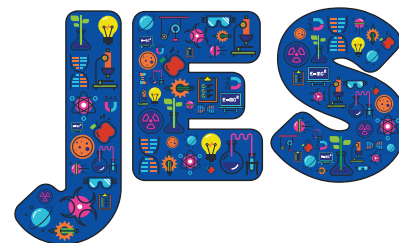


Can botanical folk tales help to reduce Plant Awareness Disparity and aid plant conservation efforts?



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Abstract

In Western society, plants are often overlooked in favour of more charismatic species. This inattention and de-prioritisation can have the effect of hindering progress towards key Sustainable Development Goals and reducing action on the climate emergency. The education system is frequently implicated in causing this Plant Awareness Disparity (PAD), possibly through focusing too much on scientific approaches to biology rather than creating more holistic and emotive connections to the natural world. We describe a small-scale intervention in which participants listened to three short podcasts focusing on the folklore of familiar UK plant species: holly, ivy and mistletoe. The Nature Connectedness Survey (NCS) was used along with additional questions to measure attitudinal changes that were interpreted as a proxy measure for changes in PAD. Significant, positive differences in NCS scores were found for all participants over the three-week intervention period. Results demonstrate the power of simple, storytelling techniques to bring emotion and meaning to teaching about plants, and we advocate for their integration into learning at all levels.

Keywords: Education, plant awareness disparity, ethnobiology, ethnobotany, plant conservation, ecopsychology

Plant Awareness Disparity

Plants comprise around 80% of Earth's biomass and form the basis for most life on Earth, providing shelter, oxygen, food and habitats for almost all animals, as well as sources of medicine, fuel and other materials for humans (Jose *et al*, 2019, Wandersee & Schussler, 1999). Plants also make up a substantial portion of the world's endangered species list, yet receive only a fraction of funding for endangered species, with the majority going towards animal conservation (Allen, 2003; Balding & Williams, 2016).

According to Allen (2003), humans have an innate tendency to ignore plants – seeing a greater inherent value in animals. This has been referred to as Plant Awareness Disparity (PAD) (Parsley, 2020), or formerly 'Plant Blindness': a cognitive bias coined by Wandersee and Schussler (1999) and described as '*the misguided anthropocentric ranking of plants as inferior to animals*'.

What may look like a simple difference in preference can have the effect of hindering motivation and progress towards Sustainable Development Goals (United Nations, 2015) such as 'Quality Education' and 'Life On Land'; policymaking, such as in relation to illegal wildlife trade, which may be affected (Amprazis & Papadopoulou, 2020; Margulies *et al*, 2019); funding for plant conservation and research de-prioritised; and interest in plant biology courses reduced (Allen, 2003; Balas & Momsen, 2017; Ro, 2019).

Plant Awareness Disparity: Causes and solutions

The term 'Biophilia', coined by evolutionary biologist E.O. Wilson (Wilson, 1986), proposed a human genetic affinity with the natural world – persisting through generations even as our actual contact diminishes (Bragg, 1996), though Allen (2003) suggests that human brain chemistry and visual processing systems may have evolved to ignore plants in favour of the movement and variable colours of animals, plants being generally static and of a more similar colouring (Wandersee & Schussler, 1999). PAD researchers often cite the lack of plant relatability for humans (Adamo *et al*, 2021; Amprazis &



Papadopoulou, 2020; Dasgupta, 2017; Richardson *et al*, 2018), with preferences reinforced through the representation of animals in culture, for example as sports mascots (Dasgupta, 2017). A link between urbanisation and 'nature deficit disorder' has also been identified (Aceituno-Mata *et al*, 2021; Knapp, 2019) – defined as harm to humans caused by being separated from nature, and a decrease in the prominence of plants in everyday life as a result of less time spent outdoors. Within a broader cultural shift towards technology and away from nature, words including *dandelion*, *bluebell*, and *mistletoe* have been removed from the *Oxford Junior Dictionary* and words such as *emoji* and *selfie* introduced (Macfarlane, 2017). Richardson *et al* (2018) also found levels of smartphone use and number of selfies taken to be associated with reduced connection to nature.

