STRANMILLIS UNIVERSITY COLLEGE
A College of Queen's University Belfast

DCU Ollscoil Chathair Bhaile Átha Cliath Dublin City University

SCoTENS
THE STANDING CONFERENCE ON TEACHER EDUCATION, NORTH AND SOUTH

Outdoor Learning in Mathematics (OLM)

Building capacity for outdoor learning in mathematics through a cross-border collaboration

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Contents

List of tables

List of figures

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Introduction

It is widely established that learning in the outdoor environment has a positive impact on children's cognitive, affective, social, and physical skills (Dillon et al., 2005; Rickinson et al., 2004). There is a great deal of overlap between these areas with the benefits reinforcing each other (Marchant et al., 2019). Healthier, happier children have higher educational achievement, and investing in children's education has the potential to improve their future health and wellbeing (OECD, 2006).

Despite these important benefits, there is growing evidence to suggest that children are spending less time in nature (Louv, 2005; Soga and Gaston, 2016). Marchant et al. (2019) argue that the school setting has the greatest responsibility and capacity to provide access to natural environments through learning activities in the school grounds. However, the provision of outdoor learning experiences appears to be insufficient in primary schools, particularly beyond the early years (Waite, 2010). Teachers report a range of barriers to outdoor learning provision, including a lack of time, resources and support (Rickinson et al., 2004). The emphasis on test-based accountability has also been linked with a decrease in outdoor learning provision (James and Williams, 2017; Shume and Blatt, 2019). Waite (2010, 2011) describes the tension experienced by many teachers who value the outdoor environment as a context for learning but feel under pressure to meet the requirements of a standardised and test-driven curriculum. Rather than view standards-based instruction and outdoor instruction as an 'either/or' choice, Shume and Blatt (2019) recommend the use of the outdoor environment as a context for learning in core areas of the curriculum such as mathematics.

Many teachers around the world appear to be uncertain about how to link the curriculum to outdoor learning, although this may depend to some degree on the policy context and the emphasis placed on the delivery of curriculum content within that education system (Waite, 2022). Providing teachers with access to resources that link the curriculum with the outdoor environment has been shown to help ease the burden on time and curriculum pressures, and increase the provision of outdoor learning experiences (Waite, 2022).

Project aims

The aim of this project was to build teacher capacity for outdoor learning in mathematics through cross-border collaboration. The project sought to promote greater knowledge and understanding of how the outdoor environment can be used to support mathematics teaching in primary schools and to equip teachers with a variety of ideas for teaching mathematics outdoors. Given the decline in

outdoor learning provision between the early years and later stages of primary education, it was decided to focus on upper primary mathematics.

The main outcome of the project was to develop an online resource freely accessible to all teachers in order to support the planning and delivery of outdoor mathematics activities in upper primary classes. It is believed that the development of such a resource, with exemplar activities and case studies of effective practice in outdoor mathematics, will play an important role in improving children's mathematical attainment as well as their ongoing health and wellbeing.

The project and SCoTENS objectives

This project met a number of key objectives of the Standing Conference on Teacher Education, North and South (SCoTENS). Firstly, it involved collaborative research and professional dialogue between two institutions in the North and South of Ireland – Dublin City University and Stranmillis University College, Belfast – on an issue of mutual concern to teacher educators. The researchers had not worked together previously, so the project initiated valuable inter-professional and inter-institutional links between both teacher educators, and helped to strengthen connections between Dublin City University and Stranmillis University College. The project promoted cross-border research and enhanced professional expertise across the island of Ireland in the teaching of mathematics outdoors: an area of current interest and concern to primary teachers. The project also encouraged collaboration between the professional learning community (PLC) of teachers who were recruited to inform the development of the resource. This initiated valuable cross-border connections and cross-border learning between teachers in the North and South of Ireland.

The development of an online resource to support outdoor learning provision in primary mathematics will be of interest to teacher educators and teachers (both pre-service and in-service), in the North and South of Ireland and beyond. The project findings will be communicated to the wider educational community through relevant conferences, and publication in research and scholarly journals. This will allow for dissemination throughout the North and South of Ireland as well as to a wider international audience.

Overview of the report

This section has provided a brief introduction to the project. Chapter 2 outlines the methodology adopted and Chapter 3 presents the key findings. Finally, a discussion of relevant issues, including recommendations for policy, practice and future research is presented in Chapter 4.

Chapter 2: Methodology

This chapter sets out the methods used in the study. It begins with an overview of the design of the study, the methods of data collection and an outline of the main phases of the project. The study participants are also identified. The ethical considerations which informed the research design and data collection procedures are discussed. The chapter concludes with a brief summary of how the data collected was analysed.

Research Design

The research questions which guided the study are as follows:

1. How can the outdoor environment be used to support teaching in mathematics? (RQ1)
2. What are teachers' views and practice in relation to the use of the outdoor environment in mathematics? (RQ2)
3. How does the online resource impact teachers' views and practice in relation to the use of the outdoor environment in mathematics? (RQ3)

In addressing the research questions, the project design progressed through six distinct phases, as shown in Table 1 below. This design prioritised an initial investigation of the current situation in relation to teachers' views and practices involving the use of the outdoor environment in mathematics. Informed by this research, the researchers worked collaboratively with teachers to design materials to support the provision of outdoor learning experiences in mathematics.

Table 1: Phases of the project with data collection strategies and links to research questions.

Project phases	Timeline	Research questions
1. Understanding the current situation	Sept 2022 – Jan 2023	RQ1, RQ2
2. Developing the draft resources (including recruitment of PLC)	Feb 2023 – April 2023	RQ1, RQ2
3. Trialling the draft activities	May 2023 – Sept 2023	RQ1, RQ2
4. Refining the draft activities	Oct 2023 – Jan 2024	N/A
5. Marketing the online resource	Mar 2024 – Jun 2024	N/A
6. Evaluation	Apr 2024 – May 2024	RQ2, RQ3

Further detail on each of the project phases is provided below.

