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An expert-led outdoor activity can have a lasting impact on the environmental knowledge of participating pupils and adults

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Abstract

Children, and the adults who are responsible for their education, demonstrate an increasing lack of environmental understanding and knowledge. This is important because the development of societal environmental literacy will be key to the responses that we make to the current climate crisis. Many teachers perceive themselves to lack the skills, knowledge and resources to undertake meaningful outdoor education but through our study we show that by working with a professional environmental educator these limitations can be overcome. We have shown that children and adults can enhance their understanding and knowledge of an aquatic habitat and that through this kind of first-hand experience the impact upon children can be a lasting one.

The current interest in outdoor learning

In the UK many primary school (children aged 4 to 11 years old) teachers are embracing outdoor learning in their school grounds and where possible further afield (Prince, 2018). They are perhaps encouraged by the inclusion of the requirement that they use local flora & fauna in their teaching in the science section of the revised National Curriculum for Primary Schools (DfE 2015) which states that 'pupils should use the local environment throughout the year to raise and answer questions that help identify and study plants and animals in their habitat'. As a result, school curricula have recently been updated to include these requirements (Bentsen, Ho, Gray & Waite 2017). An increase in levels of outdoor learning could also be attributed to other factors; more easily managed risk assessments involving online support and forms (Scott, Boyd, Scott & Colquhoun 2015), an increasing awareness and uptake of the Forest School approach (Knight 2009; O'Brien 2009, Waite, Bølling & Bentsen 2015; Smith, Dunhill and Scott 2017) or increased concern for nature deficit disorder (Louv 2005, Ernst & Theimer 2011, Moss 2012). To complement the efforts of teachers a range of organisations (e.g. local Wildlife Trusts, Royal Society for the Protection of Birds, Field Study Council) provide onsite educational support for visiting school groups. Organisations such as these have recently developed initiatives to engage family learning outdoors to complement their school visit programs with schemes such as "50 Things to do before you are 11 ¾ "(http://www.50things.org.uk), "Wild Challenge" (http://www.rspb.org.uk/fun-and-learning/for-families/family-wild-challenge) and "30 Days Wild" (http://www.wildlifetrusts.org/30DaysWild). Several evaluations of public participation in outdoor natural history or environmental activities and their effect upon and the effect on connectedness to nature and personal well-being have been carried out highlighting the importance of outdoor learning in a variety of contexts (Richardson, Sheffield, Harvey & Petroniz 2016; Richardson, Cormack, M^cRobert & Underhill 2016).

Connectedness with nature has been explored by Kossack & Bogner (2012) who have shown that a shift in connectedness with nature by a test group participating in a one day environmental program when compared to a non-participatory group results in positive experiences that were a good basis for effective environmental education. Scott & Boyd (2016) found that when children aged 9 to 11 were encouraged to explore their school grounds in order to produce their own unique field guide they demonstrated enhanced literacy levels when subsequently writing about the natural world. Children aged 5- 6 years old exposed to the natural environment through the Forest School approach gain confidence (Knight 2009). More evidence is needed however on the impact of these experiences within a curricular framework. Studies by Jose, Patrick & Moseley (2017), assessing drawings pre and post intervention showed that an experiential field trip involving secondary age children (15 - 18 year olds) did cause a change in student's knowledge of a local habitat. White, Eberstein & Scott (2018) also highlighted the multiple benefits of engaging children with a short outdoor activity studying birds in their school grounds, where pupils showed an enhanced awareness of local biodiversity; those children with little prior exposure to nature demonstrating the most significant gains. More trips to outdoor settings by school groups could see an improvement in biodiversity education as well as a greater respect and care for their local environment because of their exposure to, and experience of, the natural world. In this paper we describe a research project specifically designed to explore the impact of an expert led outdoor activity upon the ability of participating children and the adults who accompany them to acquire and retain accurate natural history and environmental biology knowledge.

