poorer mental and general health. Play in the outdoors affords children opportunities to develop physical as well as social and emotional skills (Waite, 2013, Waite et al., 2013). Exposure to natural environments, including those in and around the school, during childhood may also have implications for adult health and behaviours (Cherrie et al., 2018).

Despite this evidence of benefit there is a concern that children and young people's opportunities for contact with the natural environment are increasingly constrained and limited (O'Brien and Murray, 2007). Many children and young people are growing up in over-crowded housing without access to quality natural environment-based play and sports opportunities outside school. The evidence is mixed, but in England people living in the most deprived areas of cities such as Bristol report poorer perceived accessibility, poorer safety, and less frequent use of available natural environments (Jones et al., 2009, Ferguson et al., 2018). Even where provision may be adequate there is a perception that children are increasingly constrained in their ability to make use of local natural environments (Skår and Krogh, 2009). Limiting factors include traffic, parental concerns, and pressures on children and their families' time. Whilst the Monitor of Engagement with the Natural Environment pilot indicator of visits to the natural environment by children shows that, in general, most children are regularly visiting the natural environment (Natural England, 2015) there is significant variation according to ethnicity and socio-economic status. Approximately just 56% of children in Black, Asian and Minority Ethnic (BAME) households and 64% of children from lower income households (socio-economic groups D and E) visit at least once a week. Facilitating schools, particularly those in more deprived areas, to use natural environments could help address inequalities in access and experience and, therefore, the benefits gained through exposure.

Promoting and supporting the use of the natural environment through the school may result in both short-term impacts relating to children and young people's mental and physical health but also in longer-term impacts to adult health. For instance, the availability of natural environments has been linked to higher rates of physical activity in children and young people (Sanders et al., 2015, Wheeler et al., 2010). Adequate physical activity in childhood and adolescence contributes to preventing conditions across the life course including childhood asthma and reduced incidences of depression and anxiety, certain cancers, decreases in cardio-vascular and all-cause mortality in adulthood and is linked to good bone mass, muscle strength, balance and endurance (Lee et al., 2012). This is partly through reducing risk factors but also because physical activity behaviours and habits developed in childhood track through to adulthood (Telama et al., 2014, Hills et al., 2015). The provision of good quality, well designed and maintained natural environments in and around schools may overcome some of the issues with wider community provision and with other constraints previously mentioned, on use to positively influence children and young people's rates of physical activity (Soderstrom et al., 2013) and may influence adult perceptions and choices regarding the natural environment as a setting for activity (Ward Thompson et al., 2008, Broom, 2017, Asah et al., 2011).

2. Background to the What Works scoping review

The aim of this scoping review was to support the delivery of the three objectives of the Defra Children and Nature policy delivery programme and, more specifically, to identify and synthesise existing evidence to inform the Nature Friendly Schools project. The review will also support the design of a robust Nature Friendly Schools project impact and process evaluation.

2.1. The 'Children and Nature' policy delivery programme

The 25 Year Plan for the Environment sets out the Government's key ambitions relating to children's contact and engagement with the natural world (HM Government, 2018). The plan aims to encourage *'children to be close to nature, in and out of school'*. To achieve this the 'Children and Nature' policy delivery programme was developed. The Programme aims to *'achieve an increase in children's participation in high quality activities in nature, to support improved mental health and wellbeing, engagement with school and other programme outcomes. The programme will work in particular with schools and pupils experiencing high levels of disadvantage, as well as care farms and community forests. It seeks to improve understanding of the effectiveness of interventions in nature'*.

Three key projects have been identified and funded:

1. Community Forest outreach programme
2. Care Farming programme
3. Nature Friendly Schools programme

2.2. The Nature Friendly Schools programme

The Nature Friendly Schools programme aims to demonstrate and understand how an increase in supported delivery of high-quality activities in natural environments for pupils in schools with the highest proportion of disadvantaged pupils contributes to improved mental health and wellbeing, engagement with school and other key programme outcomes. The project will begin in December 2018 and will be completed in August 2022 with the evaluations completed March 2023. Approximately 500 schools will be supported.

The programme has three objectives:

Objective 1: To support approximately 500 target schools to establish either greener school grounds or to deliver a programme of progressive regular off-site visits in natural environments.

Objective 2: To enable school staff to deliver the quality and range of activities needed to support delivery of benefits for children's mental health & wellbeing, their engagement with learning and other programme outcomes.

Objective 3: To gather evidence to complete project monitoring and project reporting and to support programme evaluation (12 month follow up). The evaluation will prioritize the use of qualitative methods but will integrate a robust quantitative element to assess impact.

Key Nature Friendly Schools programme features:

- **Supported delivery** – enable staff to deliver quality and range of activities needed to achieve positive outcomes, ideally whole school approaches though single class/group of interest. Developing staff confidence, expertise and experience via continuing professional

development and other forms of support. Sharing best practice from across education, health and environment sectors. Establishing networks of support for those involved in design and delivery.
- **High quality activities.**
- **Contact with the natural environment** – greener school grounds or 'progressive' off site visits to natural environments including residential stays.
- **Disadvantaged children** – focus on primary schools with the highest proportion of Pupil Premium pupils, but also working with secondary and special schools and all Alternative Provision institutions.
- **Two main outcomes:** Improved mental wellbeing and school engagement.
- **Four key additional outcomes**: behaviour, attendance, physical health and care and concern for the environment.

The programme is designed so that there is a period of iterative project development with ongoing learning and a short phase for testing evaluation approaches and tools (anticipated June/July 2019). Baseline data will be collected prior to commencement of delivery.

2.3. Scoping review aims and approach

This scoping review aimed to address the following question: What works in delivering nature-based interventions and activities in schools in disadvantaged areas, in particular through improving school grounds and visits to natural environments, in order to improve mental health and wellbeing, school engagement and other key outcomes?

The present review focused on gathering evidence of what works in relation to the three Nature Friendly Schools objectives and key programme components:

1. Supported delivery.
2. High quality activities which facilitate contact with the natural environment including:
    - Modifying the school setting to encourage or facilitate changes to behaviour etc.
    - Using the natural environment (campus, local or more distant) as a setting for educational delivery with co-beneficial outcomes (e.g. mental health).
    - Using the natural environment (campus, local or more distant) as a setting for delivery of specific targeted interventions (e.g. for mental health outcomes) delivered through the school.
    - Modifying school culture, practices, attitudes and so on to encourage or facilitate use of natural environments for educational delivery or for specific targeted interventions.
3. Disadvantaged children and settings.

The review aimed to identify examples of school based natural environment activities which have been demonstrated to, or which have the potential to deliver the key primary and secondary outcomes. The primary outcomes of interest were:

1. improved mental wellbeing
2. engagement with school

Secondary outcomes of interested were:

1. improved behaviour
2. attendance
3. physical health

4. care and concern for the environment

2.4. Review design and methods

A non-systematic scoping review of published and grey literature evidence was used to provide an initial assessment of what is known about the process and impacts of nature-based interventions and activities in schools. Evidence relating to the key programme components (as above) was prioritised. Evidence relating to the impact of factors such as multi-component activities, targeting, activity scale and approach, and activity context and setting on outcomes, was also sought. The review also considers the systems, structures and processes which support school based natural environment activities and sought to identify what is needed for the adoption of activities at scale, highlighting barriers and challenges to successful delivery.

The review has not sought to be exhaustive but instead aims to describe the extent and nature of the variety and range of current evidence of 'what works'. The review focuses on current or recent (e.g. previous 10 years) evidence and practice within the UK so as to not duplicate the extensive reviews by others (Rickinson et al., 2004). Evidence and practice from elsewhere in the world was included if it was considered to be relevant to the UK context. Techniques common to rapid evidence review methodologies were used to identify evidence. Due to the resources available for the review a combination of targeted searches (i.e. focusing on specific interventions and/or populations) and iterative approaches (for example searching existing evidence reviews) was used.

The limitations of the review are highlighted and should be borne in mind while reading the findings. The review was conducted by one researcher over a three-month period. The quality or reliability of the evidence identified and included has not been assessed, this is a significant limitation of the review.

3. Extent of school based natural environment activity

There appears to be little available information about the extent of the four key types of school based natural environment health intervention strategies[2] in the UK.

During their review of the outdoor learning Fiennes et al. (2015) found:

- That there is no comprehensive or regular survey of provision and uptake in the UK.
- Several studies showing falls in the use of resources such as Field Studies Centres since the 1960s and 70s for geography and biology.
- Less than half the South London schools surveyed using local greenspaces for science education and only one for a residential trip.
- Significant variation in provision within and between Local Authority areas.

In 2004 Rickinson et al. (2004) reported a perception that the teaching of science outside of the classroom was '*heading for extinction'*. Recent news reports suggest that constrained Local Authority budgets have meant the ongoing reduction of opportunity with the closure of local field studies centres and other resources (BBC News, 2014). However, there is evidence that other provision such as Forest School and visits to open or 'care' farms appears to be expanding (Brooks, 2018, Bragg et al., 2014).

Many organisations are involved in trying to expand provision of school based natural environment activities. Organisations such as the Royal Society for Protection of Birds offer free taster sessions for schools on its reserves, the Royal Horticultural society runs a Campaign for School gardening, and the London Mayor has made £300,000 available to help improve air quality through school greening programmes (Greater London Authority, 2018). The types of actions the Mayor's fund will support include:

- installing a green screen (for example ivy), or barrier hedge around the perimeter of the school rounds;
- planting trees, shrubs and planters within the school grounds to capture emissions;
- making a green gateway on the approaches to the school, including planting on the footway or highway buildouts; and
- creating a pocket park on space reclaimed from roads around the school.

Many schools, even the smallest with the least outdoor space, are finding ways in which to integrate the natural environment into their spaces, to green their grounds, and to take learning outdoors. Soho Primary, a tiny London school with very little outdoor space, installed a two metres squared green roof planted with a variety of species, five raised beds, a cold frame filled with compost for a gardening club, a composting wormery fed with waste from the school kitchen, and bird nesting boxes, a pollinating bee log and an insect tower[3].

[2] The four intervention types are:

- Modifying the school setting to encourage or facilitate changes to behaviour etc.
- Using the natural environment (campus, local or more distant) as a setting for educational delivery with co-beneficial outcomes (e.g. mental health)
- Using the natural environment (campus, local or more distant) as a setting for delivery of specific targeted interventions (e.g. for mental health outcomes) delivered through the school
- Modifying school culture, practices, attitudes and so on to encourage or facilitate use of natural environments for educational delivery or for specific targeted intervention

[3] http://www.betterbuildingspartnership.co.uk/shaftesbury%E2%80%99s-wild-west-end-greening-soho-school

Rickinson et al. (2012) conducted qualitative work with 38 teachers and school leaders in primary, secondary and special schools with differing provision of outdoor learning and found that whilst there was very little use of local green space beyond the school grounds, most schools have developed or were developing outdoor learning programmes using school grounds. Similarly, most were undertaking day or residential trips to more 'distant' outdoor sites. Earlier research by Dillon (2010) showed that while 97% of teachers believed that '*schools need to use outside spaces effectively to enhance their pupils' development'*, 82% did not agree that their school was making '*as much use as it can of this valuable resource'*. Rickinson et al. (2012) found differences between how primary and secondary schools used outdoor settings, with primary schools using natural environments, including gardens, nature trails and outdoor classrooms, to deliver many elements of the curriculum. Secondary schools' uses related more often to delivery of Physical Education and more specific elements of the curriculum such as Science. Rickinson et al. (2012) also found significant variation in delivery between areas, this was related to local factors including school leadership, teacher confidence and school contexts.