Schooldays can form a critical period for determining whether people develop an interest in plants (Amprazis & Papadopoulou, 2020; Balding & Williams, 2016; Jose *et al*, 2019), but curricula are often heavily skewed towards human and animal aspects of biology, with only 15% of US biology textbook content focusing on plants, despite recognising plants as an integral part of science education (Allen, 2003; Balding & Williams, 2016; Frisch *et al*, 2010). A more plant-focused curriculum has been shown to increase students' environmental interest (Knapp, 2019), along with their awareness of plants, and likelihood to pursue plant science careers and maintain a connection to nature (Batke *et al*, 2020; Jose *et al*, 2019).

Balding and Williams (2016) suggested that PAD may be improved through promoting empathy with plants, rather than through teaching about biological plant systems. During the *Pet Plant Project* (Krosnick *et al*, 2018), university students were encouraged to form personal relationships with plants that they grew from seed. 73% of students noticed more plants around them after the project, with 68% showing increased engagement in course materials. This supports research by Rugg (1998) identifying two critical factors that determine recall: the degree of attention that we give to something, and the meaning that we ascribe to it. Inattention becomes attention if a stimulus has meaning (Mack & Rock, 1998). Perhaps attributing more 'meaning' to plants might encourage people to pay more attention to them.

The *Five Pathways to Nature Connectedness* (Richardson *et al*, 2017), aimed at repairing the human-nature relationship, found the social and emotional themes of contact, emotion, meaning, compassion and beauty to be more effective predictors of nature connection than knowledge-based activities alone.

The importance of plant folklore

Stories and folklore can be '*frighteningly powerful*' (Haven, 2007; Lowery, 2020; Yoon, 1979), allowing us to '*create meaning from seeming disconnectedness*' (Boje, 1991) and so make sense of the world around us (Denning, 2001). In many cultures, storytelling is one of the most common forms of nature connection for children (Beery *et al*, 2020). But alongside a reduction in time spent in nature and the many plant species disappearing towards extinction (Margulies *et al*, 2010) is a loss of traditional knowledge and stories about nature (Aceituno Mata *et al*, 2021).

PAD specifically has been shown to be influenced by cultural practices, such as storytelling (Dasgupta, 2017). Stories can also enhance learning in children, connect people to past experiences, and change beliefs – especially when used to communicate factual information (Casey *et al*, 2008; Haven, 2007; Hinyard & Kreuter, 2007; Weitkamp & Mermikides, 2016).

For many non-Western communities, storytelling is part of a learning process that encourages the conservation of the land by making it culturally relevant and engendering a respect for nature (Baker, 2013; Biome Ecology, 2017; Jones *et al*, 2008; Lowery, 2020; Riley, 2010; Chaudhuri, 2008), with traditional beliefs playing a crucial role in maintaining biodiversity and storytelling linked to the preservation of natural areas and endangered species (Colding & Folke, 1997; Singh *et al*, 2017). Plants are often highly regarded for their roles in everyday human life (Knapp, 2019), largely due to the integration of ethnobotanical folklore (Cooper *et al*, 2012). Conversely, in many Western societies this inter-generational transmission of cultural knowledge is often reduced to fragments of plant folklore, such as using dock leaves for nettle stings and the 'magic' of finding them nearby when needed (Shannon *et al*, 2017).



Though much conservation work is still led by traditional science, favouring knowledge over curiosity (Batke *et al*, 2020), conservation organisations have long recognised that storytelling increases public engagement in campaigns (Shreedhar, 2021). A storytelling approach has been shown to increase science comprehension, strengthen human-plant relationships, and portray 'static' plants as complex and significant (Balding & Williams, 2016; Mascia *et al*, 2003; Sanders *et al*, 2020).