Positive benefits of outdoor learning for pupils

As children grow and develop they are exposed to vast numbers of new experiences including exposure to the native flora and fauna of their immediate area. They have an innate curiosity for the natural world from an early age (Tunnicliffe 2011). This curiosity and the desire to learn about the natural world needs to be fostered so that it can be perpetuated into adulthood and play a part in the development of an environmentally literate and responsible population. Knowledge about local wildlife is acquired by children from a variety of sources (parents, teachers, family members, the media and television etc) and as a result the level and perhaps accuracy of that knowledge variable. Children are limited by what they have been taught or have learned and their experiences may be limited. The Forest School approach and the uptake of this kind of learning can be a way to introduce children to their local environment but as reported by Smith, Dunhill and Scott (2017) although there is strong anecdotal evidence that children connect with the environment around them but there is no real evidence that their knowledge of the flora and fauna is improved. Scott & Boyd (2014) have shown the positive benefits of an informal trip to the seashore where children (9 to 10 years old) developed their own familiarity with rock pool organisms. Five months after the informal rock pooling activity, pupils when asked to describe animals that they had encountered, scored higher in their literacy assessment than when asked to describe unfamiliar organisms. Specific improvement in the ability of the children to use specialised and descriptive vocabulary was seen. Drissner, Haase, Wittig & Hille 2014, using their established “Green classroom” have been able to demonstrate that even a short-term education program (typically half a day) can have long term effects on pupils’ knowledge and appreciation of biodiversity. Secondary pupils writing an essay about small animals showed more biological understanding, more positive emotions and fewer misconceptions compared to their peers who had not visited the “Green classroom” up to three years previously. Similarly, primary age pupils were able to draw a broader range of types of animals and a greater number of species than a control group who had not participated in the education program. Lindemann-Matthies (2002) evaluated the “Nature on the way to school” program and how it changed children’s’ everyday perceptions of local species, showing that participation in such a program significantly increased the range of animals that the children noticed on their way to school compared to a control group. Positive effects increasing with time spent on the program. Programs such as these are indeed raising awareness of local fauna through education, even in time limited sessions and can also create an emotional bond and foster an appreciation for the environment (Drissner et al. 2014). These studies demonstrate the impact of participation in outdoor learning on biological/environmental knowledge yet the experience of learning in an outdoor environment can have more wide reaching implications in pupils’ education. Often it is the accompanying staff that have the opportunity to notice these benefits when they are working outside of the constraints of an indoor classroom.