Rickinson et al. (2012) found enthusiasm for outdoor learning amongst the teachers and school leaders they surveyed. The teachers had different reasons and justifications for providing opportunities, including helping children develop a broader world view, raising children's aspirations, helping them experience other types of environments and giving them (the teachers) greater variety through which to deliver the curriculum. There was a perception that outdoor learning was of particular importance in special schools and for children with additional learning needs.

4. Extent of school based natural environment interventions evidence

Evidence relating to what works in school based natural environment interventions is patchy; as of yet we do not have a comprehensive understanding of the processes or impacts of the various different approaches or actions (Fiennes et al., 2015). However, there are significant bodies of evidence relating to specific types of school based natural environment interventions such as adventure education in natural environments. The majority of this evidence appears to be small scale individual studies, including many PhD and MSc theses and dissertations and project evaluations.

There is relatively little evidence relating to the UK context, though the evidence base has been growing in recent years (Scrutton, 2015). Much of the available evidence relates to the United States of America and to other European nations.

A small number of reviews of different types of school based natural environment interventions was found. The majority of these reviews did not follow formal systematic review methodologies such as that promoted by the Campbell Collaboration[4]. The reviews identified include:

- A formal systematic review of 'outdoor education programmes' with a synthesis of outcomes across the 13 papers included (Becker et al., 2017b). The review included studies relating to:
    - Any type of formal school- and curriculum-based outdoor education programme involving children and adolescents (5–18 years); and
    - regular weekly or bi-weekly classes in a natural or cultural environment outside the classroom with at least four hours of compulsory educational activities per week over a period of at least two months.
- A formal mixed method systematic review of the health and wellbeing outcomes of school gardens and gardening (Ohly et al., 2016).
- A systematic mapping of the extent and nature, and summary review, of the existing evidence base (Fiennes et al., 2015).
- A review of 150 primary studies published between 1993 and 2003 of the impacts of 'outdoor learning' (fieldwork and outdoor visits, outdoor adventure education, schools' grounds and community projects) for primary and secondary learners (Rickinson et al., 2004).
- A review of structured outdoor-centred courses designed to develop group work (Cooley et al., 2015).
- Two meta-analyses of early studies of the impacts of adventure education and Outward Bound activities studies (Hattie et al., 1997;Cason and Gillis, 1994).
- A methodological (quantitative) review of papers published in two key outdoor adventure education and outdoor learning journals since 2000 (Scrutton and Beames, 2015).
- A 'systematic comparative' review of the British and Danish Forest School practice literature (Waite et al., 2016a).

[4] https://campbellcollaboration.org/ The Campbell Collaboration supports the production of evidence syntheses on topics including education. There is a specific Education sub-group https://campbellcollaboration.org/about-campbell/coordinating-groups/education.html

Whilst the evidence syntheses are useful, questions have been raised about the utility of pooling of heterogeneous activity types, which take place in many different environments, with a range of different populations. Such syntheses, unless findings are stratified according to these factors, are limited in their utility for unpicking the impacts of the environment etc. from other 'active ingredients'. Many of the programmes and activities are inherently complex, involving many different components such as teaching styles, inter-personal relationships, types and spaces of delivery. As of yet there is very little research of the type which helps identify what are key contributors to success (or lack of).

The paucity of formal evidence syntheses also means that our understanding of the quality and reliability of the evidence base is limited. The assessment of the quality of studies included in the review of outdoor education by Becker et al. (2017b) found that most of the primary quantitative studies meeting the inclusion criteria were of 'low' quality and most qualitative primary studies were 'moderate'. Similarly, Ohly et al. (2016) found that the majority of the quantitative studies included in their review of the health and wellbeing outcomes of school gardens and gardening were 'weak' and the majority of the qualitative evidence was also rated as 'weak' or 'moderate' quality. Although a formal assessment was outside the scope of this review, it appears the reliability of the evidence base is limited by a number of factors (Scrutton and Beames, 2015):

- Reliance on surveys of perceived outcomes and teacher/parent reported outcomes (Scrutton and Beames, 2015) and use of post-test and pre and post-test designs (Gustafsson et al., 2012).
- Lack of experimental studies and adequate controls, similarly few longitudinal studies tracing outcomes through and beyond school years (Fuller et al., 2017, Fiennes et al., 2015, Scrutton and Beames, 2015).
- Lack of robust analysis of outcomes data including pupil achievement (Scrutton and Beames, 2015).
- Poor reporting of the types of activities children undertake and environments to which they are exposed. This prevents a more meaningful exploration of what factors are important.
- Relatively little good quality qualitative research exploring children's perceptions, experiences and choices (McCormick, 2017).

There is a well-developed body of evidence relating to the barriers and facilitators of delivery including how external providers can work with schools, motivations of teachers, integration with the curriculum and the challenges of managing risk, competing priorities and the costs of outdoor learning (Rickinson et al., 2012, Dillon et al., 2005, Kendall and Rodger, 2015).

5. What works in school based natural environment programmes

The following sections review evidence of what works relating to the different school based natural environment programmes of activity. It is structured according to 'activity' type:

1. general (non-specific) school based natural environment programmes;
2. greener and greening of school grounds;
3. school gardens and gardening;
4. greener community settings;
5. offsite experiences in local natural environments; and
6. residential activities in natural environments.

Evidence relating to each of the key outcomes is then discussed:

1. mental health, wellbeing and psychological;
2. engagement with school, attendance and academic;
3. behavioural;
4. physical health and physical activity;
5. care and concern for the environment; and
6. in relation to participant experience and perceptions.

Each section has a summary of the evidence and examples of key studies relating to each outcome for which evidence was identified.

5.1. General school based natural environment programmes outcomes

This section reviews evidence where the exact nature of the activity was not specified.

The Educational Endowment Foundation and Sutton Trust (Educational Endowment Foundation and Sutton Trust, undated) assess outdoor adventure learning (defined as involving *'outdoor experiences, such as climbing or mountaineering; survival, ropes or assault courses; or outdoor sports, such as orienteering, sailing and canoeing'* their definition excludes activities with a formal educational components such as Forest School or field trips) as moderate impact. Their review found that participants typically make four months progress on their peers and that there is evidence of positive impacts to self-confidence (Educational Endowment Foundation and Sutton Trust, undated). There is evidence that many programmes can result in co-beneficial outcomes (Dillon et al., 2005).

Mental health, wellbeing and psychological

Nine studies relating to psycho-social outcomes were included in the systematic review of classes in outdoor settings by Becker et al. (2017b). The evidence indicated benefit to self-esteem, self-confidence, trust within relationships and to a sense of belonging.

A meta-analysis published 20 years ago found generally positive outcomes from outdoor learning experiences, some of which relate to the aims of Nature Friendly Schools (Hattie et al., 1997). Participation was positively associated with improved self-concept, locus of control, and leadership.

Engagement with school, attendance and academic

The pooled findings of a systematic review of any type of '*formal school- and curriculum-based outdoor education programme'* found evidence, from seven individual studies (rated moderate – low quality), of positive impacts to academic performance and motivations to learn (Becker et al., 2017b).

Behavioural

No evidence was found relating to this outcome[5].

[5] No evidence was found, this is not a statement that there is no evidence. This paper relates to a brief scoping review and must not be considered to be a true representation of the entire extent of the evidence base.

Physical health and physical activity

Several small scale studies have demonstrated that outdoor learning is associated with higher levels of physical activity in comparison to other settings (e.g. the normal school day) (Aronsson et al., 2014).

Care and concern for the environment

There is some evidence that school based natural environment activities are associated with short term positive outcomes relating to care and concern for the environment. Three of the studies included in the review by Becker et al. (2017b) reported positive impacts to children's environmental attitudes and behaviours. A fourth study reported negative impacts.

I learnt to respect nature because nature is you. When mucking about with nature, we found lots of things but put [them] back because an animal might not find [them] again. Primary school pupil (Dillon et al., 2005)

Teachers interviewed by Dillon et al. (2005) linked experiences to development of 'awe' and wonder of nature, suggesting the experiences were life enriching.

5.2. Greener and greening of school grounds

This section reviews evidence relating to actions taken to increase the extent, amount, and/or type of natural environments in the school grounds.

The majority of the evidence regarding the benefits of greening school grounds relates to mental health and psychological health, and to physical activity outcomes. The small body of evidence identified suggests that green spaces in the school setting are associated with children and young people's psychological restoration and with some physical health and physical activity behaviours. The evidence relating the effects of greening of the school grounds is mixed but with some positive impacts to physical activity behaviours.

Mental health, wellbeing and psychological

A number of studies have demonstrated that views to and use of greener school grounds have been linked to improved student mental wellbeing, attention restoration and recovery from stress (Li and Sullivan, 2016, van den Berg et al., 2016, Wallner et al., 2018).

An Austrian natural experimental study found some evidence of effect on mental health following a school yard greening programme (Kelz et al., 2013). The pre-and post-test design (n133 children, 13-15 years) compared the outcomes between pupils in the school undergoing the greening with those in two control schools. The greening of the school yard included increasing the number of pot plants and planting a hedge, in addition sporting facilities (table tennis, volleyball net and field, and soccer goals) were provided. Psychological wellbeing amongst the intervention school pupils improved in comparison to the pre-test assessments and was higher than for the pupils in the two control schools.

A Dutch school yard greening intervention study found no effect on restoration following break times immediately after the intervention was implemented (van Dijk-Wesselius et al., 2018). However, at the two year follow up children with access to the greened school yards showed greater improvement in restoration scores after a break in comparison to those in the control schools. No

effect was found for emotional functioning. Australian research found some evidence that the total volume of vegetation was associated with playtime restorativeness in a sample of 550 children (average age of 9.73 years) (Bagot et al., 2015). Akpinar (2016) found no association between high school campus greenness and any mental health outcomes.

Engagement with school, attendance and academic

The review of school grounds projects by (Rickinson et al., 2004) found evidence of improvements to understanding and process skills relating to Science and Design and Technology subjects.