In the Amazon Basin, salvaging plant lore has become an urgent conservation goal (Schultes, 1986) and, in India, biodiversity conservation heavily relies on folklore (Pramanik & Nandi, 2019). A '*deep cultural erosion process at global scale*' (Aceituno-Mata *et al*, 2021) sees non-renewable biotic resources being lost due to a lack of traditional knowledge on how to sustain them (Osemeobo, 1994), and wild plants used for centuries for food, medicine and materials are in danger of disappearing (Simkova & Polesny, 2015).

Individuals with greater nature connection are more likely to behave in pro-environmental ways (Richardson *et al*, 2017; RSPB, 2020), and folklore has been shown to be ecologically important in addressing the human-nature disconnect (Schmonskey, 2012). Hunter (2020) identified a need for further research into the impact of folk stories on attitudes towards nature. Folkbiology has the potential to encourage a more sustainable future (Medin & Atran, 1999); animal folklore has benefited various species' conservation (Bhatia *et al*, 2021; Dhee *et al*, 2019; Holmes *et al*, 2017; Hopper *et al*, 2019; Jeeva *et al*, 2006; Murga, 2020; Orlove & Brush, 1996; Saj *et al*, 2006). Given the urgency of nature recovery and the need to mitigate the negative effects of the climate emergency, might childhood folk tales therefore hold the key to positive change by helping us to see plants as more than simply a 'backdrop for animals'? Here, we explore whether exposure to a few simple stories about familiar and common UK plants can produce a measurable change in PAD.

Materials and methods

The intervention

The primary aim of this project was to investigate whether botanical folk tales in the form of a podcast can reduce PAD and, by extension, whether storytelling can be an effective means to promote plant conservation.

Participants were invited to take part in a three-week study. This consisted of three podcasts sent by the researchers to all participants, one per week for three weeks. A survey questionnaire was used to determine levels of PAD and plant connection before and after the intervention.

Participants

Volunteer participants were all undergraduate students (n=20) on conservation courses at UWE Bristol, England. Though research suggests more plant conservationists are needed (Balding & Williams, 2016) and these individuals are aiming to pursue conservation careers, there is often a strong focus on animal biology in terms of both core course content and optional modules chosen. This is also an important target group for this research as school/university can be a critical period for determining whether or not young people develop an interest in plants (Amprazis & Papadopoulou, 2020; Jose, Wu & Kamoun, 2019; Balding & Williams, 2016).

Participants were not told that the study concerned PAD specifically, only that it was researching nature connection. The study was approved by the University of the West of England Research Ethics Committee.

Nature Connectedness Survey

Nature connectedness is known to be an important psychological construct underpinning motivation and behaviour towards a sustainable future (Richardson *et al*, 2019). Though a variety of tools exist (e.g. *Inclusion of Nature in Self Scale* (Schultz, 2001); *Nature Connectedness Index* (Cheng & Monroe, 2010); *Nature Relatedness Scale* (Nisbet *et al*, 2009)), here the *Nature Connectedness Scale* (NCS) (Mayer & Frantz, 2004) has been used for its ability to quantify participant connectedness both pre- and post-intervention. This measure has been shown to have good predictive validity and to offer a broad, nuanced analysis of nature connection and emotional responses (Navarro *et al*, 2017).



The NCS survey comprises 14 Likert-scale questions, with the maximum possible test score of five and where a high value represents a high level of nature connectedness. Additional free-response, multiple-choice and relevant demographic questions provided qualitative data relating to participants' attitudes towards plants and responses to the podcast experience and allowed for some demographic analysis. Participants were asked to describe their favourite plant or animal and asked about their hobbies and interests in order to identify any themes in participants' attitudes towards plants as expressed in their own words.

The full survey (Qualtrics, 2022) was completed by all participants before the intervention and repeated once all three podcasts had been listened to.

Creating the podcast



Podcast episodes

SEASON 1



Mistletoe Magic

S01 E04 | Jan 29, 2022 | 04:36

Find out why mistletoe is associated with immortality and the underworld, and where the tradition of kissing underneath it began...