Phase 1: Understanding the current situation

The researchers engaged in a scoping review of relevant research papers, policy documents, books and internet sources to identify good practice in outdoor learning in mathematics. This research provided insight into RQ1 and informed the creation of a questionnaire to investigate teachers' views and current practice in relation to the use of the outdoor environment in mathematics in the upper primary years. This online questionnaire contained a mixture of Likert-type responses and open-ended questions. It was circulated to all primary schools in the North and South of Ireland (n = 3926: 822 schools in Northern Ireland and 3104 schools in the Republic of Ireland). The resulting data provided insights into RQ1 and RQ2.

Phase 2: Developing the draft resources

A professional learning community (PLC) (Brodie, 2020) of teachers from both North and South was recruited. (Further details are included in the participants section). Altogether five meetings of the PLC took place across the different phases of the project. Meetings took place online and were audio-recorded for research purposes, with key questions planned as per a semi-structured focus group interview (Hennink, 2013). A full list of PLC meetings and the main topics of discussion is provided in Table 2.

Drawing on the analysis conducted in Phase 1, the project team (comprised of the two researchers, a research assistant, and a technical assistant from Stranmillis University College) began collaboration with the PLC to develop an online resource for teachers, in order to support their planning and to equip them with a variety of ideas for leading experiential mathematical activities in the outdoor environment.

Phase 3: Trialling the draft resources

A draft set of outdoor activities was compiled and shared with the teachers in the PLC who trialled some of the activities in their classrooms. They completed brief questionnaires detailing their experiences and suggesting recommendations for improvement. These were shared with the project team and discussed at subsequent PLC meetings. Audio-recordings of PLC meetings and questionnaires were collected for analysis.

Phase 4: Refining the draft resources

The online resource was refined based on the feedback received. The final version of the resource, with supporting and ancillary information on the project, was prepared for publication on

the Stranmillis University College website. Screenshots of the website and a sample activity are included in Appendix 1 and Appendix 2, respectively.

Phase 5: Marketing the online resource

The resource was launched on 14 March 2024. This shared event took place via Eventbrite. It included input from the researchers and members of the PLC. Professor Noel Pudy (Director of Research and Scholarship, Stranmillis University College) introduced the event and Dr Maura Coulter (Associate Dean for Research, Dublin City University) concluded the event. A concerted effort to publicise the resource was made, largely involving social media posting by Stranmillis and DCU accounts, in addition to circulation via emails lists.

Phase 6: Evaluation

PLC participants were invited to attend an online interview with the aim of gathering information on the teachers' views of the final product and any impact the resource and participation in the PLC had had on their practice in relation to outdoor education and mathematics. A questionnaire was developed to seek teachers' views on the resource. This is accessible via a link on the website.

Table 2: Overview of timeline and content of PLC meetings

Date	**PLC Meeting topics**
February 2023	Introduction to the project Sharing current practice Setting out expectations
April 2023	Sharing experiences of trialling activities Feedback on draft activities Reflection on challenges and benefits
June 2023	Feedback on draft activities Reflections on practice
October 2023	Feedback on draft website (content and presentation) Reflections and sharing of practice
January 2024	Planning for launch

Data Collection

Table 3 gives an overview of the data collected at each phase of the project, the participants involved, and the relevant research questions targeted through each data collection method.

Table 3: Overview of the main sources of data collected

Phase	Data source	Participants	Research questions
1	Online survey of teachers' views and current practice in relation to outdoor learning	Primary school teachers in the North and South of Ireland (n=401)	RQ1, RQ2
2-6	Audio recordings of five PLC meetings	PLC participants	RQ1, RQ2
2-6	Electronic questionnaires to evaluate draft activities	PLC participants	RQ1, RQ2
6	Audio recordings of individual semi-structured PLC interviews	PLC participants	RQ3
6	Online questionnaire seeking feedback on the *Out and About* resource	Visitors to the website	RQ3

Participants

Participants from both the North and South of Ireland engaged in various phases of the project. Participant details are outlined by phase below.

Participants in Phase 1

As noted above, Phase 1 involved a large-scale online survey which was distributed via email to schools listed on relevant databases (n = 3926: 822 schools in NI and 3104 schools in RoI). The project was also promoted on social media, with links to the survey. The total number of respondents overall was 401 (56% NI, 44% RoI).

Participants in Phases 2 – 6

Invitations to participate in a PLC were circulated via email to all schools in the North and South of Ireland and were also advertised on social media. Eleven teachers (6 from NI; 5 from RoI) expressed interest in joining the PLC. Six teachers attended the initial meeting of the PLC; this dropped to a core group of four highly enthusiastic and committed individuals (3 teachers from two schools in NI and one from RoI) who remained engaged across all phases of the project.

Participants in Phases 5 and 6

The final two phases of the project involved teachers more widely. The online resource was marketed via social media posts and email distribution, and feedback was sought via an online survey accessible on the home page of the website.

Ethical issues

The researchers were guided by the British Educational Research Association (BERA) guidelines for educational research (BERA, 2018; 2024). Approval for this research was sought from Stranmillis University College and relevant ethical procedures were followed.

Informed consent/assent was sought from all project participants. The voluntary informed consent of all teacher participants (teachers participating in the online questionnaire and teachers in the PLC) was sought before commencement of the project. For the online questionnaire, participants were presented with relevant information about the project and were not able to proceed to the questionnaire without indicating their consent to participate. Consent was also sought from the school principal and/or Board of management of PLC participants. All participants were given time to read and understand the information about the project and to ask questions of the researchers before deciding if they wanted to be involved.