Behavioural

There is some evidence to suggest that greener school grounds are associated with more positive behavioural outcomes (Mårtensson et al., 2009). Several studies have noted teachers' reports that children's focus and attention to the tasks they undertake in natural settings, many of which are self-directed at playtime, are 'uncharacteristic' and vary from usual behaviours in classrooms (Chawla et al., 2014, Mårtensson et al., 2009).

Physical health and physical activity

There is mixed evidence as to whether greener and the greening of schools' grounds are associated with physical health and higher levels of physical activity (Arbogast et al., 2009, Mårtensson et al., 2014).

A Dutch longitudinal prospective intervention design was used to evaluate the impacts of greening school yards on children (n700, aged 7-11 years) with a two-year follow-up (van Dijk-Wesselius et al., 2018). Five schools in urban areas (with varying residential density) were matched (according to urbanisation and parental socio-economic status) with four control schools. The school yards were greened by adding grassy areas, trees and bushes, loose tree branches and gardens. Assessments of physical activity before and after the intervention found that only the girls were more active with a greater effect immediately after the implementation. Research carried out in parallel in both Australia and Canada, using structured behavioural reporting systems, found greater amounts of moderate intensity physical activity in green spaces in comparison to other play spaces (such as open asphalt or courtyards) (Dyment et al., 2009). However, 'manufactured equipment' facilitated the greatest vigorous intensity physical activity.

There is evidence that children modify their play and activity behaviours after greening of a space (Jansson et al., 2014). Greener school grounds appear to facilitate exploratory behaviours, affording children opportunities to investigate a wider range of physical abilities than traditional play settings may allow (Chawla et al., 2014) and facilitate a wider range of play behaviours and types of activity (Dyment and Bell, 2007, Dyment and Bell, 2008).

A Swedish study assessed the relationship between the quality of outdoor areas of nine schools (environmental assessments included: i) total outdoor area, ii) number of trees, and amount of shrubbery and hilly terrain and iii) integration between vegetation, open areas and play structures) on the health and related risk factors of 132 children (aged 3-6 years) (Soderstrom et al., 2013). Higher quality outdoor school environments were, after controlling for confounding factors, associated with healthier body shape, better sleep patterns and higher wellbeing. The authors also found a correlation between higher quality environments and the length of time children stayed

outdoors. An Austrian study (a controlled pre-post-test design) found a positive impact of the greening of a school yard on blood pressure (Kelz et al., 2013).

A comparative study of absenteeism related to sickness found no significant difference between children (n531) who attended predominantly indoor day care centres with those who attended outdoor day care (Moen et al., 2007).

The culture of the school is an important determinant of whether or not greenspaces in school settings result in greater physical activity (Dyment et al., 2009). The use of natural spaces appears to vary according to age; one study found that while 96% of children in the first years of school used the woods for play, most of the students in Grade Six ignored the woodlands and used sports fields or hard cover playgrounds (Chawla et al., 2014). There is some evidence to suggest that spaces which are flexible with 'loose parts' (Dyment et al., 2009) and which balance spontaneous play with structured learning opportunities (Skar et al., 2016) are most effective in facilitating and encouraging physical activity. Finally, the culture of the school and within student groups was found to be an important mediator of whether or not green school grounds result in positive outcomes, particularly those outcomes which are dependent on active use such as physical activity by Dyment et al. (2009).

Experiences and perceptions

The quality and nature of the environments which are available to children appear to be influential on their health, wellbeing and behaviours (Soderstrom et al., 2013). Children value greener spaces (van den Berg et al., 2016, Persson et al., 2016, Jansson et al., 2014, Akoumianaki-Ioannidou et al., 2016) and express a preference to play in greener spaces (Lucas and Dyment, 2010)..

A Dutch school yard greening programme found higher likability ratings, especially amongst girls and younger children, for the outdoor spaces in the intervention schools in comparison to the control school yards (van Dijk-Wesselius et al., 2018).

Quality of the spaces is important and more strongly associated with satisfaction than quantity (McEachan et al., 2018). Certain types of natural environment features are important (Dyment and Bell, 2007): ponds and water (Chawla et al., 2014), diversity of types of spaces and habitats (Chawla et al., 2014, Dyment and Bell, 2007), woods (Chawla et al., 2014), insect and butterfly gardens (Chawla et al., 2014).

Chawla et al.'s (2014) ethnographic work across several settings in the USA provides rich explanatory data for why children and young people value natural features of the school grounds. For some children a wooded play area provided an escape and some privacy:

"When youre in class, its school – you cant relax, you have to work. But when you go to the woods, its a different place, and you can relax with your friends." (Tricia, 10)

Studies have suggested that natural spaces within the school setting provide a refuge for some children, allowing them to escape from pressures and problematic peer or student-teacher relationships, as well as to gain perspective.

"It feels like it is the only time I can be alone and at peace without anything to bother me. I just forget everything and relax and just think happy thoughts and rest for a while…. When I am inside and all that, its like all the work is hitting me and I have a lot to worry about." (Michael, nine) (Chawla et al., 2014).

The alternative educational experiences afforded by informal use or more structured classes in the greener school grounds (though presumably also in other community or more distant settings) appears to be of particular value for children who struggle with traditional settings and approaches. Chawla et al. (2014) illustrated this perception with a quote from a mother of severely dyslexic child,

"*So much is hard for her. This – being in the woods – isnt hard. She loves it*." and "*I think for her it levels the playing field*".

It is important to note that not all children will be attracted by more natural spaces (Jansson et al., 2014). Some children may just not be interested, others may be reluctant to get dirty or messy, and for some natural spaces don't provide a context in which they can undertake the types of activities they are most interested in (e.g. ball sports). Providing children with choice, particularly for more informal uses, such as playtime, is crucial. However, even for those children who define themselves as "*…just not a woodsy kind of person"* (Girl, no age. Chawla et al., 2014), appropriate introduction to natural environments can bring about a change in perspective and environmental self-identity.

5.3. School gardens and gardening

This section reviews evidence of the benefits of school gardens and gardening activities.

One systematic review was found relating to the health and wellbeing impacts of school gardens and gardening activities (Ohly et al., 2014). The available evidence, much of which is qualitative, indicates there are a number of positive impacts to mental health and psychological outcomes.

Mental health, wellbeing and psychological

Ohly et al.'s (2016) review included a number of studies which considered the impacts of gardening on quality of life, life skills and interpersonal relationships. None of the studies which used valid and reliable instruments to assess outcomes found any significant positive impact.

A study described as a 'pilot' intervention published in 2018 examined the impact of a school based therapeutic horticulture intervention for students experiencing behavioural, emotional and social difficulties (Chiumento et al., 2018). The intervention was designed around the Five Ways to Wellbeing model. Thirty-six children from two primaries (24 children aged 9-12 years) and one secondary (12 children aged 12-15) participated. Teachers identified children who had behavioural, emotional and social difficulties for participation. The Mental Wellbeing Impact Assessment tool, Wellbeing Check Cards and the seven-item Warwick-Edinburgh Mental Wellbeing Scale were used to assess wellbeing outcomes. Results were mixed, with no statistically significant change to wellbeing scores after participation. The authors suggest that without a control group it is not possible to know whether external factors, such as an imminent move to secondary school for some of the pupils, account for the lack of change. The qualitative results did, however, suggest some benefit, with positive impacts on 'feeling involved', 'having a valued role', 'sense of belonging' and 'social networks and relationships' (Chiumento et al., 2018).

Ohly et al.'s (2016) review of qualitative evidence showed that a range of perceived wellbeing impacts were attributed to participation in school gardening activities. Benefits included enjoyment and feelings of achievement, satisfaction and pride from nurturing and watching plants grow and the enjoyment of harvesting crops. The majority of the included qualitative studies described how school gardening allowed children, particularly those with learning difficulties, to grow in confidence and self-esteem,

A child who struggled and had learning disabilities … and just her confidence and her ability to outshine other kids, who have strengths in other areas was just amazing and she was just really comfortable, in her element. She knew exactly what she was doing, she was in control, she was starring while she was organising the other kids. The building of confidence was just amazing. – Teacher, primary school (Block et al., 2012).

School gardens, similarly to greener play areas, provide a refuge for some children, including those struggling with peer relationships,

"I like it because I know it all works together, just a big old complete cycle. It calms me down. It makes me feel relaxed, at ease. It reminds me of who I am, and I don't have to worry about anything else." Aaron, 17 (Chawla et al., 2014).

Engagement with school, attendance and academic

There is some evidence that experience of gardening in the school setting contributed to choices relating to higher education and careers later in the participating children's lives (Chawla et al., 2014).

Behavioural

No evidence was found relating to this outcome[6].

Physical health and physical activity

The systematic review by Ohly et al. (2016) found one study which reported statistically significant impacts of school gardening on diastolic blood pressure, with lower rates in the intervention group compared to the control group (both sets of readings were, however, within the normal range for children). A second study, which used a cluster randomised controlled trial, found that the gardening group reported less sedentary time and more moderate intensity activity than the control group.

The qualitative studies included in the systematic review by Ohly et al. (2016) highlighted the value teachers ascribed to school gardening activities in keeping children active, particularly for children who struggle to concentrate in the classroom.

Care and concern for the environment

No evidence was found relating to this outcome[7].

Experiences and perceptions

Gardening (alongside conservation activities to some degree) is considered to have value because of the direct involvement a child has with the natural environment. Chawla et al. (2014) argued that in comparison to other forms of school-based activities, such as science or geography lessons in the outdoors, where the emphasis is on leaving the environment as it was found and doing no damage, gardening requires children to activity engage with or to '*participate in nature's processes through*

[6] No evidence was found, this is not a statement that there is no evidence. This paper relates to a brief scoping review and must not be considered to be a true representation of the entire extent of the evidence base.
[7] No evidence was found, this is not a statement that there is no evidence. This paper relates to a brief scoping review and must not be considered to be a true representation of the entire extent of the evidence base.

caring actions'. The participants in their case study of school gardening for teenage mothers drew parallels between developing nurturing skills for babies with caring for a garden:

"It makes me feel good inside, all fresh, good… I enjoy touching the soil, the plants. You can feel them…I feel part of them…Yes, it makes me feel that I can care more about things… Being more gentle, caring more, the plants are like people." Natalie, 17 (Chawla et al., 2014).

The systematic review by Ohly et al. (2016) found some evidence that school gardens were associated with children's' self-reported willingness to taste fruit and vegetables.

5.4. Greener community settings

This section considers the impacts of greener community settings. Typically, there is no assumption as to whether the spaces beyond the school gate are used, instead the studies assess general exposure.

The evidence relates predominantly to the United States of America and is mixed but suggests that greener community settings for schools are associated with higher academic achievement.

Mental health, wellbeing and psychological

A controlled Spanish study found that greener school community settings were associated with higher ability to cope with stressful life events and lower overall rates of stress in 172 urban children (Corraliza et al., 2012).

