Sports Med (2016) 46:955–962
DOI 10.1007/s40279-016-0487-z

CURRENT OPINION

Bringing Nature to Schools to Promote Children's Physical Activity

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Published online: 18 February 2016

Abstract Physical activity (PA) is essential for human health and wellbeing across all age, socioeconomic, and ethnic groups. Engagement with the natural world is a new defining criterion for enhancing the benefits of PA, particularly for children and young people. Interacting with nature benefits children's social and emotional wellbeing, develops resilience, and reduces the risk of obesity and type 2 diabetes mellitus across all population groups. Governments around the world are now recognizing the importance of children spending more active time outdoors. However, children's outdoor activities, free play, and nature-related exploration are often structured and supervised by adults due to safety concerns and risks. In this context, schools become more accessible and safe options for children to engage in PA outdoors with the presence of nature features. Research on school designs involving young children has revealed that children prefer nature-related features in school environments. Affordances in nature may increase children's interest in physically active behaviors. Given that present school campuses are designed for operational efficiency and economic reasons, there is a need to re-design schools responding to the positive role of nature on human health. If schools were re-designed to incorporate diverse natural features, children's PA and consequent health and wellbeing would likely improve markedly.

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Key Points

Human health and wellbeing benefit from outdoor physical activity.

Children prefer natural features in their schools.

Nature landscapes in school designs promote children's physical activity.

1 Introduction

Physical activity (PA) is essential for human health and wellbeing across all age, socioeconomic, and ethnic groups [1–4]. Outdoor green space has emerged as a new defining criterion for enhancing the benefits of PA, particularly for children and young people [5–7]. Interacting with the natural world benefits children's social and emotional wellbeing, develops resilience, and reduces the risk of obesity and type 2 diabetes mellitus across all population groups [8–11]. The aim of this article is to demonstrate that primary schools, if re-designed with nature-related features, can be effective environments to promote PA in children. Nature, in this context, is defined as a physical environment consisting of plant life, water bodies, animal life, and other features consistent with the natural world. Drawing from an ecological dynamics rationale, we argue that the presence of nature in school environments invites children to develop affordances resulting in PAs [12]. Two strands of research evidence support this argument: the first strand shows that children benefit in their physical and mental health when they connect with nature; the second

demonstrates that young children prefer the presence and use of nature-related features in their schools which, in turn, promotes PA. We argue that schools need to be re-designed to incorporate nature features to promote children's PA.

To do this, we first explore research evidence that links PA in nature to improvements in children's health. Second, we identify schools as a key and safe option for children's PA with the inclusion of nature. Third, we explore evidence from research and media documentation that shows schools can be re-designed in a manner that recognizes children prefer the natural world for active behaviors. Last, we use a recent research project as an example to consolidate our opinion that PA in schools will be enhanced when children can engage better with nature-related features. We conclude that re-designing school environments with a variety of nature features and utilizing them as PA spaces for children is essential.

2 Health Benefits of Physical Activity (PA) in the Natural World

Concern is growing about how electronic devices and social media not only encourage a sedentary lifestyle in young people but might also result in behavioral disorders [13]. As a result, society and policy makers have begun to emphasize the benefits of outdoor PA. For example, governments have recommended that school children should spend more time actively outdoors and in nature (https://www.natureplayqld.org.au). Schools have introduced innovative programs for enhanced PA and outdoor play (e.g., Change4Life and Forest School programs in the UK). General practitioners and pediatricians are prescribing walks in nature for children and their families to combat obesity and diabetes [14–16].

Mental health benefits have also been affirmed when children and young people connect with nature [17, 18]. Exploration in the woods, gardens, backyards, parks, and wilderness areas are potential sources for nurturing focused learning, mindfulness, and reflective practice in children and young people. Affordances in the natural world are immensely beneficial for humans [19–25]. For example, Kuo and Taylor [26] found that children diagnosed with attention-deficit disorder demonstrated significant positive changes in behavior and an increased capacity to concentrate when they spent more time in nature. They have also reported that exposure to green space potentially reduces the severity of diagnosed attention-deficit/hyperactivity disorder among children. The implications of these findings are that the health of children and young people would be considerably enhanced by active behaviors and time spent in nature. As other researchers also have stated, nature is perceived to be good for children's physical and mental wellbeing [27, 28].