Positive benefits of outdoor learning for teachers and accompanying adults

Scott, Boyd and Colqhoun (2013) have shown that anxiety about a lack of personal expertise can deter teachers from engaging with learning outdoors. However, by visiting a nature reserve or environmental education organisation teachers can rely on the site staff to provide expert knowledge of the local fauna and flora as well as essential knowledge of the outdoor space and its limitations. This can then take away the need for expert knowledge on the part of teachers and provide them with the time and space to observe and react to their pupils, and to learn alongside them. Waite et al. (2017) saw that teachers were able to spend more time observing children rather than organising them when the children were given a self-guided outdoor activity. They also got a better idea of how children react to others and were more aware of non-participatory children when in an outdoor setting, especially one run by site specific educational staff. Scott, Boyd & Colquhoun (2013) also report that that whilst teachers were initially reluctant to become learners alongside their pupils in an unfamiliar setting, they found that by sharing that learning, their relationship with their pupils changed in a very positive way. The children themselves expressed the view that they had enjoyed working together (with one another and with their teacher), and that they had communicated more effectively whilst learning. With more long-term implementations using the local school environment, Mygind (2009) and O'Brien & Murray (2007) demonstrated positive effects on relationships between staff, their students, and their attitude towards learning motivation and nature. Similarly, Scott et al. (2013) found that the children involved in the outdoor learning activity in their study were described by their teachers as being motivated and engaged, helping to alleviate teacher anxiety and a feeling of losing control when moving learning outdoors. The benefits of outdoor learning have been discussed many times (Dillon, Rickinson, Teamey, Morris, Choi , Sanders & Benefield 2006, Dillon & Dickie 2012, Nundy 1999) showing the impact of outdoor learning on pupil education, yet there are also implications for the accompanying staff. Teachers themselves should be the best practitioners to deliver sessions to their own classes within school and Scott et al. (2015) found that teachers expressed little concern when teaching outside of their specialism within the classroom but then expressed concern once they moved into an outdoor space. It appeared that there was too much unfamiliarity for them and that lack of teacher self-confidence was found to be the main reason why children were not taken outside, even within the school grounds. Although this mainly related to their lack of knowledge of the local fauna and flora it also related to a lack of confidence in working in the outdoor environment. The theory in relation to outdoor learning is recognised (MacQuarrie 2016) as being underdeveloped. What may be effective in the classroom may not be as effective outside. Skills honed teaching within the classroom are often not transferrable to an outdoor space; participation or even observation of skilled outdoor providers can be essential continuing professional development. Experienced outdoor teaching staff with an excellent knowledge of their own working environment are able to relay those teaching skills to accompanying staff who then benefit alongside their pupils when taking part in an outdoor activity away from the classroom. When teachers learn alongside their pupils teachers become learners themselves in the outdoor setting (Scott et al. 2015). They then recognise that finding something that was unplanned should be regarded as a valuable teaching and learning opportunity rather than a distraction. In participating they are facilitating their own learning and in doing so moving their school as well as their pupils forward.

Potential barriers to outdoor learning

These outdoor learning experiences will always need to be justified in terms of time out of school, risk factors, cost and the value of the learning experience (Scott el al 2014). Scott et al. (2015) found that practising teachers were aware of the benefits of outdoor learning but found that excessive paperwork regarding risk assessments was off putting and time consuming and the need for parental contributions to fund trips were sufficient barriers to prevent trips taking place. Parental perceptions of the value of outdoor learning are complex and it has been demonstrated by Parsons and Traunter (2019) that effective communication between parents and teachers is essential if outdoor learning is to be wholly effective. Waite el al (2017) suggests that without evidence of the impacts of outdoor learning at a local level for specific contexts, there maybe reluctance on the part of schools and organisations to invest resources and make room in busy schedules for it. All of these are barriers have been previously reported (Waite 2010, Scott, Boyd, Scott & Colquhoun 2015, Barker, Slingsby, & Tilling 2002) but can be overcome if solutions to these barriers are in place. Scott and Boyd (2016) encouraged the teachers in their study to carry out their outdoor learning activity within the school grounds, therefore addressing the problems of leaving the school site. With some specific CPD they also found that in-service teachers have a willingness to overcome the many barriers that they face. However trips to other establishments can provide that expert knowledge and give pupils (and staff) an insight into a more diverse range of habitats.

Outdoor learning provision beyond the school gates

Trips to local nature reserves involving site staff with specific knowledge are widely available and provided by a range of organisations (e.g. local Wildlife Trusts, Royal Society for the Protection of Birds, Field Study Council) throughout the country and these organisations welcome a wide range of schools throughout the year. Sites can often provide dedicated classroom facilities, specialised equipment and qualified educational staff to accompany groups. Knowledge and experience in teaching and delivering educational programs in an outdoor setting by specialist staff can increase visiting staff confidence. This is a benefit when revisiting ideas and concepts back in their school environment as seen by Waite et al. 2017. A range of curriculum areas are covered by these establishments at a range of levels. They are delivered in a variety of ways from outdoor play and storytelling (usually aimed at 5 -7 year olds) to formal field studies collecting scientific data in a more rigorous manner (A level students; 17-18 year olds). Science education, whether inside the classroom or in a field based session helps, students develop science process and skills and reflect those used by the scientific community. Lieboritz, Faria, Baro & Borges (2017) carried out a species survey on a marine wetland to allow primary pupils an understanding of the work of a marine biologist. Their inquiry based activities helped students to develop not only scientific knowledge of the marine invertebrates but also a better understanding about the processes that scientists use in their research and practical experience of scientific equipment, giving pupils an active role in their learning. The study showed that children are perfectly capable of engaging in scientific field research activities; data collection and explanation. Using personal meaning maps (PMMs) Lieboritz et al. (2017) were able to also assess pupils' biological understanding following the activity, results showing that in general there was some progress in the complexity of the PMMs at the end of the activity. This supports the view put forward by Thorburn & Allison (2012) that a meaning derived from an experience (scientist carrying out an ecological survey) can support children's' wider understanding. Seeing the environment, working in the environment and being part of a scientific investigation helped students to visualise and understand the issues of biodiversity and to grasp the scale and importance of local and perhaps even global problems (Lieboritz et al. 2017). Taking part in this kind of research is a vital part of the visit to the nature reserve, something that is less accessible within the school grounds and provides the pupils with an ownership of part of their natural environment.