Parents/guardians and children in the classrooms of teachers in the PLC were informed about the nature of the project and invited to participate. As this project only minimally changed the normal learning environment of children, no potential for physical and/or psychological harm/distress to children was foreseen. The parents' voluntary informed consent and children's assent was sought before commencement of the project, including permission to collect samples of work, photos and videos for sharing within the PLC. Additional permission was sought from the relevant parents/guardians and children to publish samples of children's work, photos and/or videos on the project website.

Participants were assured that their participation in the project was entirely voluntary and that they retained the right to withdraw, without penalty, at any point. Should children and/or parents/guardians decide at a later period that they no longer wish their work, photos or videos to be shared on the project website, they may inform the relevant teacher/researcher via email and all samples will be removed.

The research was conducted to the highest standards with careful attention to rigour and integrity at each stage of the process, in line with the BERA (2018, 2024) ethical guidelines. The confidentiality of research participants was ensured at all stages in the research, from data collection to analysis and publication, subject to legal limitations. Research data (including consent/assent forms, questionnaire responses, transcripts of PLC meetings, copies of PLC teachers' journals) are held securely on a password protected webserver at Stranmillis University College and protected from

external intrusion. Hard copies of data are stored in a locked office at Stranmillis University College or in a locked office at Dublin City University by the named researchers. Hard copies of data will be destroyed (via shredding) and digital records will be destroyed (via deletion) no later than 5 years after completion of the project.

All efforts were made to protect the anonymity of participating teachers and children in reports and presentations associated with this project. Pseudonyms will be used for all participants in written reports. Some PLC participants have chosen to forgo their right to anonymity in order to share their experience and so, since this is a small-scale study, it is not possible to guarantee complete anonymity.

Data Analysis

The data collected included both qualitative and quantitative data. Quantitative data arising from Likert-type responses on the online questionnaires was analysed and descriptive statistics were produced. Qualitative data included open-ended questions from questionnaires, audio-recordings of PLC meetings and interview transcripts. The qualitative data was analysed using thematic analysis (Braun and Clarke, 2022).

Key findings will be presented in the next chapter.

Chapter 3: Key findings

In this chapter, a selection of interim findings is presented. First, findings arising from the large-scale survey carried out in Phase 1 of the project are presented. Then, analysis of the qualitative data arising from PLC participant interviews is presented. Finally, initial feedback on the use of the resource is discussed.

Findings of the large-scale survey

As discussed in Chapter 2, the Phase 1 online survey was informed by a review of the literature. The chief purpose of the survey was to gain insight into teachers' views and practice in relation to the use of the outdoor environment in mathematics. The survey was circulated via email to schools listed on relevant databases (n = 3926: 822 NI, 3104 RoI) and the total number of respondents was 401 (56% NI, 44% RoI).

Respondents

Teachers from a range of year groups were represented amongst the respondents with just less than 50% teaching upper primary. Respondents also included teachers with different years of teaching experience, as evident in Figure 1.

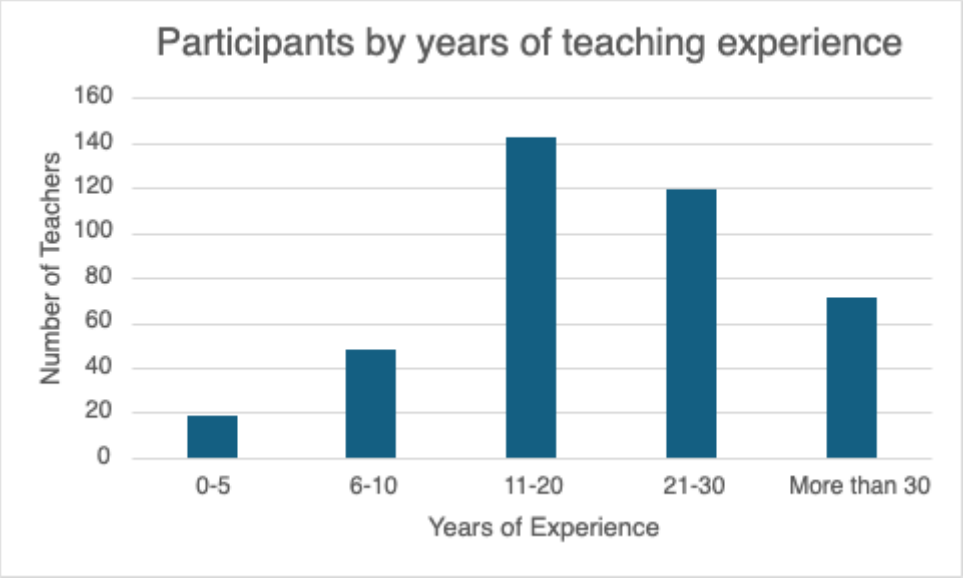

Figure 1: Participants' year of teaching experience in Phase 1 online-survey

In addition, there was variability in the school contexts of the participants, as shown in Figure 2. While some teacher respondents worked in schools which might be considered to have an established practice and policy around outdoor learning, significant numbers reported not having, or

being unsure about having, an Outdoor Learning Policy (71.6%) or an Outdoor Learning Coordinator (77.3%). In addition, 78% of respondents reported not working in, or being unsure about whether their school is, an FSA recognised Forest School Provider.