Engagement with school, attendance and academic

Several studies, predominantly from the USA, have investigated whether the total and type of 'greenness' in the wider community setting of the school is associated with a number of academic outcomes (Wu et al., 2014, Tuen Veronica Leung et al., 2019). A study of Massachusetts public schools research found, after controlling for a number of socio-demographic and educational factors, a positive association between greater surrounding greenness (assessed using NDVI) and academic outcomes in English and Maths for 27,493 children (Levesque et al., 2013). The authors suggest that the established pathway between exposure to natural environments and stress reduction may partially account for the finding. A similar study by Matsuoka (2010) of 101 schools in Michigan, USA, also found positive associations between views of surrounding greenness and academic achievement and behaviour after controlling for school socio-economic status, ethnicity, enrolment and building age.

A replication of the Massachusetts study using data from Chicago, USA, found a small negative association, in that greater greenness was associated with poorer academic outcomes (Browning et al., 2018). Browning et al. (2018) suggest that limitations associated with how the environment of the school setting is assessed may be a factor in the negative findings. No association was found between greenspace around the school and academic performance in a sample (n1351) of 10-15 year old German students (Markevych et al., 2019).

Other studies have suggested a link between certain types of vegetation in the environment surrounding a school and academic outcomes. Hodson and Sander (2017) focused on the Twin Cities Metropolitan Area of Minnesota, USA, and while no association (after controlling for school socio-economic and demographic characteristics) was found for the presence of grass, shrub and water on maths and reading performance in the study population of third grade pupils, a positive link was

found between tree cover and reading performance. Analysis by Kweon et al. (2017) and Sivarajah et al. (2018) also found that a greater proportion of trees in the school environment was positively associated with academic performance. Both studies accounted for some socio-economic factors such as race, income and first-language.

Spanish research found that after controlling for key socio-economic and demographic factors, greater total amounts of green elements (assessed using NDVI) around the home and school, and along the commuting route to the school, was associated greater progress in indicators of working memory and superior working memory and greater reduction in inattentiveness over 12 months in a sample of 2,593 children aged 7-10 years (Dadvand et al., 2015). The authors attribute the finding to reduced exposure to poor air quality and noise, greater opportunities for 'green exercise' and the impacts of views of greenery on stress responses.

Behavioural

No evidence was found relating to this outcome[8].

Physical health and physical activity

No evidence was found relating to this outcome[9].

Care and concern for the environment

No evidence was found relating to this outcome[10].

5.5. Offsite experiences in local natural environments

This section considers the impacts of school-based visits to local natural environments, it is assumed these are non-residential.

The evidence, while mixed, suggests that regular use of local natural environments is associated with a number of positive mental health, wellbeing and psychological outcomes, and with increases in physical activity for some children and young people. There is also evidence that activities such as Forest School may have positive impacts on behaviours, particularly for children with pre-existing behavioural difficulties.

Mental health, wellbeing and psychological

Several studies have suggested that regular experiences in local natural environments, through programmes such as Forest School, have a number of beneficial outcomes to children's personal development (O'Brien and Murray, 2007, Beyer et al., 2015). Regular group experiences resulted in greater group cohesion, social connectedness and feelings of solidarity (Richmond et al., 2018).

[8] No evidence was found, this is not a statement that there is no evidence. This paper relates to a brief scoping review and must not be considered to be a true representation of the entire extent of the evidence base.
[9] No evidence was found, this is not a statement that there is no evidence. This paper relates to a brief scoping review and must not be considered to be a true representation of the entire extent of the evidence base.
[10] No evidence was found, this is not a statement that there is no evidence. This paper relates to a brief scoping review and must not be considered to be a true representation of the entire extent of the evidence base.

Being 'away' distanced participants from the stress and anxiety embedded within the formal education context and even from those associated with the home (Richmond et al., 2018).

A Swedish study using a quasi-experimental non-equivalent groups design evaluated the impacts of outdoor education in the local community on the mental health of 230 children aged 6-11 years (Gustafsson et al., 2012). The participating children were taught in the outdoors for at least one hour per day using elements of the natural environment to deliver lessons (e.g. pine cones were used to illustrate concepts in geometry). Mental health was assessed using *The Strengths and Difficulties Questionnaire,* a validated tool for assessing psychiatric symptoms in children. The study showed no significant general effect on any of the mental health outcomes assessed after controlling for confounding socio-demographic factors in comparison to the control school. When stratified by gender, the results showed a small decrease in mental health problems amongst the boys but not the girls. Gustafsson et al. (2012) suggest that the use of a rural intervention school and an urban control school (selected for 'practical reasons') may partially account for the findings.

The evaluation of the John Muir Award on the health-related behaviours, attitudes and 'trajectories' of 10-16-year olds from Scotland found participation had no clear impact on self-esteem (Mitchell and Shaw, undated).

Engagement with school, attendance and academic

The review of outdoor school trips (including to places other than natural environments) by Rickinson et al. (2004) concluded that if '*properly conceived, adequately planned, well-taught and effectively followed up'* they can impact positively on some learning outcomes, primarily through adding value to concepts learnt in the classroom and memorable experiences.

Kuo et al. (2018) conducted an experimental study of the impacts of lessons outdoors on subsequent classroom behaviour and engagement with lessons on 9-10 year old students in the Midwestern United States. A lesson in nature, undertaken in a small grassy area adjacent to a stream and woodlands sited just outside the school campus to which the students walked, or a control lesson indoors was followed by a five minute indoor break and 20 minute indoor teaching period. Classroom engagement and behaviours were assessed using teacher ratings, student ratings, number of redirects (how often a teacher had to interrupt and redirect a student's attention), and independently assessed photo ratings. The children's engagement was significantly better in the observed lessons conducted after a lesson in nature in comparison to a previous indoor lesson. Engagement was higher according to four of the five measures, only student ratings of engagement were not significant. On average a teacher had to 'redirect' the attention of a student in the class once every 6.5 minutes following an outdoor lesson, significantly less than the once every 3.5 minutes following an indoor lesson. The effect remained stable, with no significant difference in outcomes between the first and last five weeks of the 10-week study. The authors suggest that effects could be attributed to 1) contact with nature, 2) a break from routine, 3) physical activity, and/or 4) positive impacts on the teachers (Kuo et al., 2018).

Behavioural

A small number of studies suggest that regular use of local natural environments and environmental settings is associated with improved behaviours,

There was this lad, digging away like mad, working really hard and the teacher says to me, 'You should have seen him yesterday...he was throwing chairs at me in the classroom' Educator, (Dillon et al., 2005).

Roe and Aspinall's (2011b) comparative study of the impacts of Forest School on the mood and behaviour of 18 young people in Scotland (12 were assessed to display 'poor' behaviour, eight 'good' behaviour) found that, overall, the forest setting improved outcomes. The magnitude of change was greatest for the poor behaviour group. Later ethnographic work with boys with 'extreme behaviour problems' by Roe and Aspinall (2011a) indicated that behavioural benefits of Forest School were linked to increased trust and social cohesion and with opportunities for exploratory activity. Further studies have reported improved behavioural outcomes associated with learning experiences in local environments (Szczytko et al., 2018).

Physical health and physical activity

Several studies have shown increases in physical activity resulting from the use of local natural environments for the delivery of education (Mygind, 2007, Romar et al., 2018, Lovell, 2009).

Romar et al.'s (2018) assessment of the rates of physical activity associated with outdoor learning in a Swedish primary population (n20) found that the children engaged in 15% more light1-intensity activities, 55% more light2 intensity activities (the authors split the light intensity category to better understand patterns of activity) and 27% more moderate to vigorous intensity physical activity in the outdoors in comparison to indoor settings. The children took 24% more steps in the outdoor setting compared to the indoors.

No significant effect on the perceived exertion or enjoyment of 86 11-12 year olds was found when comparing 1.5 mile runs in urban or local natural environments (Reed et al., 2013). Similarly, a study comparing the outcomes of playground sports with nature-based orienteering in local natural environments found that the former resulted in a greater amount of moderate to vigorous physical activity than the latter (Barton et al., 2015).

The evaluation of the John Muir award suggested that although immediately after completing the Award, the young people demonstrated more positive attitudes towards physical activity, however this was not sustained in over time. Participation did not appear to have any impact on participants' physical activity levels (Mitchell and Shaw, undated).

Care and concern for the environment

There is a small body of evidence that suggests regular educational experiences in local natural environments is associated with greater environmental awareness and empathy and can improve knowledge of local environments (Jose et al., 2017, O'Brien and Murray, 2007, Beyer et al., 2015).

A comparative study of the impacts of Forest School found significant differences in environmental attitudes between children (aged 8-11 years) who took part in Forest School with those who didn't (Turtle et al., 2015).

Experiences and perceptions

Waite et al. (2016b) used a suite of interviews and 'reflective surveys' to evaluate the perceived impact of the Natural Connections Demonstration Project across 125 of the 190 schools taking part in the programme. The Natural Connections Demonstration Project sought to enhance schools' use

of local natural environments for educational delivery through a structured support system of the central team supporting hub leaders, beacon schools and cluster schools. The teachers and school leaders generally reported positive perceived impacts across a number of outcomes:

- 95% thought participation was associated with enjoyment of lessons
- 94% thought it had enhanced the children's connection to nature
- 93% thought it had improved social skills
- 92% thought it had improved engagement with learning, and health and wellbeing
- 85% thought it had improved behaviour
- 57% thought it had enhanced attainment

The children taking part also had positive perceptions of their experiences, 89% agreed that they had felt happy and healthy during the lessons in the outdoors (Waite et al., 2016b).

Qualitative studies have demonstrated that children and young people, on the whole, appreciate outdoor learning opportunities (Ridgers et al., 2012). A qualitative study explored the Forest School experiences of 33 children (n18 8-9 years, n15 4-5 years) from two schools in England (Coates and Pimlott-Wilson). The authors found that the children appreciated the break from normal routine, being outside was associated with feelings of refreshment, activity, playfulness and being child-like,

[At Forest School] *you don't have to work and you don't have to be trapped inside—you can be your normal self outside. The thing I like about Forest School is basically that you can be yourself every single time*. Mai, 8/9 years old (Coates and Pimlott-Wilson)

The opportunity to explore social, behavioural and physical boundaries and to exert control over what they did was also of importance to the children interviewed by Coates and Pimlott-Wilson (2018). Older children considered that Forest School activities were more than just play (though that was important) and afforded opportunities to learn,

It's quite different [from school] *because we don't have to do working, maths, like we're doing maths but we're not writing it down anywhere. We needed to know how many ropes and tarps we needed if we were building our den and we needed to use maths for that. So, you're actually out playing while learning*. Florence, aged 8/9, (Coates and Pimlott-Wilson, 2018)

Forest School also enabled the children to develop new social relationships through collaborative activities (Harris, 2017). Where the classroom was considered to be primarily individual, Forest School was characterised by team work,

You've come closer with people from going to Forest School because you had to work in a group with people who might not have been your friends but are now like your best friends! … I always think I learn better when I'm with my friends, but sometimes I can learn a little bit more than I already did about something with someone, like a boy or something. Jess, age 8/9, (Coates and Pimlott-Wilson, 2018).