The Study Context

Establishing the impact of an outdoor learning opportunity

Drawing together all of these themes the aim of our research has been to explore the potential of a short educational excursion to a local nature reserve to have a lasting impact upon aspects of the ecological knowledge of participating children and of the adults who accompany them.

Yorkshire Water is a water supply and treatment company that allows public access for educational and recreational purposes at many of their water supply and treatment sites and facilities. Educational centres that aim to provide opportunities for school children and the wider public to learn about the supply of water have been established at a number of their sites. Tophill Low is a Yorkshire Water water treatment site in East Yorkshire that is surrounded by 300 acres of mixed woodland and wetlands that have been managed as a nature reserve for more than 30 years. In April 2017 an education centre was developed at the site and a range of educational programs were developed and offered to visiting school parties. These activities are delivered by an Education Guide who has excellent knowledge of the site and who is an experienced outdoor educator (MB, author). Discussions that we have had with teachers who make use of the facilities suggest to us that their classroom and school grounds based curriculum did not provide a sufficient opportunity for the study of local fauna and that their primary purpose in visiting the site was to expand the pupils' knowledge of a local habitat.

In November 2016 a large pond was established adjacent to the environmental centre specifically to enable safe pond dipping opportunities for visiting children. Each visiting group is given instruction by the education guide on how to sample the pond (pond dipping) and how to correctly identify organisms using the Field Studies Council "*Identification of common freshwater invertebrates*" guide, with assistance from volunteer wardens where necessary. To give the activity an authentic context it is explained to the group that they are in effect acting as scientists (ecologists) monitoring the colonisation of a young pond.

Informal feedback gathered following the first of these school visits was very positive. Fedback captured at the end of visits or through thank you letters sent following a visit were full of compliments, descriptions of fun that was had, and declarations of interest, excitement and amazement were common. It was also common for informal feedback to make reference to knowledge gained, species that have been encountered are named, and the relationships between species or between species and their environment are mentioned. In this paper we describe a structured attempt to collect data from children and accompanying adults who have participated in pond dipping visits specifically to understand the potential value of such an experience with respect to the acquisition and retention of accurate natural history and environmental biology knowledge.

Data collection

We have used a personal mind mapping approach (after Lieboritz et al. 2017) to establish the knowledge base of children and accompanying adults participating in pond dipping visits upon arrival at the site (prior knowledge), during a classroom session immediately following the pond dipping (acquired or reinforced knowledge) and during a school-based session a month or more after the visit (retained knowledge).

During a short on-site introduction to the activity about to be undertaken participating children and adults and were asked to complete a personal mind map work sheet – simply a single page in the centre of which was an oval (a pond) containing the words 'Life in a Pond".

Participants were asked to write their given name on the sheet so that these data could be linked to other data provided by that participant in subsequent mind maps. Minimal direction was given to individuals completing the mind map, participants were simply asked to add as many words as they could that they felt were associated with life in a pond, and it was completed in a set time period (maximum 10 minutes). This exercise was repeated at the end of the visit, and again approximately one month later in the classroom (administered by classroom teachers).