Ivy Folklore & Folk Tales

S01 E03 | Jan 22, 2022 | 04:01

Did you know this commonly known plant is associated with bonds, friendship, and according to one folk tale in particular has the power to bind loved ones together even after death?



Holly Folklore & Folk Tales

S01 E02 | Jan 14, 2022 | 04:20

Also known as 'Prickly Christmas', this well-known yule plant is brimming with magic. Get to know holly a bit better through this dive into its folklore and tales.

Figure 1. Podcast cover thumbnails for holly, ivy and mistletoe, created using stock images from *Unsplash* and the editing software *Canva*. Also seen in context on RSS podcast homepage screenshot.

Three short audio podcasts of less than five minutes' duration were created by the first author, each focusing on a common UK winter plant and its associated folklore.

Podcasts were the medium used for this intervention as they can be listened to remotely, are easily accessible and can be uploaded to multiple free platforms. Podcasts have been shown to be effective for primary, secondary and tertiary science education (Sutton-Brady *et al*, 2016; Frisch *et al*, 2017), particularly shorter ones that allow pupils to maintain focus (Jung, 2021; Riddell *et al*, 2021).

For example, Borgia (2009) found that teacher-created podcasts benefited the science learning of fifth-grade (age 10-11) students.

Mistletoe (*Viscum album*) and ivy (*Hedera*) were chosen as species that have, despite their cultural familiarity, been removed from the *Oxford Junior Dictionary* (Macfarlane, 2017). Holly (*Ilex aquifolium*) was chosen for its fairy folklore and endangered species status (Morris, 2010).

Each podcast incorporated the three elements of 'springboard stories' identified by Denning (2001) as essential in cause-focused storytelling: connectedness, strangeness and comprehensibility. Storytelling was favoured over facts, with complex scientific language avoided, since narrative approaches to ecological learning have been shown to be more effective (Hunter, 2020).

Meaning has been shown to increase connection (Boje, 1991), and content was designed to make the three species feel more relatable and to encourage empathy. Each episode began with a 'floriography', exploring the meaning behind the plants' names, and included references to folk medicine, since the perception of utility has been found to counteract PAD in education (Pany, 2014; Pany *et al*, 2019). Birdsong was also used to increase nature connectedness (Ferraro *et al*, 2020; Richardson *et al*, 2017).

Unexpected and humorous folklore introduced a sense of strangeness. Psychological development theory (Erikson, 1950) suggests that humans pay more attention to the unexpected, and that humour is effective in podcast learning (Riddell *et al*, 2021).

All episodes are available at:

https://rss.com/podcasts/naturestales/?_gl1*1gjjg8n*_gcl_au*NjQwMDQoNDI5LjE3MjY5OTIwNDI and scripts available on request from the second author.

Results and discussion

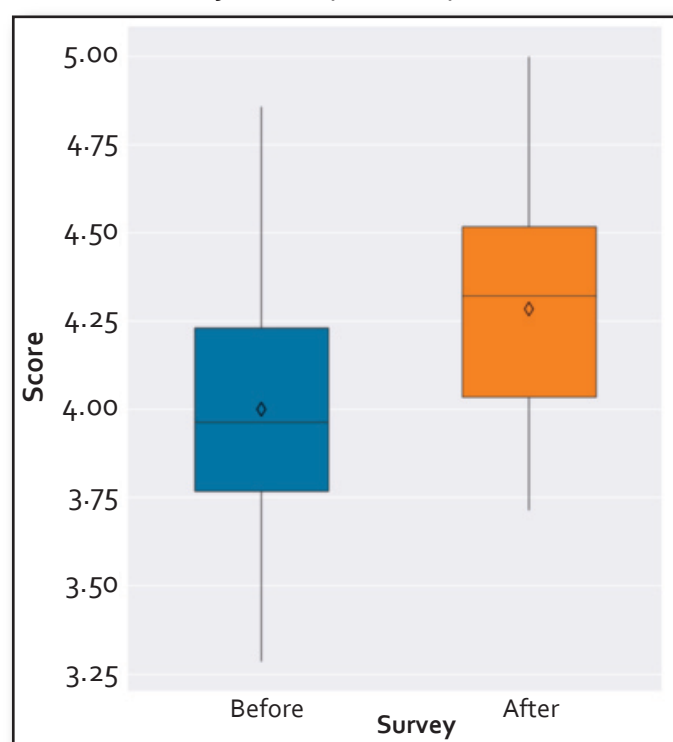
Mean scores were calculated for each participant and each question in the survey. A paired t-test was used to compare results for both the pre- and post-intervention. The mean, whole cohort, pre-intervention NCS score (n=20) was 4.0, with a post-intervention mean of 4.3 (Figure 2). Despite the relative small number of participants, this change was statistically highly significant ($p=0.00013$).