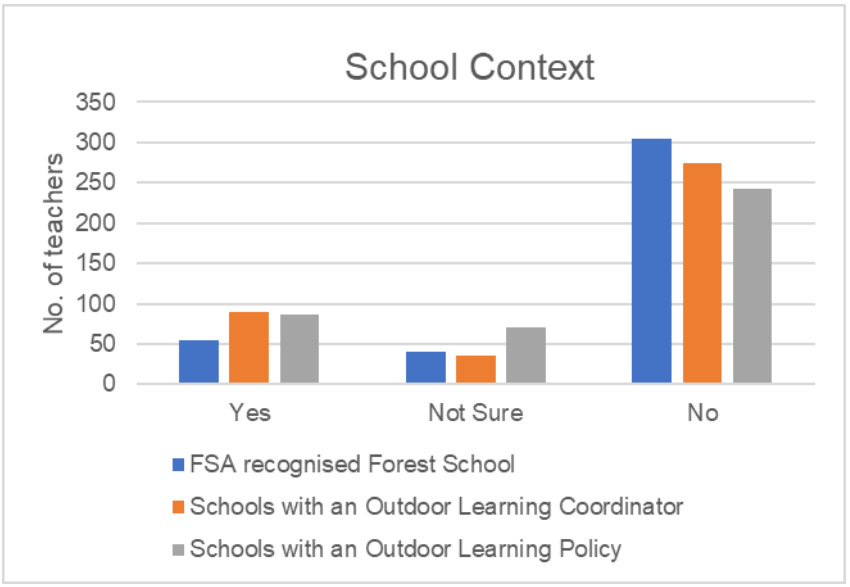

Figure 2: Respondents' descriptions of their school contexts

Teachers' views

In general, teachers were positively disposed to the idea of outdoor learning with negligible numbers disagreeing with the idea that children of all ages should engage in outdoor learning experiences in primary schools (less than 1% of respondents). The statement was phrased to deliberately include 'children of all ages', as research indicates a fall-off in outdoor learning experiences as children progress through the primary school (Waite, 2010). As Figure 3 suggests, the vast majority of teachers agreed or strongly agreed with this idea. Notably, respondents from the North of Ireland expressed this view more strongly than respondents from the South of Ireland.

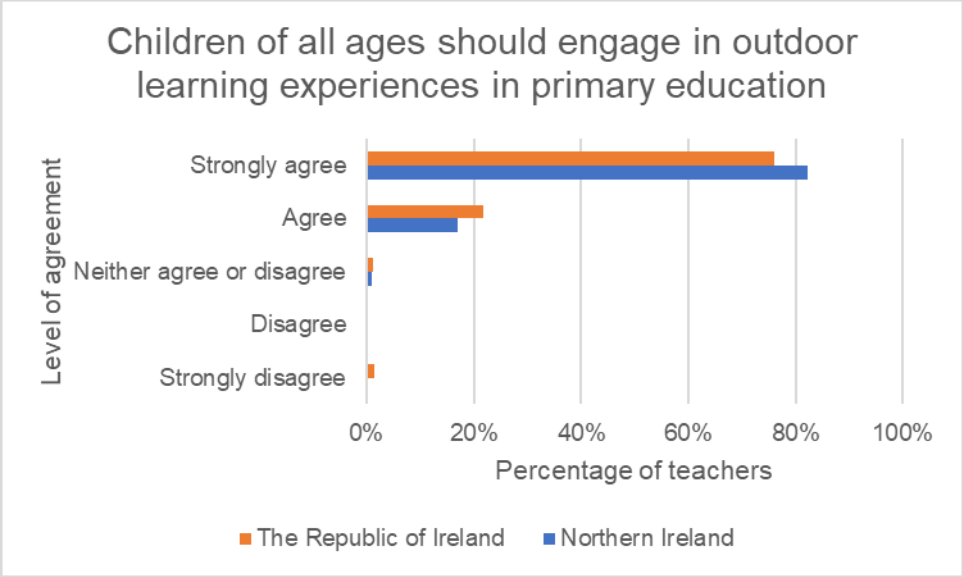

Figure 3: Overview of responses to the statement 'Children of all ages should engage in outdoor learning experiences in primary schools'

While largely positive, responses to the statement 'Outdoor education should be a compulsory element of the primary school curriculum' were more diverse (Figure 4). There was strong support for this statement, particularly from respondents in the North of Ireland, but a significant proportion of respondents (18%) from the South of Ireland neither agreed or disagreed with the statement, perhaps indicating uncertainty. While the proportion of respondents who disagreed with this statement was small, disagreement was noticeably higher from respondents based in the South of Ireland.

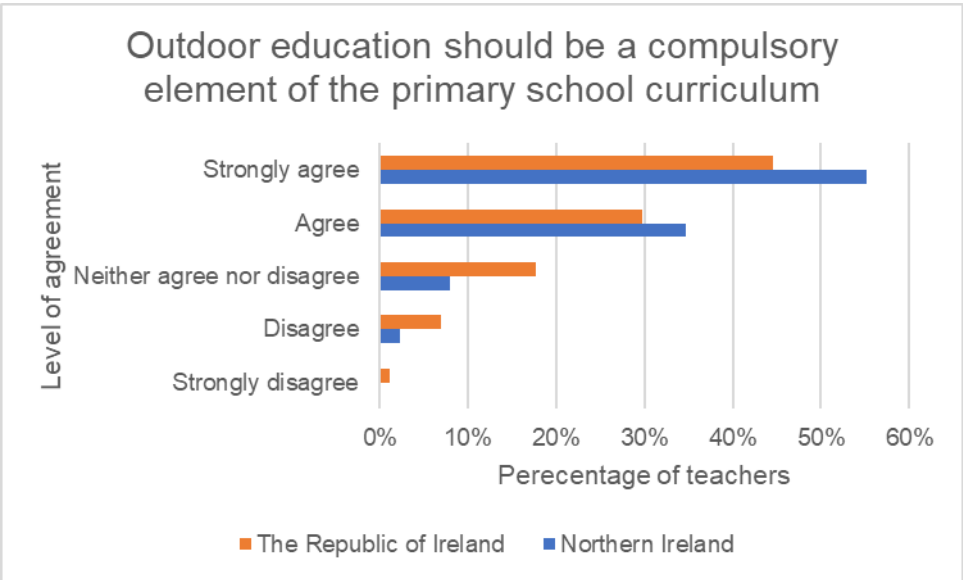

Figure 4: Overview of responses to the statement 'Outdoor education should be a compulsory element of the primary school curriculum'

The literature identifies several potential challenges to implementing outdoor learning in mathematics. The survey asked teachers to rank barriers identified in the literature from most significant to least significant (Figure 5). More than half of respondents ranked the pressure of an 'already-packed curriculum' as the most or second most significant barrier. Similarly, the weather was also identified by respondents as a highly significant barrier. Relatively small proportions of teachers identified management, school environment, or a lack of support as a significant barrier for the implementation of outdoor learning in mathematics.