Being physically active and eating healthily are currently in the forefront of most health behavior change interventions involving children. For example, a school-based behavior change study conducted in Germany involving elementary school children and their classroom teachers reduced cardiovascular disease and obesity risk factors in early childhood [29]. Children who reduced dependency on screen time, engaged more in PAs, practiced active transportation, and active play showed improvements in their physical health. A similar study conducted in the USA [30] found that enhanced PA and healthy eating reduced disease risk. A study from Taiwan [31] found that high school students who interacted with plants inside their school buildings demonstrated better physical health and improved psychological wellbeing.

Researchers studying childhood and youth behaviors have repeatedly found a positive relationship between outdoor PAs and improvements in health and wellbeing [10, 32, 33]. For example, a study in relation to the "No Child Left Inside" program in the USA showed that informal garden-based PA positively impacted academic outcomes and social development in school children [34]. The place-based outdoor learning model [35]—visiting the same place frequently and developing a connection with the land as aligned with the Australian indigenous perspective of "connection to the land in knowing the self" [36, 37]—supported by many outdoor educators has demonstrated increased PA and socio-emotional wellbeing [38–40]. Connection to the land and the natural world at an early age has been found to correlate with psychological wellbeing [41].

Less structured activities and more free play benefit children in their development [42]. Risky outdoor play is found to promote healthy child development [43]. The Danish model of "Udeskol", education outside the classroom, has the specific intention of encouraging learning in natural settings to enhance physical, social, and emotional health and wellbeing [44]. Similar programs are running in Sweden, Spain, and the UK. The Forest School program, implemented by many primary schools in the UK, connects children with nature for healthy child development [45, 46]. However, these well-intended programs may be limited in their ability to achieve their aims when schools place more emphasis on literacy and numeracy lessons in outdoor space alongside prioritizing students' safety. This may diminish the focus on the value gained in outdoor PA. It may also qualitatively reduce children's experiences in the natural world. Parents may also show aversion towards their children getting dirty in school. Despite differential perceptions of parents and teachers, the Forest School and similar outdoor programs have gained significant attention

for their value in enriching young children's experiences in nature [47, 48]. Further research is needed to explore such perceptions.

Such perceptions and possible interference point to a potential conflict within the educational system. On the one hand, the system has been charged with producing 'educated' citizens who will contribute to the economy. On the other, there is an expectation that schools should respond to the growing research evidence on children's health. Although this appears to be a dichotomous state of affairs, schools can still emerge as central to enhancing PA in children if the school environment is designed to use natural features in a consistent and safe manner. In the next section, we explore how schools are emerging as safe and key places for children's outdoor PA.

3 Schools as Safer Places for Outdoor PA

Despite the overwhelming evidence to show that free play outdoors benefits health and wellbeing, the notion of childhood with freedom to play outdoors and to explore nature conflicts with the current focus in western society of child protection and personal safety. Gill [49] analyses how the 'nanny state' of the UK has come to criminalize some exploratory behaviors of childhood. Being outdoors with freedom and independence is considered risky, dangerous, and suspicious and, in some instances, may even be deemed an 'offence'. Families are fearful that their children might be harmed due to the social and environmental risks and dangers [50]. On the other hand, children may also be fearful of being outdoors on their own due to their own past experiences and being cautioned by parents and schools about strangers potentially causing harm and abuse [45]. This may restrain their green space experiences, impacting on their PA.