5.6. Residential programmes

This section considers a range of school based natural environment interventions which involve residential stays usually to more distant natural environments than the previous section.

Although mixed, there is evidence of a number of positive impacts to mental health and wellbeing associated with school based residential trips to natural environments including increases in

resilience and capacity to face challenges, improved relationships and enhanced social skills. There is also some evidence of increases in student motivation to learn associated with residential experiences and in connection to nature.

Mental health, wellbeing and psychological

There is a body of evidence which suggests that residential school based natural environment interventions can impact positively on the resilience (Hayhurst et al., 2015, Neill and Dias, 2001, Whittington and Budbill, 2013, Sammet, 2010) and self-esteem of children and young people (Barton et al., 2016). A controlled study by Hayhurst et al. (2015) examined the impacts of a 10 day 'developmental voyage' for New Zealand students aged 16 years. The study showed increases in resilience associated with social effectiveness and self-efficacy that were maintained five months after participation (Hayhurst et al., 2015). The authors speculate that the increase in resilience relates to the challenges the young people faced and overcame on the journeys. Other studies have suggested that residential programmes can build resilience by improving peer relationships and communication skills (Sammet, 2010).

Several of the studies identified improvements to confidence were a key outcome of residential school based natural environment activities (Dillon et al., 2005). In the focus groups held to evaluate the Learning Away programme teachers reported that improvements to students' self-confidence in themselves, their learning and in relationships with others were one of the key differences residential trips has made to students (Kendall and Rodger, 2015),

She was not keen at the start of the week, then the last activity [gorge scrambling] they were given an easy or a harder route and she chose the hard one. At the start of the week, she wouldn't have even dreamed of going for something like that. Her confidence went through the roof in the space of three days" (Secondary Staff Focus Group) (Kendall and Rodger, 2015)

Seventy-five percent of the teachers involved in delivering the Learning Away programme also thought that the students' resilience and general wellbeing had improved (Kendall and Rodger, 2015). The Learning Away programme was delivered by 60 schools working in 13 partnerships. Residential experiences included camping (on school sites, locally or further afield), co-constructed partnerships with outdoor providers, and school exchanges in urban and rural environments.

The qualitative elements of the controlled longitudinal study by Fuller et al. (2017) found that the young people who took part in residential trips attributed their greater self-perceived self-efficacy and confidence to their experiences,

"[Describing the night forest walk] I was very nervous because I never done it before … being in the woods, and it was quite, like, it was dark, and it made me really nervous because I am never usually out that late, it's kinda scary! … I wasn't gonna bother, you know, not try because I was too scared. But I did it and I felt really good about myself! … and it's made me feel more brave in class … to put my hand up and answer questions … more confident in lessons and in general … I think I am doing better than I was before because I am more confident sort of thing and I realised that it helps, having confidence in class." Alice, no age given (Fuller et al., 2017).

The quantitative elements of a Scottish study of the impacts of residential trips involving a variety of adventurous physical outdoor activities and exercises on secondary age students' self-perception assessed using the *The Life Effectiveness Questionnaire* found little effect in comparison to a control group (Christie et al., 2014). The qualitative elements of the study were more positive, the authors report that 'virtually' every student taking part in the residential experiences thought that it had

contributed to improved self-confidence and ability to manage social situations. The students related these self-perceived improvements to their academic capacity and ability. However, some students were less positive and felt that the time would have been better spent on academic study.

A controlled before and after study (a week before and then one and 10 weeks after participation) of four-night residential adventure activity trips for 360 Scottish Primary Six and Seven (ages approximately 10-12) carried out by Scrutton (2015) examined impacts on self-perceived personal and social skills. A significant but small effect was found in outcomes in the group taking part in the residential experience in comparison to the control one week after participation. However, the effect was lost at 10 weeks post participation. Scrutton also tested whether benefit was related to environmental knowledge and found no association. Finally, Scrutton found that children with the poorest self-perceived social and personal skills at baseline appeared to benefit the most and were more likely to have maintained the improvements in outcomes between the two post activity evaluations.

Residential programmes may provide space and time to develop new teacher and peer relationships away from the usual demands of the formal education setting (Fuller et al., 2017, Dettweiler et al., 2015). The large-scale evaluation of the Learning Away programme found that residential trips (majority of which related to the natural environment) improved peer and student-staff relationships (Kendall and Rodger, 2015). The surveys showed that over 80% of secondary students thought the residential trips had improved their relationships with peers and their teachers. Similar results were reported by other studies (Dillon et al., 2005).

Engagement with school, attendance and academic

There is some evidence to suggest increases in student motivation to learn associated with residential experiences (Dettweiler et al., 2017, Dettweiler et al., 2015).

The (un-controlled) analysis of pupil achievement data for a selection of students who participated in the Learning Away programme showed that they outperformed their peers who did not attend or improved their projected outcomes (Kendall and Rodger, 2015).

A three-year controlled longitudinal study focusing on two groups of children (n12 intervention and n12 control group, matched for educational and socio-economic and demographic factors) initially aged 14 years compared the outcomes for those who took part in three day weekend residential visits twice a year with a control group who did not (Fuller et al., 2017). The visits were to a Tudor estate in the countryside, the young people took part in a range of activities including mountain biking, canoeing, archery and countryside skills. The academic attainment (achievement of expected grade at GCSE) of the group taking part in residential trips was significantly better than those who didn't have the opportunity (average of 0.23 points below expected grade in comparison to 13.88 points below). The residential group achieved significantly better English and Maths outcomes, Science outcomes were non-significant. The authors of the study linked the improvements in greater self-perceived self-efficacy and confidence (see below) resulting from the experiences on the residential trips to the students' better performance.

The mixed method evaluation of the impacts of science lessons in outdoor settings during week long residential trips by Detweiller et al (2015) (German, n84 10-12 years old from two different schools) found positive impacts on learning behaviours and motivations. Benefits appeared to be greater for the children with lower 'self-regulated motivational behaviour'. The qualitative findings showed that on the whole the children enjoyed and valued the experience. The different learning context and

style was important, as was the perceived autonomy,*…we learned a lot but we learned it in a pleasant way (not like we do in school).* Boy, (Dettweiler et al., 2015)

Behavioural

Kendall and Rodger (2015) found that the Learning Away programme had positive impacts on students' behaviour and attendance, helping some students, particularly those at risk of exclusions, to more fully engage with school. Similarly, nearly a quarter of parents reported better attendance for their child following a residential trip.

Physical health and physical activity

No evidence was found relating to this outcome[11].

Care and concern for the environment

There is some evidence, from a variety of different study types, which indicates that extended time spent in natural settings has some influence on environmental beliefs and emotional connection with nature (Collado et al., 2013). However, Collado (2013) did not find an additive benefit of the environmental education elements of a programme delivered during Spanish residential summer camp in a natural environment on environmental beliefs and emotional connection with nature.

6. The impacts for disadvantaged and hard to reach groups

The evidence suggests that school based natural environment activities can be of particular benefit to disadvantaged and hard to reach groups, as well to children and young people with mental health or behavioural challenges. However, the existing evidence is drawn from small scale studies, is patchy on exposure, activity and outcome, and is highly heterogeneous in method.

Scrutton (2015) argues that children from the more deprived social groups may benefit disproportionality from school based natural environment activities. His research showed that children with the poorest self-perceived social and personal skills, which tend to be those from the more deprived backgrounds, appeared to benefit the most from residential trips. Shared experiences away from the school setting can help some children develop meaningful relationships (Richmond et al., 2018). Small scale ethnographic study concluded that outdoor play opportunities helped build resilience in Scottish children with 'challenging backgrounds' (McArdle et al., 2013). Further studies have shown benefits for children at risk of exclusion and experiencing behavioural difficulties (Dillon et al., 2005).

A systemic review of school gardens and gardening found that children who struggle in the traditional classroom setting appear to benefit to a greater degree than other children (Ohly et al., 2016). Similarly, an evaluation of a wilderness adventure programme found the greatest benefit was experienced by the young people aged 12-18 years with the poorest mental health (assessed to be in the clinical range) (Bowen et al., 2016). Significant improvements were found for depressive symptomology and behavioural and emotional functioning self-reported in the sub-sample of 26 young people. Reviews of wider, not necessarily natural environment based, mental health

[11] No evidence was found, this is not a statement that there is no evidence. This paper relates to a brief scoping review and must not be considered to be a true representation of the entire extent of the evidence base.

promotion in schools consistently shows greater effect for higher risk children (Weare and Nind, 2011).

Some forms of school based natural environment activities, particularly those which offer more adventurous options may be effective in reaching children and young people who are 'turned off' by more traditional forms of physical activity. The evaluation of a community based 10-week adventure play based programme for disadvantaged communities showed that the approach was effective in engaging typically hard to reach groups with low uptake of sports opportunities (Gibson and Richards, 2018).

There is, however, also evidence that some children and young people with health and wellbeing challenges may not benefit to a greater degree. Pre-school children with chronic poor health or disability attending outdoor day care centres were found to be absent for sickness reasons more often than children without an identified health condition (Moen et al., 2007).

7. Key pathways to benefit

While very little of the available research is able to provide evidence of cause and effect, some studies do provide a greater understanding of likely 'active ingredients' in school based natural environment strategies, some of which relate to the wider evidence base of schools based mental health promotion strategies (Fazel et al., 2014). The Learning Away programme evaluators, for instance, identified a number of factors which may have contributed to the positive results (Kendall and Rodger, 2015):

1. The time, space and the intensity of the residential programme – this was linked to the development of relationships as well as being away from normal routines and places.
2. The 'levelling' of relationships, normal structures and hierarchies of power (between students-teachers and between students themselves) were re-constructed.
3. Development of new relationships through living together.
4. The challenging nature of the activities.
5. Exposure to different ways of learning.

Natural spaces in the school environment and trips to local or more distant natural environments may help create the conditions in which children and young people's health and wellbeing and learning outcomes are positively impacted by:

- Forming positive social relationships; both peer and adult-child relationships (Richmond et al., 2018). This is of value to both the students, who may see adults as mentors and facilitators as opposed to authority figures, but also for teachers and adult leaders: *"Interpersonally, I have felt that I have really gotten to know the girls and the girls have really gotten to know each other in a totally different environment that's not at all academically focused. One that really focuses on who they are and how they behave and how they express reactions about each other … the relationship building aspect of it is really important."* Adult chaperone, no age. (Richmond et al., 2018).
- The different environments and approach to learning may help the children and young people in their development of self-efficacy (Chawla et al., 2014), in new and different skill sets (Richmond et al., 2018), and feelings of competence (Chawla et al., 2014). Additional skills development may impact wider academic achievement (Durlak et al., 2010).
- Giving children a 'break' from place based stresses and anxiety, from normal routines, from digital technology (Richmond et al., 2018).