Five primary schools, located within 20 miles of the nature reserve were involved in this project. Three are small rural primary schools having 40 (school *a*), 105 (school *b*) and 110 (school *c*) children on their rolls. 30 pupils from school *a* (year group 2, aged 6-7 years); 31 pupils from school *b* (year group 3, aged 7-8 years); and, 21 pupils from school *c* (year group 3 and 4, aged 7-9 years) participated in the learning activity. The other two schools are larger urban schools with 214 (school *d*) and 506 (school *e*) on their rolls. 31 pupils from school *d* (year group 1, aged 5-6), and 26 pupils from school *e* (year group 1, aged 5-6) participated in the learning activity.

All of the pupils involved were either currently studying habitats as a theme in their curriculum or had learned about habitats in the preceding summer term. Schools were visiting Tophill Low either to link their current learning to a different habitat away from their school grounds or to consolidate previous learning. Data were collected and analysed for 143 pupils who completed personal mind maps before and immediately after the activity whilst at the site, and 107 personal mind maps were completed by children in school approximately one month after the activity. 19 accompanying adults (teachers and non-teaching staff) completed personal mind maps before and immediately after the pond dipping activity, none were completed in school.

Data analysis

Personal mind maps were collated and their content coded. We adopted a thematic analysis (Nowell, Norris, White & Moules, 2017) and an inductive approach to generate initial codes from the data itself (Braun & Clarke 2006; Nowell et al. 2017). Primary coding was carried out by one of the authors, and then a sample were coded by the second author as a verification technique. Verification initiated re-coding in an iterative way until agreement was reached. During coding the authors discussed the words used by participants and developed a classification system that attributed a numerical value to words according to the level to which they demonstrated accurate knowledge about life in a pond and pond life. In essence words that had no clear linkage to pond life such as *tree* or *car* were given a low score (1) whilst the name of a specific pond organism such as *lesser water boatman* was given a high score (7) (see Table 1 for the score range and examples).

Table 1 about here

Table 1: Scores attributed to words appearing on personal mind maps, see text for an explanation of the derivation of scores.

Score	Description of classification	Examples
1	Nothing to do with water	Car, spider, tree
2	Incorrect but related to freshwater	Shark, seaweed
3	Very general ideas connected to freshwater	Animals, plants, mud, nature, drowning
4	Shows some basic knowledge of water	Fish, swimming, prey

	life/living and/or adaptations	
5	Shows general knowledge of water life/living and/or adaptations	Ducks, insects (bugs), gills, webbed feet
6	Good level of awareness of organism types found in freshwater	Swan, stickleback, frog, otter, newt, tadpole, lilly pad, reeds, dragonfly
7	Specific knowledge of organism types found in freshwater	Pond skater, marsh frog, (water) boatman, common darter

Results

To test the hypotheses that the relevant knowledge base of participants increases immediately following the educational activity and to explore the level to which it is retained over the weeks following the activity we have simply considered the average scores of words used by individuals in each of their personal mind maps. To consider the statistical significance of increases/decreases in word score through time we have used Wilcoxon matched pairs tests to compare median word scores of known individuals immediately before and after the activity, and before the activity and approximately one month later. These data are presented in Table 2 and in figures 1 and 2.

Table 2 about here

Table 2. The use of words by children and accompanying adults when completing personal mind maps to capture their knowledge about life in a pond. See text for derivation of scores. Values represent the mean number of words used by an individual having each score +/- the standard deviation of that mean.