Additionally, specific socio-cultural communities viewing children as wild, 'roaming around freely', portray children as 'aimless', hinting they are a potential threat to the community. This perception can raise doubts as to whether parental responsibilities are being met as determined by accepted community standards. This could become a leading factor in pushing families to choose indoor environments over outdoors [51]; it could also influence children to become less physically active and demotivated to go outdoors. Furthermore, the present day risk-averse society tends to focus on protection and safety in all environments, whether built or natural. Families concerned with children's safety seem to be choosing the 'safer' option of letting children stay indoors with electronic devices, resulting in a sedentary lifestyle.

Within the context of concern for children's safety and parental anxiety around risks and dangers, educational institutions present themselves as safe, key alternatives. As child development theories highlight, early childhood exploration in the natural world or outdoor play is crucial for healthy adulthood [10]. As alluded to in Sect. 2, children's experience of the natural world is significant in their socio-emotional health. Thus, schools are potentially ideal places to encourage children's experience of the green space and their outdoor PA.

However, the present education system's practice of standardized achievements conflicts with this idea in three ways. First, young students are compelled to be desk-bound for at least 4 h of a school day whilst achieving expected levels of literacy and numeracy. Second, the short weekly physical education lesson may not incorporate interaction with nature. Third, school environments are traditionally designed to meet adult and professional needs of efficiency and economy rather than children's preferences [52, 53].

In response to current government and local regional policies, school campuses are becoming more risk-free environments, lacking natural features, rather than purposeful spaces for children to learn risk-management strategies and processes through outdoor play and PAs in nature. School campuses as purposeful environments will benefit children's PA in two ways. First, children can learn how to accept affordances for risky activity during their interaction with nature. Second, they can learn how to manage risks in their relationship with the natural world in and out of their school environment. Both these avenues call for ideal school settings for such learning experiences to emerge and consolidate. Cordovil et al. [54], postulating an ecological dynamics approach, have emphasized that those responsible for children's safety need to have a greater understanding of the dynamics of individual capabilities and environmental opportunities for action. Management of risk environments in nature and the risk behaviors they invite is more conducive to children being physically active and less likely to impede their opportunities for PA in nature.

If the state and society are to take the health and wellbeing of our young people seriously, schools might offer an ideal context for enabling interactions with nature and outdoor PA. To make the most of this possibility, it is advantageous to re-design school campuses. Involving children in the re-design process might be an important consideration. In the next section, we evidence how research has supported the idea of school re-designs and give examples of how school children have been involved in participatory design processes.

4 Emerging Research on School Re-Designs: Children Prefer Nature

Research on school design and participatory design process has shown that children as educational stakeholders show more interest in nature features for play and PA. Researchers have recognized that children, when invited to express their imaginations of school design, create layouts that are remarkably different to their current school design. One of the characteristics of their imagined designs is the inclusion of nature inside and outside of the school building [55–58]. The presence of nature is linked to PAs, with children feeling invited to develop individual relationships with different features of the natural world.

Whilst research studies on children re-designing their schools are still exploring possible ways for children to be involved [57, 59], there are successful examples [60, 61] that showcase children's participation in school designs. In one particular example, architect Marta Brkovic teamed up with Simeon Aranicki Primary School, Serbia, to develop a design proposal for a sustainable school. Children enthusiastically participated in a game that was initiated to get ideas on how to improve the school's architectural re-design. Children were also encouraged to outline what features they wanted in their school and where they would prefer them to be. This project became "the first participatory evaluation of a school in Serbia" [personal communication, M. Brkovic, Sustainable Schools as the Third Teacher (unpublished PhD), University of Sheffield, UK, 2013], a community effort, and a model for the country. Thus, re-designing schools needs collaboration from all other stakeholders and it is more often an inclusive community effort that values children's voices [62–64].

Several progressive educators have practiced inclusive community participation principles in their schools, giving more importance to children's voices in the school design process or the re-organization of school environments. Most progressive schools around the world have been designed keeping the natural features within their campuses. A.S. Neill's Summerhill School in the UK [65] and Rabindranath Tagore's Shantiniketan in India [66] are noteworthy examples serving the value of democratic learning in and with nature. Sustained PA in the outdoors has always been a prominent characteristic in most democratic schools.