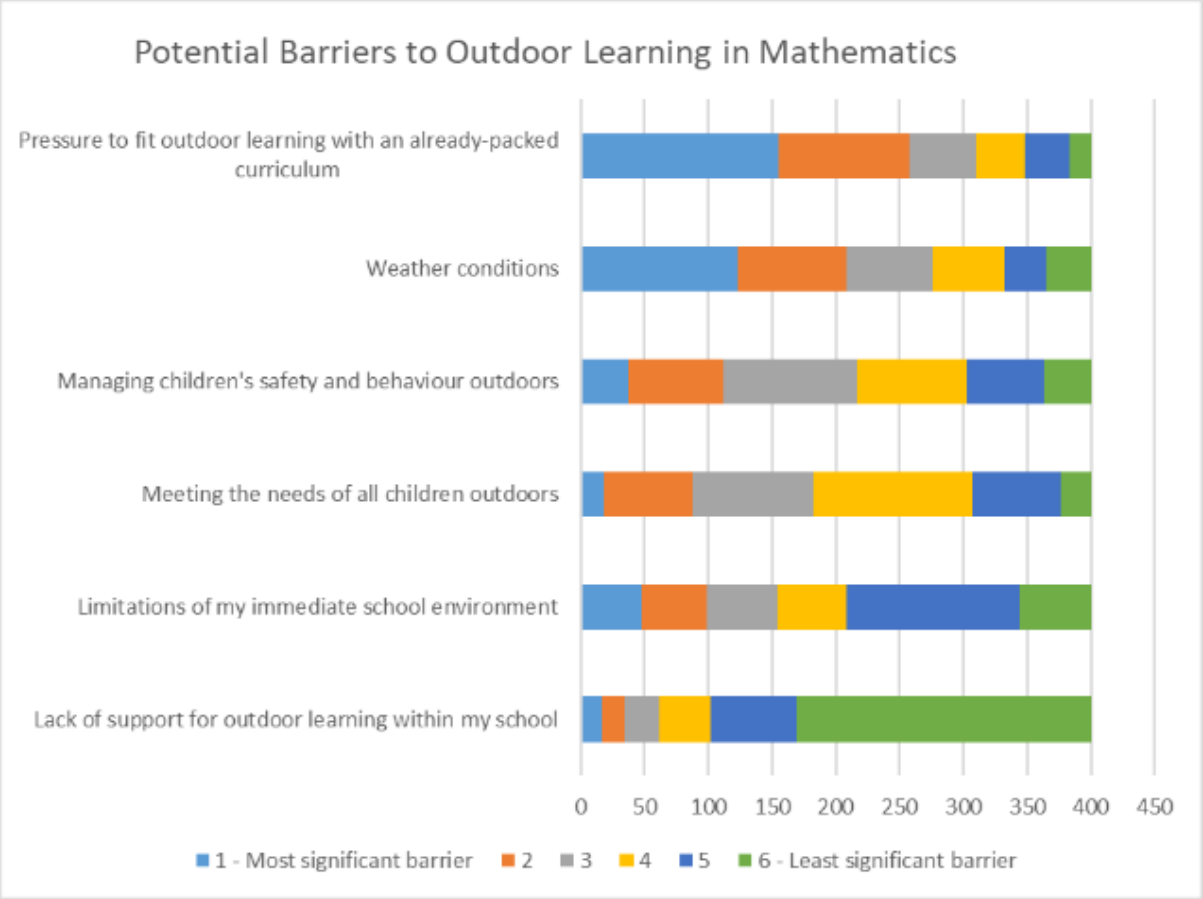

Figure 5: Teachers' ranking of potential barriers to outdoor learning in mathematics

Teachers' current practice

The online survey also sought information about teachers' current practice in relation to outdoor learning in mathematics. In line with the literature, the data suggests that children in the early and middle years of primary school engage in outdoor learning experiences more frequently than children in upper primary years (Figures 6 and 7).

For example, 22% of Foundation Stage teachers in Northern Ireland teach outdoors every day, whereas no teachers of Key Stage 1 or Key Stage 2 teach outdoors every day. In Foundation Stage,

an additional 40% of teachers teach outdoors a few times a week. In Key Stage 1, 11% of teachers teach outdoors a few times a week, 29% about once a week and 34 % a few times a month. These percentages decline further in Key Stage 2 with 9% teaching outdoors a few times a week, 18% about once a week and 23% a few times a month. The most popular response (34%) for Key Stage 2 teachers was 'several times a year' and 3% of KS2 teachers indicated that they never implement outdoor learning in mathematics.