	Word score	**Before activity**	**After activity**	**After one month**
Children	1	0.47 ±0.83	0.63 ±1.16	0.39 ±0.81
	2	0.32 ±0.81	0.18 ±0.51	0.19 ±0.47
	3	2.49 ±2.12	2.92 ±2.66	3.07 ±2.74
	4	1.02 ±0.79	1.06 ±0.88	1.14 ±0.85
	5	0.34 ±0.68	0.20 ±0.58	0.26 ±0.48

	6	1.43 ± 1.34	1.21 ±1.38	1.56 ±1.37
	7	0.08 ±0.83	1.16 ±1.36	1.53 ±1.20
Adults	1	0.05 ±0.23	0.05 ±0.23	
	2	0.05 ±0.23	0 ±0.00	
	3	3.68 ±3.38	2.42 ±2.12	
	4	1.84 ±1.26	0.89 ±1.05	
	5	0.42 ±0.61	0.26 ±0.56	
	6	3.31 ±2.02	2.15 ±2.29	
	7	0.68 ±1.16	3.58 ±1.54	

On average the mean scores for words used by children was 3.8 +/- 1.37 (SD) (n = 141) prior to the activity; 4.1+/- 1.61 (SD) (n = 141) immediately after the activity and 4.3+/- 1.64 (SD) (n = 119) after approximately one month. Whilst there were incidences of children using words from all seven categories during each period of data collection children most commonly used words linked in a superficial way to pond life (category 3). However, immediately after the pond-dipping activity and again one month later, children were more likely to also use more precise terminology, or words indicative of an increased level of awareness than was the case prior to the activity (categories 6 and 7). As might be expected the adults accompanying the children were unlikely to use words from the lowest categories (1 and 2) under any circumstances. The mean score for words used adults used immediately before the activity was 4.54 +/- 0.74 (SD) (n = 19), and the mean score immediately after the activity was 5.45 +/- 0.81 (SD) (n = 19) .Prior to the activity adults, like children, were most likely to use category 3 words (superficial association with pond life), but they were equally likely to use category 6 words suggesting a higher level of awareness of the types of organisms commonly found in a pond. Immediatley after the pond dipping activity adults were most likely to use category 6 and 7 words suggesting that they had learned the specific (common) names of organisms encountered during the activity. We believe therefore that our data demonstrate that in the case of both children and adults participation in the pond dipping activity has resulted in the acquisition of specific knowledge about life in a pond. Furthermore two-tailed Wilcoxon matched-pairs tests confirm that these knowledge gains are statistically significant at the level of the individual (children z-value -2.4084, $p < 0.01$, $n = 92$; and, Adults z-value -2.5842, $p < 0.01$, $n = 19$). In the case of the children this effect persists and acquired knowledge is retained (z-value -4.4943, $p < 0.01$, $n = 119$).