Analysis of score changes by question

For 13 of the 14 NCS questions, mean response values were higher post-intervention, with only one question (Q14) showing no change (Table 1).

However, changes were uneven across the survey, with some questions showing greater difference between pre- and post- testing than others. Q3 ('I recognize and appreciate the intelligence of plants'), Q6 ('I often feel a kinship with plants') and Q7 ('The Earth belongs to me as equally as it does to plants') showed the greatest increases, of +0.5, +0.65 and +0.4 respectively. Questions with the smallest changes were: Q8 ('I understand that my actions affect the plant world') and Q14 ('My personal welfare is independent of the welfare of the natural world'), with a difference of +0.05 and 0 respectively.

Figure 2. Mean whole-cohort *Nature Connectedness Survey* scores pre- and post-intervention.



These differences, over the course of listening to three short podcasts, suggest a reduction in plant awareness disparity (PAD) and the development of a more nuanced and complex view of plants and our place within the natural world.

The podcasts followed the recommendations of Ro (2019) that plant representation in stories allows people to view plants as part of a larger natural system of which they are a part rather than separate from, and those of Knapp (2019) that, in order to reduce PAD, *'humans should be considered as part of the natural system, rather than outside and above it'*.

Table 1. Mean scores for *Nature Connectedness Survey* questionnaire questions, showing change. (*Note that, for questions 12 and 14, the value of the response is reversed such that a higher score equates to greater nature connectedness.)

NCS question	Pre-intervention survey mean score	Post-intervention survey mean score	Difference
1. I feel a sense of oneness with plants.	3.95	4.3	+ 0.35
2. I think of plants as belonging to the same community as me, the natural world.	4.4	4.65	+ 0.25
3. I recognize and appreciate the intelligence of plants.	4	4.5	+ 0.5
4. I often feel disconnected from plants (reversed).	3.55	3.9	+ 0.35
5. I often feel a sense of wonder and/or magic when I think of nature.	4.45	4.7	+ 0.25
6. I often feel a kinship with plants.	3.2	3.85	+0.65
7. The Earth belongs to me as equally as it belongs to plants.	4.05	4.45	+ 0.4
8. I understand that my actions affect the plant world.	4.7	4.75	+ 0.05
9. I am part of the web of life.	4.55	4.75	+ 0.2
10. I feel that all inhabitants of Earth, including humans and plants, share a common 'life force'.	4.1	4.4	+0.3
11. Like a tree can be part of a forest, I feel embedded within the broader natural world.	3.9	4.2	+ 0.3
12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature (reversed)*.	3.7	4.05	+0.35
13. I am only a small part of the natural world around me. I am no more important than the grass on the ground or flowers that grow.	3.85	4.1	+0.25
14. My personal welfare is independent of the welfare of the natural world (reversed)*.	3.55	3.55	0



Table 2. Results for free-response survey questions.