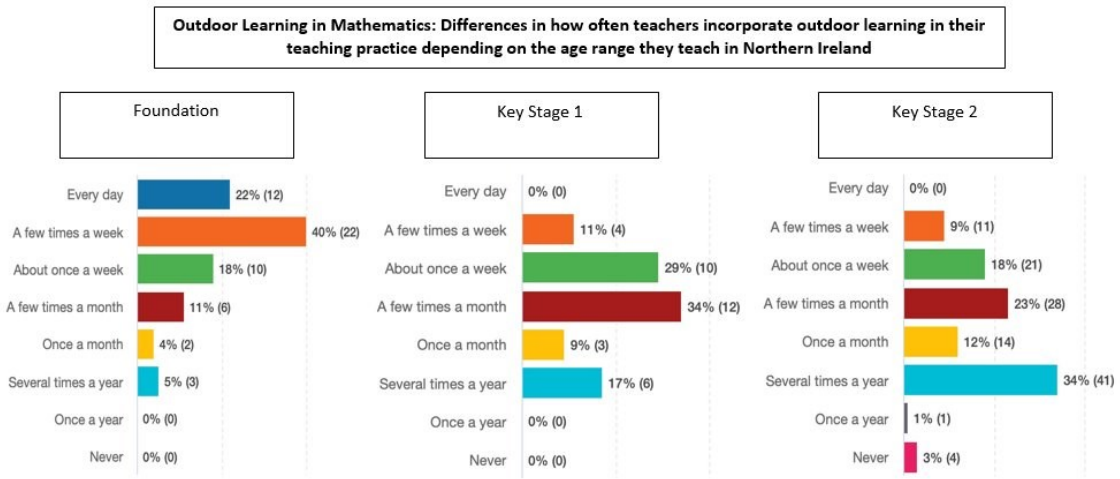

Figure 6: Overview of frequency of outdoor learning by age range reported by respondents from the North of Ireland

Similar patterns are evident in the responses from the South of Ireland, though it is noticeable that these start from a lower base. Just 4% and 21% of infant teacher respondents reported engaging in outdoor learning experiences in mathematics every day, or a few times a week respectively. Interestingly, the relative proportions of teachers of senior primary reporting teaching mathematics outdoors a few times a week is higher than the figure reported by respondents in the North of Ireland. However, caution is needed in extrapolating general trends from this data given the small numbers of respondents involved in each subcategory, and the voluntary nature of the survey.

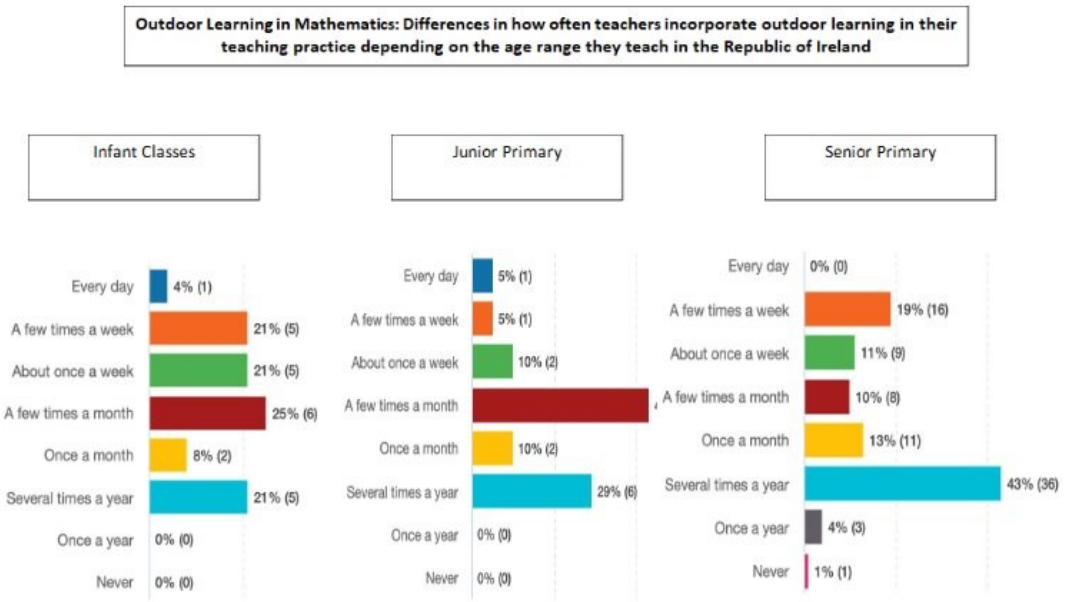

Figure 7: Overview of frequency of outdoor learning by age range reported by respondents from the South of Ireland

Teachers' support and development needs

A key focus of data collection was to understand teachers' support and development needs. While recently graduated teachers were more likely to report having experienced outdoor learning in initial teacher education, the vast majority of respondents had no experience of outdoor learning in their initial teacher education (Figure 8).