Media outlets have also shown interest in inviting children to imagine an ideal school. For example, The Guardian newspaper in the UK conducted such a competition in 2001 and 2011 [67]; the newspaper also ran a live chat in 2013 on how important school design was to student learning [68]. The commonly shared view from teachers and architects in the live chat was that lively and colorful learning environments in an innovative school design benefitted children. Outdoor activities and the presence of nature features were part of such lively innovative designs, supporting earlier findings [69]. In two examples from Australia, The Sydney Morning Herald and The Age newspapers ran similar competitions in 2005 [70]. Children from all grade levels were invited to send in expressions of their imagined, dream school in the form of a drawing, painting, poem, multimedia presentation, drawn plan, essay, song, or documentary film. The participants were asked to imagine their ideal school representing the best possible place to learn. A significant thematic feature of such ideal school creations was the prominence of nature features—trees, grass, water, garden—as opposed to dull and dark school spaces. Participants, by choosing nature in their imagined school designs, demonstrated their affordances in nature. Such affordances may promote green exercise and various types of PA.

Research studies involving children in the imagined redesign of their schools reveal children's desire to be physically active using a variety of features in natural landscapes. Children may feel "invited" to participate in physically active behaviors. Their levels of academic performance increase with the presence of natural features in the school campus [71, 72]. Recognizing the contradiction of urban outdoors being termed increasingly unsafe for children and a growing emphasis on getting children outdoors and physically more active, schools need to be redesigned taking into account children's preferences for natural features [73]. In the next section, we further evidence the potential advantages of re-designing schools with natural features for promoting PA. We quote our research study as an example that documented children's imagination of their preferred ideal school. The most prominent theme of their imagined ideal school was the presence of the natural features that children were interested in using and relating to.

5 Role of Nature in Re-Designed Schools Influencing Children's PA

Children's drawings provide valuable information on how they perceive their living environments, including home, community, and school [74–78]. Partly inspired by "The School I'd Like" competition run in the UK and Australia [67, 70], "Imagine a School", a non-competitive, formal research project adopting visual methods [79] was carried out with participation from 133 students from nine primary schools in Queensland, Australia [80]. The 10- and 11-year-old children (years 5 and 6) drew their imaginary school with a written annotation producing visual narra-

tives. As "students-as-researchers" expressing their views [81], children's meanings were contained in their visual narratives, providing insights into their preferred elements of their ideal school. Their drawings represented the elements documenting the educational ecology of classrooms and schools [52, 80, 82].

One of the key findings was that the participants chose internal and external school environments with green features, space for PA, and calming behaviors such as space to gaze at the sky, lie down on the ground to watch a rainbow or birds flying, and listening to running water. The main themes included natural features, food production units, calming features, sports grounds, outdoor classes, outdoor activities, environmental features, animal-related features, and moving-around space. Undoubtedly, their re-designed schools support a variety of PAs and children's psychological well-being both inside and outside of the school building.

As evidenced in the above and current sections, media reports from different parts of the world have found that when children draw their ideal school pictures, they choose natural features. Architects and education specialists have showcased children's roles in re-designing educational spaces that incorporate green space. Researchers have pointed out that children prefer naturally lit, colorful classrooms allowing ample physical movement and at least a few nature-related features. However, at the moment, the physical environments of most schools have not incorporated children's preferences for nature.

In our study, primary-aged children preferred inspiring school designs with diverse learning environments and nature-related features with which they wished to interact. The presence of nature features itself is an invitation for them to be active, healthy, and well [80] as the two representative drawings demonstrate affordances in nature (Figs. 1, 2). Over 80 % of the participants preferred one or more features that reflected a desire to be physically active outdoors as well as indoors. For example, sustainable living (e.g., a vegetable garden, growing food, dairy farm) and activities that provided them with opportunities for direct interaction with nature features (e.g., creek, farm, animal farm, zoo, aquarium, rainforest patch, trees, swimming pool, water slides) were emphasized. Some participants connected nature features with calmness, peace, care, compassion, better concentration, and a deeper engagement in learning.