Participant	What is your favourite plant?	What is your favourite animal?	Do you have any other hobbies/ interests?
1.	Sunflower	Seal	Arts, crafts
2.	Rose, edelweiss, orchid	Cat	Reading
3.	Succulents, cacti, plants that are alien in appearance, roses	Reptiles, frogs, toads, dogs	Writing, painting, psychology, animal-keeping, singing, music, stitching
4.	Willow tree	Wolves and whales	Being in nature, reading, writing
5.	Peace lily, orchid – it's amazing seeing my peace lily grow	Whale shark	Running/walking in nature, going to the gym. Anatomy, animal behaviour, veterinary medicine
6.	Bluebells, snowdrops (second survey)	Tapirs and guinea pigs	Reading, walking, drawing, nature, music, writing, wildlife
7.	Oak tree	Elephant	Painting
8.	Venus fly traps	Wolves and orcas	Singing, ukulele, guitar, being active, hiking, exploring
9.	Vegetables, willow tree (second survey)	Rabbit	Swimming, animals, cooking, socialising
10.	Breadnut tree, foxgloves – I think it changes	Again, I think it changes. Mantled howler monkey, Mustelids are my favourite family	Music, mammals, hiking, psychology, dancing, skateboarding, wildlife
11.	Baobab tree	Leopard	Sport, diving
12.	New Zealand fern, after listening to podcast 2, I have become really intrigued by ivy. It is now one of my favourites	Snakes, Brazilian Boa	Dancing, singing, running, gym, snowboarding, piano, botany, boxing, conservation, sailing, free diving, hiking
13.	Fern moss, ferns	African elephant	Photography, reading, walks in nature
14.	Snake plant, snowdrops (second survey)	Elephant	Nature, animals, gym, art, walking
15.	Echeveria succulents	Parrots	Spending time with animals, art, veganism, ice skating
16.	Lavender	I can't decide	Socialising and walking in nature, e.g. park or beach
17.	Lily of the valley	Horses	Pottery, painting, reading, going for walks, spending time with animals and friends, anything that relaxes me
18.	Don't have a favourite	Tortoise	Film and photography
19.	Sunflower	Insects	Resource management sustainability
20.	Poppy	Cats	Zoo visits with my children, animals

Results for free-response questions

Almost half of the twenty participants (n=8) cited 'animals' as an additional interest, while no participants listed 'plants' and only one cited 'botany', indicating a general preference towards animals consistent with PAD theory (Balding & Williams, 2016).

Half the participants (n=10) mentioned either 'walking in nature' or 'hiking'. However, this did not appear to have a significant bearing on the individual PAD score, since the overall scores for these participants increased by an average of 0.31, while participants not mentioning them increased by an average of 0.26. This supports existing research that simply spending time outdoors does not dramatically increase a person's nature connectedness, unless it incorporates one of the *Five Pathways to Nature Connectedness* previously mentioned (Richardson *et al*, 2017).

In the first survey (carried out in December), no participants cited *Galanthus* (snowdrop) as their favourite plant, while in the second survey (January), two participants mentioned it as their favourite. This suggests that species preferences, rather than being fixed, may reflect seasonal changes, since snowdrops are more visible in January than December. Alternatively, a post-intervention reduction in PAD may have caused them to notice snowdrops more.

Participant 12 mentioned podcast Episode 2 as having impacted their choice, stating that it had 'really intrigued' them and made ivy one of their favourite plants. However, the same participant listed 'botany' in their hobbies, suggesting a pre-existing interest in plants that might have increased their receptiveness to storytelling and folklore that mitigates PAD. Participant 3 commented that their favourite plants are 'any that look alien in appearance', aligning with the part of PAD theory suggesting that humans are drawn to features that stand out rather than that blend in – the latter being something that plants often do, especially when not in flower (Wandersee & Schussler, 1999).

Demographic data

Demographic questions provided some context for NCS changes in respect of participant characteristics, though there was relatively low diversity across the cohort with respect to the specific questions asked. All were students on an ecology course at UWE Bristol; 19 were born between 1993 and 2002 (6 born in 2000). Only one was a parent, and most grew up in the southern UK, though there were also participants from Brunei, Spain, the Netherlands and the US. Work by Richardson *et al* (2017) suggests that place of birth is generally not a factor that influences nature connection.