- The Educational Endowment Foundation and Sutton Trust (undated) suggest that outdoor adventure learning activities may be of benefit to learning outcomes through the development of non-cognitive skills such as resilience and perseverance.
- Facilitating increased opportunities for higher intensity, and more varied forms of physical activity which allow children to develop new physical competencies (Dyment et al., 2009, Fjortoft, 2001, Fjortoft, 2000).
- Allowing children to take part in 'risky play' may be associated with physical activity behaviours and a number of health and wellbeing outcomes (Brussoni et al., 2015).
- Providing opportunities to develop independence and leadership capabilities as a result to take on new roles (Richmond et al., 2018).
- Contributing to development of supportive school cultures (Chowdry et al., 2010,Dyment et al., 2009) relating to the development of a sense of belonging and a supportive academic community (Richmond et al., 2018).
- Improved environment quality of the school (Dadvand et al., 2015).
- Contributing to the children and young people's quality of life.

8. Using broader evidence to understand benefits and pathways

In this section high level evidence (systematic reviews, reviews of reviews, meta-analyses) was used to examine the evidential backing for some of the key pathways theoretically linking school based natural environment activities and approaches to the key outcomes.

8.1. The effectiveness of health and health behaviour promotion in schools

A systematic review of 52 previous systematic reviews of mental health promotion in schools identified a number of key components of effective interventions and delivery (Weare and Nind, 2011). The reviews were published since 1990 and considered primary evidence relating to the outcomes of interventions aiming to improve mental health, prevent mental ill-health or to reduce or address mental health problems in school-aged children and young people aged 4–19 years in any type of school. The findings of the authors' 'tentative' synthesis of the design and delivery factors showed that factors associated with positive outcomes included:

- improving teachers' competence and skills and focusing on teaching methods;
- going beyond behavioural strategies and 'impacting on attitudes, values, feelings and behaviour';
- focusing on positive mental health;
- balancing universal and targeted approaches, while both approaches are valuable the use of them in combination appears to be most successful;
- making use of combined approaches and drawing on effective methods such as developing social skills, reinforcing behavioural norms while also working with parents;
- starting with young children and continuing through as the children get older;
- sustained programmes 'operating for a lengthy period of time' (at least nine months to a year), one off and very short-term interventions are ineffective;
- embedding the activity or programme with a whole-school approach and by linking to and modifying factors such as the curriculum, teaching and delivery, school cultures, communication with parents and working with local communities and other agencies; and

- high quality implementation, key factors include '*a sound theoretical base and a direct, intense and explicit focus on the desired outcome rather than using a different focus and hoping for indirect effects*' (Weare and Nind, 2011).

A Cochrane systematic review and meta-analysis of school-based interventions to reduce body mass and associated risk and behavioural factors found that changes to the school curriculum that promote physical activity during school hours were associated with positive effects (Dobbins et al., 2013). A systematic review of eight previous reviews of school-based behavioural interventions for controlling and preventing obesity found that longer term programmes with mixed components were most effective (Khambalia et al., 2012).

8.2. Physical activity promotion associated with schools and learning environments

A meta-analysis (68 studies) of out of school activities found participation was associated with significantly improved self-perception and more positive feelings about their school, and children displayed more positive social behaviour (Durlak et al., 2010). A significant improvement in academic performance was also found. Problem behaviours were also significantly reduced.

A systematic review of 28 studies found time spent outdoors is positively associated with increased physical activity, reduced sedentary behaviours, and to better cardio-respiratory health (Gray et al., 2015).

A systematic review of 25 studies of the mechanisms linking physical activity interventions to mental health outcomes in children and young people concluded that the strongest evidence related to improvements in physical self-perceptions and enhanced self-esteem (Lubans et al., 2016).

8.3. The impacts of health and health behaviours on achievement

A systematic review found some evidence that physical activity promotion in primary and secondary schools can improve some academic outcomes (Pucher et al., 2013, Public Health England, 2015).

A number of systematic reviews have shown that healthier students, after controlling for the many confounding factors, tend to achieve better academic outcomes (Murray et al., 2007). Similarly, health behaviours in children and young people are linked to academic outcomes (Busch et al., 2014).

8.4. The impacts of schools-based behaviour interventions

The What Works education initiative (Educational Endowment Foundation and Sutton Trust, undated) found eight meta-analyses which showed that school based behavioural interventions (including developing a positive school ethos or improving discipline across the whole school, supporting greater engagement in learning; universal, typically classroom based, programmes seeking to improve behaviour; and specialised programmes targeted at students with specific behavioural issues) do have the potential to improve behaviours. However, effects are moderate and closely related to the specifics of the design and delivery of the intervention. The assessment also found that reducing challenging behaviour in schools can have a positive and long-lasting effect on pupils' learning. Programmes lasting two-six months and which seek to involve the 'community' result in more sustained outcomes.

8.5. The impacts of school cultures on health and wellbeing in children and young people

A meta-ethnography found that positive teacher-student relationships are critical in student wellbeing and prevention of risky behaviours (Jamal et al., 2013). The authors also found that children and young people who are unhappy in the school setting may seek sources of escape, either physically through truancy, or emotionally through substance abuse.

8.6. Contact with natural environments on health and wellbeing outcomes

A systematic review of 35 primary papers assessed the impacts of exposure and access to and engagement with natural environments on children and teenagers' mental health (including emotional wellbeing, attention deficit disorder/hyperactivity disorder, overall mental health, self-esteem, stress, resilience, depression and health-related quality of life) (Tillmann et al., 2018). The synthesis of the heterogenous studies found that although the quality of the research was generally poor there is evidence of positive association with exposure to nature and ADD/ADHD, overall mental health, stress, resilience and health related quality of life. A greater proportion of positive and significant findings (as opposed to negative and/or non-significant) were reported for general exposure to nature, than for access or engagement.

8.7. The impacts of schools-based interventions in raising children and young people's aspirations

The What Works education initiative (Educational Endowment Foundation and Sutton Trust, undated) concluded that there is currently little evidence (weak existing evidence showing little or no effect) to support the use of school-based interventions to raise aspirations. The evidence related to interventions that focus on teaching practice and/or out-of-school interventions or extra-curricular activities, sometimes involving peers or mentors. The authors suggest this is primarily because children and young people tend to have relatively high aspirations for themselves.

8.8. The impacts of collaborative learning approaches

The What Works education initiative (Educational Endowment Foundation and Sutton Trust, undated) found ten meta-analyses, which indicate that collaborative learning approaches (where children and young people work in small groups designed so that each member can participate and success is dependent on teamwork) can improve learning outcomes.

8.9. The impacts of social and emotional learning interventions

The What Works education initiative (Educational Endowment Foundation and Sutton Trust, undated) found seven meta-analyses of the impacts of social and emotional learning interventions. There are three broad categories of social and emotional learning interventions: 1) universal, classroom-based programmes; 2) targeted, specialised interventions for children and young people with particular social or emotional needs; and 3) whole school approaches relating to school ethos and support for greater engagement in learning. The evidence, of varying quality, suggests that such interventions can have a positive impact on attitudes to learning and social relationships in school and can improve attainment.

8.10. Pro-environmental behaviours

A review of the personal and social factors that influence pro-environmental concern and behaviour concluded that childhood experience of the environment and taking pro-environmental actions is associated with adult attitudes and behaviours (Gifford and Nilsson, 2014).

8.11. Design and delivery of interventions

The wider evidence base indicates that effective health and wellbeing programmes are clear about the 'level' at which the intervention is intended to operate. Typically, schools based mental health interventions are delivered at one of three levels: 1) at the 'universal' level, delivery at a 'population' level, for example whole schools, year groups or classes; 2) 'selective', delivering to specific targeting groups within a wider population; or 3) 'indicated', where the intervention is delivered to population sub-groups identified to have or be at risk of clinical disorders (Fazel et al., 2014). Similarly, effective programmes tend to be clear about intervention point (temporally or in relation to the children and young people's life stage). Some programmes have had success through targeting key change points, e.g. the transition to secondary school (Marks et al., 2015). Although there is little evidence that has explicitly tested the impacts of clarity of targeting, implementation and delivery of school based natural environment activities it is likely that such lessons are still applicable.

Clarity in *how* the intervention is intended to achieve impact is also important. Effective interventions targeting health and wellbeing outcomes in schools are explicit about programme goals, about how the activities are implemented so as to achieve the goals, and, in many cases involve the children and young people in developing and delivering the activities (Durlak et al., 2010). Some intervention studies have used logic and theory of change models to illustrate the processes and pathways the activity will target (Nielsen et al., 2016) (Figure 1 and Figure 2).

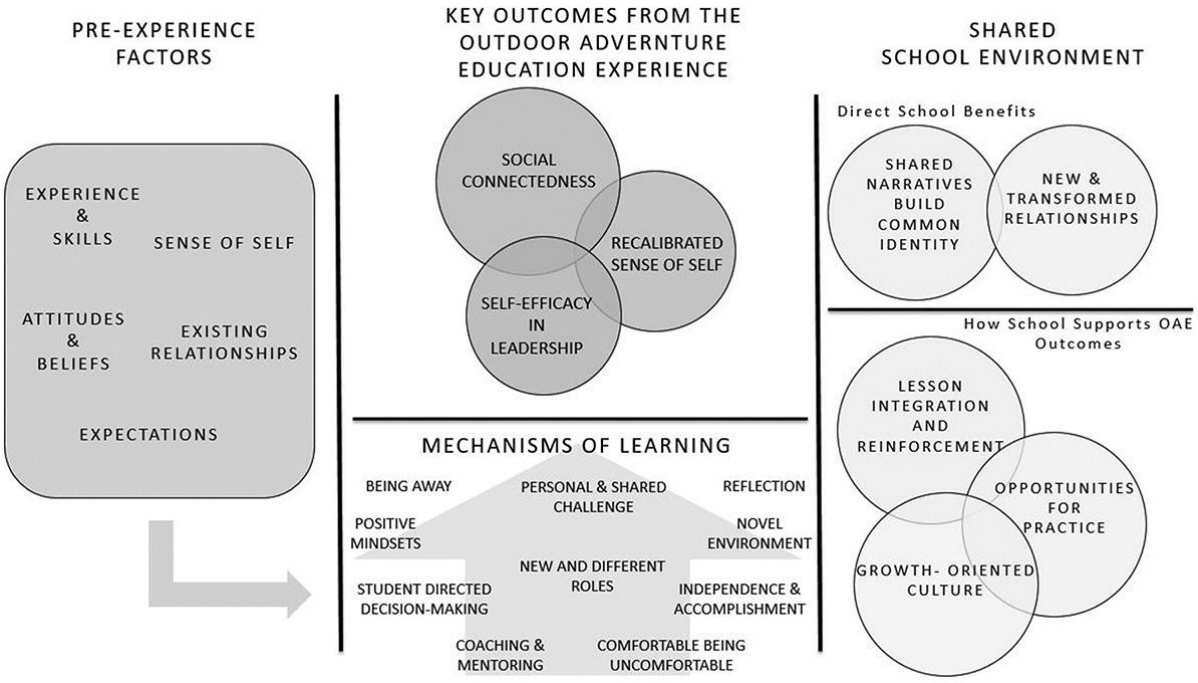

Figure 2. Richmond et al.'s (2017) theory of change model illustrating how school-related outdoor adventure education experiences may support student learning.