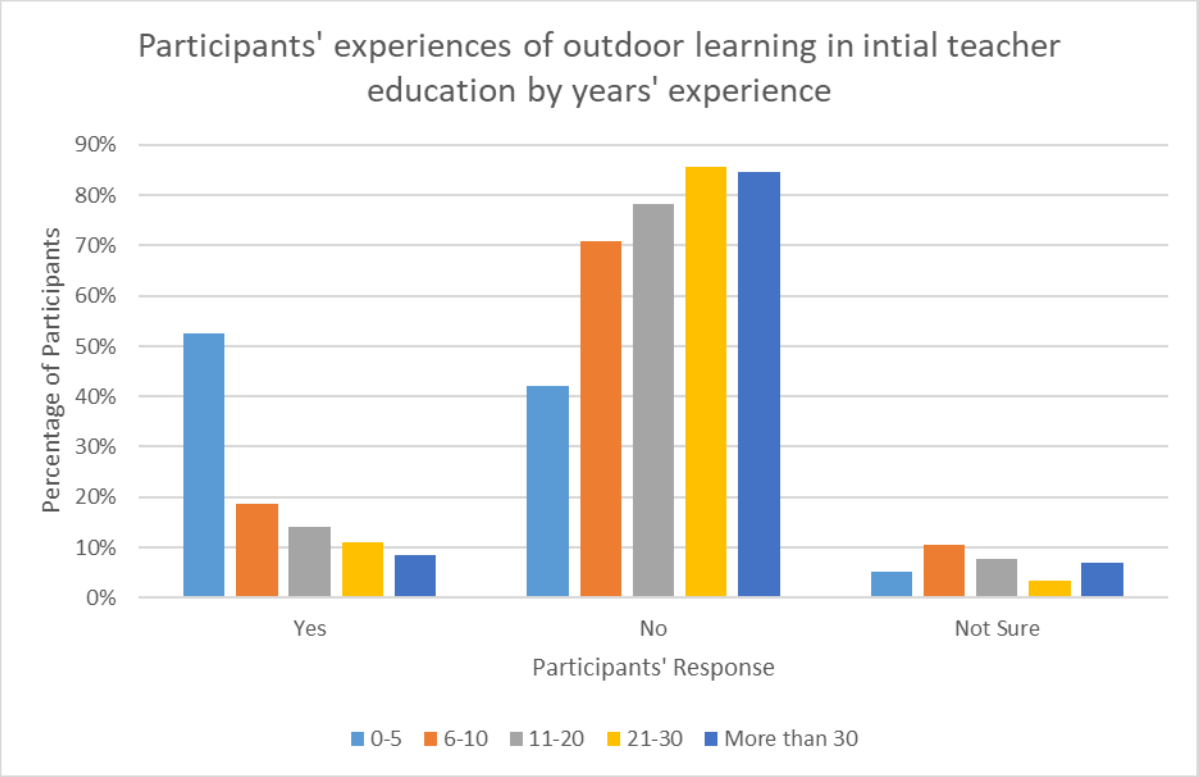

Figure 8: Participants' experiences of outdoor learning in initial teacher education by years of experience

Importantly, many of those who have engaged in professional development in outdoor learning since initial teacher education did not experience any input on the teaching of mathematics outdoors (Table 4).

Table 4: Participants who did/did not receive input on the teaching of mathematics outdoors during professional development

Did the training incorporate elements of mathematics?	
Yes	41
No	101

Teachers identified the need for ideas for teaching mathematics outdoors, case study exemplars and video clips of effective practice as support that would be of benefit to them.

Findings of the PLC participant interviews

Participants in the Professional Learning Community (PLC) were interviewed individually following the launch of the resource. Three areas of interest were explored:

1. Participants' views of the impact of the project on their practice
2. Participants' views of the use of the outdoors in mathematics
3. Participants' views of participating in the PLC

Findings from the interviews are presented below.

Participants' views of the impact of the project on their practice

Analysis of the interview transcripts identified three key themes relating to participants' views of the impact of the project on their practice. Firstly, participants noted an improvement in their confidence in teaching mathematics outdoors:

> *"It's definitely improved my confidence."*
>
> *"Having this experience has really built my own confidence."*
>
> *"I'm much more confident and much more willing to give it a go now."*

Two of the participants detailed how their confidence had evolved over the course of the project. They both referred to initially feeling "hesitant" or "scared" at the prospect of teaching mathematics outdoors, but over time they became less apprehensive:

> *"I wouldn't have done maths outdoors before this… The first time it didn't go smoothly but it wasn't nearly as bad as I thought and it gave me that confidence to try it again, and then the more I tried it, the more I was able to just do it without being apprehensive."*
>
> *"I was a little bit scared in the beginning… Would they do any maths, or would they just see this as an extra playtime? But actually taking part has opened my eyes and I'm more open now."*

Secondly, participants noted an improvement in their teaching competence due to their involvement in the project. One participant gave specific examples about feeling more "innovative" and "creative" in her lesson planning, and another talked about how it had positively impacted her organizational skills:

> *"It's encouraged me to develop a breadth of activities… I'm more innovative in my teaching practice."*
>
> *"It made me think better in terms of, what am I actually doing? It's definitely improved my teaching and the organization in my teaching."*

Thirdly, all participants expressed their motivation to continue integrating outdoor learning in mathematics in future. They said that they would continue using the *Out and About* resources in future lessons, with one participant adding that she wanted to make sure that outdoor learning in mathematics was incorporated into her planning for September:

"I'm more prepared now than I was last year so I'm going to start in, you know, September… Some of the activities kind of lend themselves to that time of year and I need to find the opportunities to [teach maths outdoors] as much as I can."

Participants' views of the use of the outdoors in mathematics

Participants were also questioned about their perceptions of the use of the outdoor environment in teaching mathematics. One of the participants admitted that her perceptions had changed over the course of the project:

"I admit I almost had a sort of preconception that sometimes outdoor learning is a bit gimmicky, you know? Was there real educational value in simply taking the activity outside? But through the experience of being involved in the project, the answer to me is yes, there is definite value and the children get so much out of it."

All of the participants agreed that there were numerous benefits to using the outdoors in teaching mathematics. The most frequently cited benefit of outdoor learning was that it was more engaging for the children, particularly since it involves hands-on experiences:

"The children are definitely more engaged when you bring them outside."

"They just love the hands-on experience."

"They're much more engaged with whatever we do outside… Children would just kind of tune out of a maths lesson because they're at that tricky age but they were much more hands on and doing whatever they could and they really enjoyed the kind of working together."

Providing the opportunity for group work was also mentioned by the participants as a further benefit of teaching mathematics outdoors:

"There's more opportunity for group activities. There aren't that many [opportunities for group work] in the classroom."

"It's nice to see the children working away together."

The participants claimed that their students were more enthusiastic when the mathematics lessons were taken outdoors. One participant said that her whole class felt "more relaxed" when they were outside the classroom. Another participant referred to outdoor learning as consolidating prior learning, noting that it helps to "build on [the students'] existing knowledge… It sort of cements the learning".