Figure 1 about here

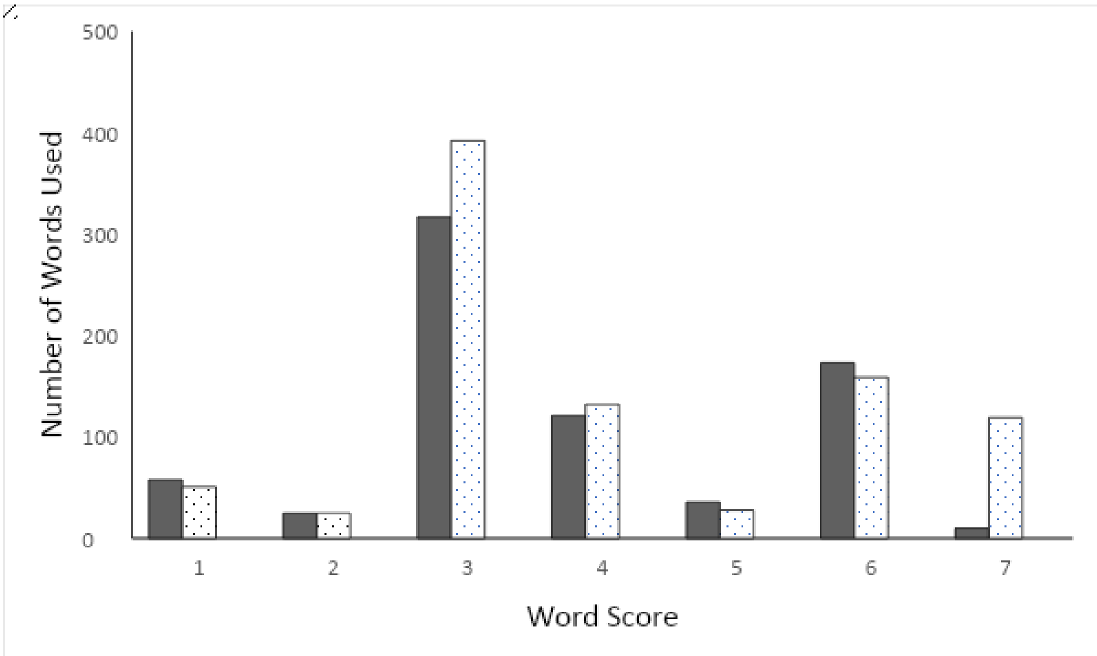

Figure 1. The frequency of word use by children completing personal mind maps prior to (solid bars), immediately after (dotted bars) and one month after (hatched bars) the pond dipping activity.

Figure 2 about here

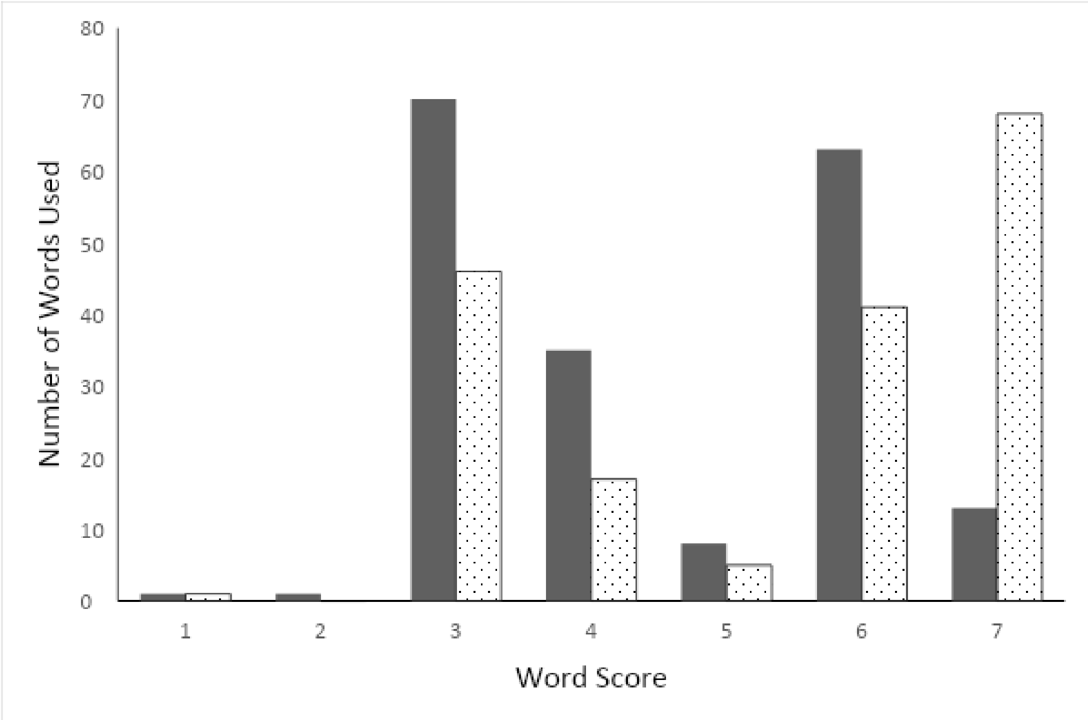

Figure 2. The frequency of word use by accompanying adults completing personal mind maps prior to (solid bars) and immediately after (dotted bars) the pond dipping activity.