The importance of involving children and young people in the development and design of school based natural environment activities was highlighted in a number of the studies (Foster, 2006, Dyment and Bell, 2007, Viner, 2017). Children and young people's involvement in the greening of school grounds, especially those intended for informal and play uses, appears to be of particular value. Such an approach can also help mitigate some of the factors which may prevent uptake for certain communities. Co-designing programmes so that they appeal to particular demographic sub-groups such as girls and ethnic minorities can help ensure equity of opportunity (Gibson and Richards, 2018, von Benzon, 2011, Mitchell and Shaw, undated) and may extend the positive outcomes for those children involved in designing the programme (Kendall and Rodger, 2015, Gibson and Richards, 2018). Giving children and young people agency over how they want to undertake activities is also of value,

You have more choices at Forest School, so when you're at school you don't have any choice but you have to do the lesson; and then at Forest School you have a choice if you want to do it or if you don't want to do it. Summer, aged 8/9, (Coates and Pimlott-Wilson, 2018)

Progressive experiences where children and young people are able to take an active role in the school based natural environment activity appears to be an important approach to sustained outcomes (Kendall and Rodger, 2015, Richmond et al., 2018). The mixed method evaluation of outdoor adventure education by Richmond et al. (2018) illustrated the value of a progressive pathway. Seventh grade children were given the opportunity to contribute to decisions about activities, by 11th grade the children were enabled to take on those decisions for themselves and the group. In the qualitative work the students reflected on the consequences of taking on decision making roles, recognising the implications and how they supported others. The young people also spoke of how, as a result of their experiences in the out of school activities, they intended to try and become more involved in decision making in the formal school setting.

Effective approaches to engaging with schools are likely to build on the motivations of teachers. Rickinson et al. (2012) found that the teachers' own experiences (particularly of outdoor education in their childhood) and values, the curricular requirements of the subject they taught, their perception of their students' educational and developmental needs, and their knowledge of practices in other schools were all influential.

Several studies underlined the importance of building up to and then building on the school based natural environment activities. Christie et al. (2014) found that a number of the schools they worked with began the process of support and preparatory work some weeks before the residential outward-bound trips. This was of value to both the students as well as teachers and residential leaders. Embedding in such a way helped make a connection between the residential experience and the students' home and school environments. Scrutton (2015) speculated that the reasons for the reversal of the positive gains made during a residential outdoor education experience for Scottish Primary 6 and 7 children was linked to the school's failure to integrate the experience into their teaching in the following weeks. Such ongoing support may also be critical where the aim of the programme is to improve emotional and mental health outcomes (Richmond et al., 2018). A quote from Christie et al. (2014) highlights the potential fragility of gains made during one-off or fleeting experiences,

For once people thought I was bright … folk kinda thought I was like brainy … and I thought 'yeah' I am brainy for once … and then I came back to school with a bang … dopey … dunce. Boy, no age given (Christie et al., 2014).

There is some evidence that effective programmes link the 'offer' (i.e. the activities) and the anticipated outcomes to teacher and school leaders' priorities (Dillon et al., 2005). High priorities are improvements to students' motivation, behaviour and self-confidence, a clear link to the curriculum and cross-curricula themes, and opportunities to help students develop wider skills (Rickinson et al., 2012). Tailoring the activities to the type and needs of the individual school is of particular importance in addressing the needs of schools serving disadvantaged populations (Rickinson et al., 2012). It may be that such an approach allows the teachers to more explicitly and consistently integrate the experience and learning into the classroom-based delivery, thus extending and embedding positive outcomes. Embedded supported delivery was found to be important for achieving positive outcomes, including student experience, in Christie et al.'s (2014) study of residential outward bound experiences for Scottish secondary students. The research undertaken by Richmond et al. (2018) also supports the value of the embedded approach, suggesting that 'out of school' activities can be used instrumentally to support and embed the personal and social skills needed for 'classroom based learning'. For modifications to school grounds it appears that ensuring the spaces provided are integrated into learning and development plans, as well as into play and behaviour policies is important (Foster, 2006).

Working with the wider community, including the families and carers of the children and young people, has been suggested to be important (Foster, 2006). It may be that extending the role of the school and developing new partnerships with other providers such as environmental, sports and arts organisations, helps ensure continuity and extent of impact.

8.12. Avoiding harm

Not all children have positive experiences (Richmond et al., 2018, Whittington and Budbill, 2013, Sammet, 2010). Ensuring that the experience avoids unnecessary risk and is not detrimental to students' wellbeing, welfare or academic progress is fundamentally important (Dillon, 2010). Some studies have indicated that poor peer relationships can influence the outcomes of activities, some children resist the aims and processes the programmes, and others may be fearful or feel unsafe (Sammet, 2010, Whittington and Budbill, 2013). Involving children in the design of the activities, or potentially giving them some choice in participation may help to mitigate concerns (Christie et al., 2014).

Following best practice in the targeting of interventions and identification of populations of interest is crucial for mental health interventions. Further providers should be aware of the highly complex ethical considerations of mental health interventions in the school setting (Fazel et al., 2014). Mental health is highly stigmatising. Further, as Fazel et al. (2014) point out, the children or young people and the adults with an interest in their health do not necessarily agree on whether or not they need help, nor on the ways in which they may be best helped or supported.

There is recognised equity challenge in providing school based natural environment activities. Maintaining equity of access is a specific issue, there is evidence that the most deprived children have the poorest access (Mitchell and Shaw, undated, Dillon, 2010), especially where participation depends on financial contributions from parents and carers (Scrutton, 2015).

8.13. Supporting schools and teachers to deliver activities

School based natural environment strategies potentially add to a teacher and school leader's workload. Mitigating those impacts is likely therefore to be important in both embedding the practice and in achieving positive sustained outcomes (Dillon, 2010).

The study of the needs of schools with differing levels of outdoor learning in natural environments by Rickinson et al. (2012) provides useful guidance on the types of factors which will enable outdoor learning (Box 1.)

Box 1. Teachers' and school leaders' views on factors which would enable outdoor learning from Rickinson et al. (2012)

Specific support: *interviewees wanted:*

- *skilled face-to-face support in schools - to help them find expertise, inspiration, ideas,*
- *to provide INSET training, and to assist local networking etc.*
- *a simple online database/resource bank - to help them find information on local spaces and resources etc.*
- *ways to facilitate more collaborative projects between schools - to share resources and to develop research and practice.*
- *additional resources - both human and financial - to enable local action, for example by bringing in volunteers skilled in supporting across a range of school-based roles. (There was little or no indication that schools were aware of or using any of the support or resources already available from outdoor learning providers).*

Targeting: *interviewees advised that any action should focus on:*

- *all schools, adopting a tailored approach with each school;*
- *enthusiasts and senior staff; and*
- *skilled, independent facilitators and volunteers.*

Overcoming challenges: *interviewees emphasised the need to:*

- *promote the benefits of outdoor learning;*
- *allow for building participation over time;*
- *overcome local limitations such as availability of local green space, and cost/time issues; and*
- *manage its development through effective coordination and legacy/sustainability.*

Christie et al. (2014) highlighted the value of a whole school approach in overcoming some of the challenges to outdoor learning. Similarly to Rickinson et al. (2012) they found that school leadership, culture and commitment were fundamental, providing the context in which teachers have the time and space to develop confidence in and enthusiasm for the approach. Knowledge of and access to the resources needed to deliver outdoor learning, including local greenspaces and the materials needed for lessons (or to overcoming the impacts of poor weather (Gibson and Richards, 2018)), were also basic factors. Teachers and leaders may also need to be supported to develop the skills and competencies necessary to bring about the desired change by using very different learning activities in different settings (Durlak et al., 2010). The need for access to or support from specialists with relevant expertise, particularly in relation to the delivery of more targeted mental health interventions, to help teachers and leaders develop confidence, competence and suitable delivery approaches has been raised in a number of studies (Rickinson et al., 2012, Dillon, 2010). This support can range from appropriate teacher training, continuing professional development opportunities, to

the direct involvement of health professionals. The high cost of transportation and cover teachers, the time need for travel, a crowded curriculum, and teacher qualifications and confidence have also been raised as key obstacles to greater delivery of outdoor learning projects in schools in the UK (Waite et al., 2016a).

Several of the studies included in this review have identified some of the factors needed for the adoption of school-based outdoor activities at scale, highlighting barriers and challenges to successful delivery (Waite et al., 2016b, Rickinson et al., 2012, Dillon, 2010). Such factors may include; funding; sustainability of commissioning; providing continuity of service; political support and leadership; and robustly demonstrating project outcomes.

9. Economic value of school based natural environment activities

There appears to be almost no evidence of the economic benefits of school based natural environment activities (Dillon and Dickie, 2012). Mourato and colleagues (2010) estimated that the value of the ecological knowledge of GCSE and A2 geography, science and biology students in 2010 to be approximately £2.1billion of the ecological knowledge, to which outdoor learning contributed.

The Educational Endowment Foundation and Sutton trust assess a outdoor adventure learning (defined as involving *'outdoor experiences, such as climbing or mountaineering; survival, ropes or assault courses; or outdoor sports, such as orienteering, sailing and canoeing'*) as moderate impact for moderate cost.

10. School based natural environment intervention evidence needs

A more comprehensive set of synthesis studies which aim to critically examine the existing evidence and to help identify and unpick the relative and contextual importance of the 'active ingredients' of school based natural environment programmes and activities is needed. Previous meta-analyses have synthesised the outcomes of heterogeneous programmes encompassing a range of different types of activities and study populations. The validity and utility of the resulting synthesis is questionable (Gustafsson et al., 2012, Becker et al., 2017b). The earlier section in this brief review on key pathways briefly (and un-systematically) listed some of the likely factors for which there is indicative evidence. A more critical and systematic consideration and, where possible, meta-analysis of these factors would be valuable in informing future practice and research. The syntheses could be stratified according to environment type, activity type, aims of the programme/activity, population characteristics, delivery mode, frequency and duration, and wider contextual factors (e.g. whether or not the activity was integrated into wider school delivery).