Connections made with the natural world for play and curriculum-related activities would undoubtedly enhance a young child's overall health and wellbeing [83]. It is essential that innovative school designs offer all young children opportunities for affordances in nature. Newer ways of including children with dependency on electronic screens for the purpose of play need further focus. Exploiting their interest in digital technology to design

Two children's representative drawings with annotations

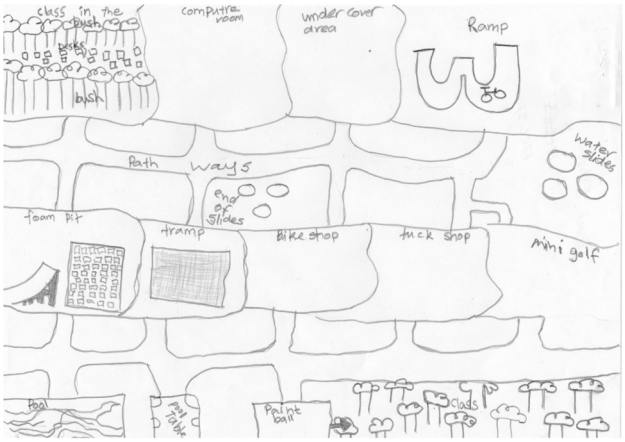

Fig. 1 "I believe the best school should be located in the bush. It will have a foam pit, 200 m trampoline, sugar world, classroom in the bush, paint ball, fireplace, swimming hole, drink machine, bike shop, computer room and a skate park." (male, year 6)

Fig. 2 "My learning space concept is an untouched, secluded, unreal rainforest. I like learning in a peaceful environment away from all the noise. I would like to be able to walk outside with a book, sit in the flower beds and read. I would also enjoy to learn about all the different animals and plants. There is so much to explore as well. I think the classroom is too crowded and enclosed. It feels good to be outdoors. I would love to live in a rainforest just like this." (female, year 6)

affordances into nature landscapes may facilitate opportunities for children to take part in physically active behaviors in such landscapes. Aspects of digital technology could be harnessed to help some children engage with nature and green exercise, even more in school play areas with 'exergaming' [84].

Such innovative ideas could be tested in urban, inner-city schools and climates that are not conducive to spending more time outside. However, natural environments provide more distinct benefits for overall health and

wellbeing that cannot be accrued from involving digital technologies in outdoor PA. Direct interactions with nature have proven to elicit positive behaviors in school children.

Therefore, school environments need to be re-designed as effective spaces for PAs by integrating nature. Children's preferences for nature-related features must be included in such designs. Bringing nature to schools will promote and sustain children's PA. Such re-designed environments will also fulfil policy makers' expectations of school children practicing active behaviors.

6 Conclusion

Ongoing research underlines the significant role of nature in human health. Research evidence also identifies and affirms the role of nature in children's physical and mental health. School children's interaction with the natural world positively impacts on their overall wellbeing. Governments around the world are now recognizing the importance of children spending more active time outdoors. However, children's outdoor activities, free play, and nature-related exploration are often structured and tightly supervised by adults due to issues of personal safety and risks. In this context, schools become more accessible and safe options for children to engage actively in outdoor PA, especially with nature features. Research on school designs involving children has revealed that children prefer natural elements and features in schools and that these might support their interest in PA. Affordances in natural landscapes provide opportunities for children to actualize active behaviors. Given that existing school campuses are designed by adults for the functional purposes of education, there is a need for re-designing school environments with nature features not only to promote PA but also to realize the health benefits arising from connections with nature.

Compliance with Ethical Standards

Funding No sources of funding were used to assist in the preparation of this article.

Conflicts of interest Vinathe Sharma-Brymer and Derek Bland declare that they have no conflicts of interest relevant to the content of this article.

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