Discussion

Our work has demonstrated that at one level a relatively simple outdoor learning activity facilitated by an expert environmental educator can support teachers who may not have the experience or training to teach out of doors to provide meaningful and impactful learning for their pupils. We have also demonstrated that personal mind maps (PMM), similar to those used by Leibovitz et al. (2017), allow the collection of a large amount of data in a short period of time without impacting upon the day's learning activities. PMMs are therefore a useful tool in this context and one that we would recommend to others who want to take a snap-shot of the knowledge base of a group for either research or teaching purposes.

Before the pond-dipping activity children and the adults accompanying them demonstrated a limited awareness of the ecology of a pond ecosystem. Although there were some children and adults who did use technically appropriate language and who demonstrated some knowledge of the life in a pond prior to our pond dipping activity, the majority did not. Like others (e.g. Drissner, Haase, and Hille 2010, Klingenberg 2014, Maynard, Waters and Clement 2013) we have demonstrated that when children (and in this case adults) are provided with an opportunity to learn out of doors they are able to do so. In this case we were able to record an increase in the use of appropriate vocabulary and an increase in ecological knowledge immediately after the pond dipping activity, and to demonstrate in the case of the children that acquired knowledge can be retained for a period of at least a month.

Randler and Bogner (2002) have suggested that familiarity with a species through first hand observation may enhance knowledge retention for some learners and a similar effect has been demonstrated by Scott and Boyd (2014) who have shown that even after a relatively short out door experience children who have first-hand familiarity with an animal or plant typically demonstrate a higher level of ability to write about the ecology of a species than children who have not had a similar experience. In the same study they also demonstrated that children demonstrated a higher level of literacy *per se* (assessed through standard testing) when writing about familiar organisms and places. A similar positive impact of learning outside of the classroom has been reported on the reading performance of children by Otte, Bölling, Stevenson, Ejbye-Ernst, Nielsen and Bentsen (2019). In the current study we were also able to demonstrate that in the case of the children their knowledge gains persisted and were still evident approximately a month after the learning event. This is not in itself a surprise to us given that Scott and Boyd (2014) have shown that after even an informal out-door activity children demonstrate a retention of knowledge about the organisms and ecologies that they have encountered for a number of months. It is likely that the novelty of working out-doors and first-hand experience combine results in a particularly strong interaction of the affective and cognitive learning domains enabling the formation of strong positive memories (Waite, 2007).

The involvement of an expert educator in our learning activities enabled children and the adults accompanying them to learn together. Shared outdoor learning opportunities like this are important because they can help to overcome problems related to a lack of self-confidence in learning out-doors that is experienced by some teachers (Scott, Boyd and Colqhoun, 2015). Learning together can also shift perceived adult/child power relationships and enhance the learning experience (Scott, Boyd and Colqhoun, 2013). It is not uncommon for accompanying adults involved in visits to sites like Tophill Low to include parents as well as members of the wider school teaching community. Extending the learning together community in this way may have additional value in that it facilitates a discussion and contributes to the development of a shared understanding between parents and teachers about the aims and potential value of out of classroom learning. This is a discussion that has been identified as lacking by Parsons and Traunter (2019) but that they believe to be essential for the successful promotion of outdoor learning.

Our findings matter because we are living through a climate crisis during which individual connections with nature are diminished, but ecological awareness and literacy are increasingly important. Outdoor experiential learning can also help children to meaningfully contextualise classroom-based environmental education James and Williams (2017). Furthermore, it has been demonstrated previously that learning outdoors can promote connectedness to nature (Berg, Barrett, Robinson, Camara & Perry 2020), and that the development of personal links with the environment can have a positive impact on individual attitudes towards nature conservation and play a vital role in conservation (Ernst & Theimar 2011; Otto & Pensini 2017). We believe that it is incumbent upon educators to do all that they can to redress this imbalance, to enable a connection with the natural world, and to develop the ecological literacy of those that we can influence. Ecological fieldwork of the kind described in this paper, facilitated by an expert educator is one strategy by which this might be achieved.

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