Effort should be devoted to the identification and selection of appropriate, robust and reliable methods to better understand the process and impacts of school based natural environment interventions. There has long been a call for more robust and rigorous choice and application of methods in school based natural environment activities, particularly in relation to outdoor education (Scrutton and Beames, 2015, Rickinson et al., 2004, Becker et al., 2017b). The analysis of the methodological limitation sections of 22 published studies of the impacts of outdoor education on personal and social outcomes by Scrutton and Beames (2015), supplemented by their own critiques, highlights the paucity of robust quantitative evidence. Significant issues related to sample recruitment, the reliance on un-validated questionnaires and lack of consideration of confounding

factors. The authors argue that more robust quantitative research, including the use of demonstrably reliable measures, adequate samples and control groups, collation of longitudinal data and greater consideration of cofounding factors, is necessary to help clarify to what degree and for whom outdoor education is effective.

Several of the research needs regarding school based mental health interventions identified by Fazel et al. (2014) are of relevance to better understanding the impacts of school based natural environment strategies, these include:

- The mechanisms and processes contribute to successful delivery of interventions.
- How to best target interventions and identify the populations for which the activity would be of value.
- A greater understanding of the delivery and implementation strategies to ensure and improve uptake, maintain fidelity of the intervention, and enable ongoing learning and development.
- Development of appropriate, valid and robust measures that can capture the relevant outcomes relating both to process and impacts from participant through to systems level.
- Identifying sustainable intervention options that while effective are not overly burdensome, costly or require specialist delivery.
- Development of quality indicators.

Beyond the more generic need to improve the evidence base a number of specific evidence needs were identified:

1. How to best equip teachers with the knowledge and skills to undertake outdoor learning (Dillon, 2010).
2. Collecting consistent data about the type, extent and reach of school based natural environment activity. This would allow tracking of progress and inform future developments, important for equity (Dyment and Bell, 2008).
3. Clarifying the 'dose' in terms of frequency, duration and intensity of school based natural environment activities that is needed to bring about positive outcomes.
4. The durability and sustainability of outcomes, and how to ensure positive outcomes are not lost (Scrutton, 2015).
5. The longer term impacts of school based natural environment activities, potentially achieved through greater use of longitudinal designs (Tillmann et al., 2018).
6. The potential for and ways in which school based natural environment activities and leaders may instigate pro-environmental behaviours and actions in young people (Prince, 2017).
7. How to ensure equity of experience and benefit (Mitchell and Shaw, undated).
8. The experiences of marginalised groups such as learning disabled children (von Benzon, 2011).

11. Conclusions

This scoping review aimed to support Defra's Nature Friendly Schools programme by identifying and examining examples of school based natural environment activities which have the potential to positively impact the mental health and wellbeing, and engagement with school of participating children and young people. The review also considered outcomes such as improved behaviour, attendance, physical health, and care and concern for the environment.

The evidence identified indicates that the key school based natural environment activities or exposures are linked to a range of positive outcomes, with particular benefits for disadvantaged children and young people, and for those suffering with health or behavioural issues. One of the strongest arguments for many forms of schools based natural environment activity is the potential for co-benefits. The greening of school grounds, for instance, has the potential to impact on the health and wellbeing and environmental attitudes of children and young people through several pathways.

Currently, however, our understanding of what works is limited by a patchy evidence base, a high percentage of lower quality studies with a reliance on self-reported or teacher assessed outcomes, and little understanding of exactly how programmes work. The challenge now is how to use the existing evidence base to design robust interventions which are equitable in outcome and which complement and build on wider classroom-based learning so as to ensure sustained outcomes.

Schools have an increasingly important role in facilitating children and young people's knowledge of and contact with different natural environments. Similarly, schools are of crucial importance in promoting mental health in children and young people. Schools based natural environment activities, if well designed and ethically and fairly implemented, have the potential to meet both these aims.

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Appendices

Appendix 1. Definitions of key terms and concepts

Health

Health is a complex adaptive system and relating to resilience and capacity to self-manage in the face of social, physical and emotional challenges. Health, is usually considered to be a dynamic state, one that is not fixed nor absolute, and one that is constantly responding to environmental, social, biological, emotional and cognitive conditions or states (Naumova, 2014, Sturmberg, 2014, Lovell, 2018).

Wellbeing

Wellbeing is defined following the approach of Dodge et al. (2012) *'stable wellbeing is when individuals have the psychological, social and physical resources they need to meet a particular psychological, social and/or physical challenge'*.

Health promotion

The World Health Organisation define health promotion as *'the process of enabling people to increase control over, and to improve, their health. It moves beyond a focus on individual behaviour towards a wide range of social and environmental interventions'* (World Health Organization, 2017).

Health intervention

Defined by the WHO as *'an act performed for, with or on behalf of a person or population whose purpose is to assess, improve, maintain, promote or modify health, functioning or health conditions'.*

Other health terminology

For other health related terms see the glossary produced by the National Institute of Health and Care Excellence (NICE). A brief glossary of health and research terminology is provided in Natural England's evidence summary note EIN016.

Natural environment, greenspace, bluespace, open space etc.

There is as of yet no definitive definition of the 'natural environment' or typology of different types of natural environments in different settings. For the purposes of this report the natural environment is defined as places with a greater percentage of natural features (i.e. plants), whether urban or rural. The definition does not specify or seek to limit the use of the term in relation to the ownership, management or ecological integrity of any place.

Greenspace Scotland uses an adapted typology (based on one used in the Scottish planning system) to provide a pragmatic set of terms (such as open space, greenspace etc.) of particular relevance to more built up settings such as villages, towns and cities (Greenspace Scotland, undated). When not referring to a specific primary source (see below), these usages are followed in this report.

There are a variety of 'natural environment' terms used throughout this report, this is deliberate and reflects the use of the original term as used in the source material being discussed.

Natural environment-based school health intervention

There is a huge variety of terminology used to refer to different natural environment-based school interventions and activities, with little consistency in application (Becker et al., 2017b). Examples include:

- Outdoor learning
- Outdoor classroom
- Outdoor education
- Outdoor adventure education
- Education in the outdoors
- Education outside the classroom
- Environmental education
- Learning in the natural environment
- Greening school grounds
- Forest Schools
- Terms used elsewhere in the world but with relevance to this review such as Udeskole ('Outdoor School') and Friluftsliv ('Open air living')

In addition to the plurality of language there is further variation according to aim, context, delivery and intended impacts and outcomes and within these broad categories. Waite et al. (2016a) compared British and Danish understandings and approaches to 'Forest School' finding that while there are shared philosophical underpinnings – both seek to increase children's engagement with nature - there is divergence in practice between the two countries. Becker et al. (2017b) suggest that an all-encompassing definition would not be possible or necessarily desirable.

Appendix 2. Age and school grades

Table 1. Age and grades comparison table

<table>
<tr><th>Age</th><th colspan="2">England and Wales</th><th>Scottish</th><th>Northern Ireland</th><th colspan="2">US/International Grades</th><th>International Baccalaureate Programmes</th></tr>
<tr><td rowspan="2">04-05</td><td rowspan="2">Reception</td><td rowspan="2">Early Years Foundation Stage</td><td>Primary 1</td><td rowspan="2">Year 1</td><td rowspan="2">Pre-Kindergarten</td><td rowspan="3">Early Childhood</td><td></td></tr>
<tr><td></td><td rowspan="8">Primary Years Programme</td></tr>
<tr><td>05-06</td><td>Year 1</td><td rowspan="2">Key Stage 1</td><td>Primary 2</td><td>Year 2</td><td>Kindergarten</td></tr>
<tr><td>06-07</td><td>Year 2</td><td>Primary 3</td><td>Year 3</td><td>1st Grade</td><td rowspan="4">Lower School</td></tr>
<tr><td>07-08</td><td>Year 3</td><td rowspan="3">Key Stage 2</td><td>Primary 4</td><td>Year 4</td><td>2nd Grade</td></tr>
<tr><td>08-09</td><td>Year 4</td><td>Primary 5</td><td>Year 5</td><td>3rd Grade</td></tr>
<tr><td>09-10</td><td>Year 5</td><td>Primary 6</td><td>Year 6</td><td>4th Grade</td></tr>
<tr><td>10-11</td><td>Year 6</td><td>Primary 7</td><td>Year 7</td><td>5th Grade</td><td rowspan="3">Middle School</td></tr>
<tr><td>11-12</td><td>Year 7</td><td rowspan="3">Key Stage 3</td><td>S1</td><td>Year 8</td><td>6th Grade</td><td rowspan="5">Middle Years Programme</td></tr>
<tr><td>12-13</td><td>Year 8</td><td>S2</td><td>Year 9</td><td>7th Grade</td></tr>
<tr><td>13 - 14</td><td>Year 9</td><td>S3</td><td>Year 10</td><td>8th Grade</td></tr>
<tr><td>14 - 15</td><td>Year 10</td><td rowspan="2">Key Stage 4 (GCSE)</td><td>S4</td><td>Year 11</td><td>9th Grade (Freshman)</td><td rowspan="4">High School Advanced Placement, High School Diploma - Grade 11/12</td></tr>
<tr><td>15 - 16</td><td>Year 11</td><td>S5</td><td>Year 12</td><td>10th Grade (Sophomore)</td></tr>
<tr><td>16 - 17</td><td>Year 12 / Lower 6th</td><td rowspan="2">A Levels</td><td>S6</td><td>Year 13</td><td>11th Grade (Junior)</td><td rowspan="2">IB Diploma</td></tr>
<tr><td>17 - 18</td><td>Year 13 / Upper 6th</td><td></td><td></td><td>12th Grade (Senior)</td></tr>
</table>

Appendix 3. Key studies and papers (as of 2018)

- Delivery approaches, motivations of teachers etc. (Rickinson et al., 2012)
- Reviews of the outcomes of school based natural environment type activities (Becker et al., 2017a, Dillon and Dickie, 2012, Rickinson et al., 2004, Becker et al., 2017b)
- Design and delivery of a large-scale residential programme (Kendall and Rodger, 2015).
- Useful guidance on how the outdoor sector can work closely with schools (Natural England and Big Lottery Fund, 2013)
- Methods for the assessment of the outcomes of some school based natural environment activities (Scrutton and Beames, 2015)
- What works in mental health intervention delivery in schools (Fazel et al., 2014, Weare, 2015)
- Reviews and guidance on key educational strategies (Educational Endowment Foundation and Sutton Trust, undated).
- Guidance on types of school based natural environment interventions can be found from the coordinating bodies such as LOTC https://www.lotc.org.uk/ and the Children and Nature Network https://www.childrenandnature.org/initiatives/schoolyards/hub/
- The Mersey Forest has a forthcoming green learning toolbox https://www.merseyforest.org.uk/our-work/green-learning-environments/ and Groundwork provides guidance on improving environment quality through school greening programmes https://www.groundwork.org.uk/Sites/london/news/school-air-quality-greening