The majority of participants (16 of 20) were female (n=16) with only three male and one trans male. Literature suggests that women tend to have slightly greater connectedness to plants than men (Wandersee & Schussler, 1999) and results here agree with this (mean NCS scores: male = 3.6, female = 4.1), though the small number of men taking part means that differences are not statistically significant. The one trans participant had the largest initial plant connection score of the genders, highlighting the potential weakness of simple binary categories.

Pre-intervention, only 5% of participants said that they preferred plants over animals, increasing to 10% post-intervention. This doubling suggests that interest in plants can increase within a short period and supports research showing that young people have an inherent interest in plants if exposed to suitable information (Batke *et al*, 2020).

Asked to choose between a visit to a zoo, botanical garden or nature reserve, most participants chose the nature reserve both before and after the podcast intervention (n=16). However, the number selecting 'zoo' decreased from three to just one, and two participants selecting 'nature reserve' in the first survey changed to 'botanical garden'. These shifts suggest that the podcasts may have impacted participants' interest in visiting zoos versus a botanical garden or nature reserve.

Though changes were consistently positive, the extent to which changes reported here were sustained is unknown since follow-up surveys were beyond the scope of this study. However, this would be valuable data to collect.

Conclusions

The intensity of the climate and ecological crisis calls for innovative and effective educational approaches that promote engagement and the development of pro-environmental behaviours.

In England and Scotland, school curricula (Department for Education, 2013; The Curriculum for Excellence, 2010) generally delineate between science, humanities and the Arts (Osbourn, 2009). In Northern Ireland and Wales, teachers are encouraged to link science with other subjects (Northern Ireland Curriculum, 2007; Curriculum for Wales, 2022). Research notes the positive impacts of cross-curricular teaching at primary level (Kelly, 2012) and there would seem to be considerable potential for closer integration of primary science content with other curriculum aspects such as creative writing and spoken English, history and geography, and the use of plants as a focus for visual art.

There is also a need identified for a greater educational focus on plants in particular (for instance by Allen (2003), Balding & Williams (2016), Frisch *et al* (2010)). Though the primary phase includes several specific mentions of plants and their relationship to other living things, Thomas *et al* (2022) point to a low acceptance of the value of multidisciplinary approaches within plant education – something that is undoubtedly more easily realised at this stage. A narrative, Arts-based approach could be used to complement and enhance science learning and provide additional routes into science as part of a broader cultural knowledge and understanding, without compromising scientific ‘accuracy’. The study reported here illustrates how the union of these subject areas has the potential to bring plants into everyday life, with the significant increase in NCS scores found after exposure to only three short podcasts demonstrating an impact of emotion-based storytelling that foregrounds connection to nature over separation from and control over it (Kurth *et al*, 2020).

Whilst science education undeniably delivers important understanding of the natural world, folk tales can offer a rich and more personally resonant experience for the learner, allowing them to simply ‘be’ in nature without the need for conventional scientific sense-making (Bragg, 1996; Osbourn, 2009). These stories can be found through online searches, or in books such as *Botanical Folk Tales of Britain and Ireland* by Lisa Shneidau.

We advocate for the integration of storytelling within science at all levels, enhancing the benefits of both disciplines and acting to mitigate against the development of PAD (Amprazis & Papadopoulou, 2020). This intervention is, we argue, exciting for its simplicity and effectiveness. As an approach, it is easily replicated, easily scaled and can be adapted to a range of formats that appear likely to have similar potential (e.g. in-class reading, creative writing, pictorial storyboarding). Whilst our science undergraduate participants might reasonably have been expected to have high pre-existing levels of engagement with the natural world, this fact makes the significant increase in their nature connectedness all the more interesting, and gives us reason to be hopeful about positive outcomes for learners of all ages exposed to similar interventions.

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