However, the participants also identified a few challenges that they had encountered in teaching outdoors. One participant said that she had found the weather to be a barrier. Another noted that outdoor learning was more time consuming than conventional classroom teaching. This was especially true for the P7 teacher, who said that it was difficult to "find the time" to teach outdoors when the existing scheme of work for their year group was already extensive.

Participants' views of participating in the PLC

The participants were asked to evaluate their involvement in the PLC. All participants were incredibly complimentary about their experiences:

> *"It was great being involved."*
>
> *"It's been a thoroughly enjoyable experience."*
>
> *"I found it fantastic."*
>
> *"It's been a really valuable opportunity, and more importantly, I've seen the benefits for the children."*
>
> *"I loved being involved in this project… It's going to make a big, big difference in my teaching."*

They were all enthusiastic about the opportunity to meet with other teachers who were also exploring outdoor learning in mathematics:

> *"It was really nice just to share experiences."*
>
> *"It was nice to know that other people were as enthusiastic as I am about outdoor learning."*
>
> *"It was nice to hear from other people's experiences and hear what they enjoyed and how the lessons went for them."*

One participant who self-identified as having the "least experience" in the group, said that for her it had been especially useful because she was able to draw from the experience of the rest of the group.

The participants indicated that being part of the PLC became an incentive in itself: "[The PLC] inspired me to carry on… Plus if I knew there was a meeting coming up, I wanted to try out a few things so I had something to say… It gave me the incentive to just keep going." In terms of the meetings themselves, again the participants were complimentary, suggesting that they were "low-

key", "non-pressurized", and "encouraging". One participant went so far as to say that she would "actually miss" the meetings!

The only suggestion for improvement of the PLC related to the lack of participants:

> *"I would like to have had maybe a few more schools involved… It was fairly well publicised… So it's just a bit disappointing that more schools didn't get involved."*

> *"I think more people would've been nice. I know it's down to who's interested, but it just, even in a slightly higher, like five or six people might just bring more, you know?"*

Initial feedback on the resource

The *Out and About* resource was launched on 14 March 2024 via Eventbrite. The event was recorded and is available at: https://youtu.be/YiVPjBGxpCA?si=fcc3ZJ2bPAbkk2Ix

80 people joined the event. A further 139 registered interest in the event but were unable to join on the day. To share the project more widely, details of the launch event (including a link to the YouTube video recording) were shared via email and social media and recipients were encouraged to provide feedback. In addition, a questionnaire to seek users' views on the resource was developed and is accessible from the *Out and About* home page.

Website analytics

Figure 9 below shows that, as of 31 May 2024, there have been 1,200 unique users accessing the website. In other words, 1,200 different people have been visiting the website. Overall, there have been 3,695 website views, indicating that people (on average) are returning to the website two or three times.

	Page path and screen class +	↓ Views	Users
		3,695 0.73% of total	1,200 0.64% of total
1	/resource-centre/outandabout/	2,021	1,128
2	/resource-centre/outandabout/number-and-algebra/	512	370
3	/resource-centre/outandabout/getting-started/	288	223
4	/resource-centre/outandabout/shape-and-space/	273	198
5	/resource-centre/outandabout/measure/	270	217
6	/resource-centre/outandabout/handling-data/	250	178
7	/resource-centre/outandabout/acknowledgements/	81	57

Figure 9: 'Out and About' website analytics (31 May 2024)

Website survey

Five people have completed the website survey to date. All five are primary teachers and have asked to be added to a mailing list to be kept up to date with the project's developments. Three of the respondents joined the original online launch event; one of the respondents was recommended to visit the website by a friend, and one saw a post about the website on social media.

All respondents agreed that the website was attractive, engaging, and easy to navigate. They agreed that the information on the 'getting started' page was helpful. They agreed that the content was appropriate for upper primary and that the teacher guidance notes were helpful. All of the respondents strongly agreed that there was a good range of activities. Particular strengths of the activity pages were identified as follows:

> *"Accessibility and clarity" of the activity pages.*
> *"Clear ideas of exactly what to do with clear learning objectives."*
> *"The information is set out clearly and the pages reduce teacher workload."*
> *"Well organised creative planning that makes it much easier to take Numeracy Outdoors. Lessons are easy to follow."*

None of the participants felt that there would be any challenges to using the outdoor activities in practice.

The survey invited respondents to report on whether the resource had influenced their planning in any way. Four respondents agreed that it had and indicated their intention to include outdoor learning in future planning in mathematics, with one respondent noting that assessment of children's learning would also need to change:

> *"Absolutely, it has motivated me to try these activities outdoors and also to adapt some of them for active learning indoors."*
> *"I will ensure moving forward that I include more outdoor lessons in my Mathematics planning."*
> *"Yes, it has made me more open to taking Numeracy outdoors."*
> *"Yes, I think for my school it is about trying out a lesson or two initially to build the confidence of teachers. Assessment of learning will be different and will be pictorial rather than pages in books."*

Finally, participants were invited to make any additional comments on the resource. There were three comments:

"Thank you so much for all the hard work that is clearly evident in preparing this valuable resource."

"Keep adding to the resources."

"Thank you very much for this fantastic resource!"

The participants were asked if there was any further support for outdoor learning in mathematics that they would like to see in future. All respondents highlighted that it might be beneficial to see curriculum content linked to suggestions for outdoor mathematics activities. However, they appreciated the challenges of doing this across two different educations systems with different curricula.

Email feedback

A number of people provided feedback on the *Out and About* website via email. Comments include:

"I just want to say what a wonderful resource 'Out and About' is. I will be recommending it to all our preservice teachers." (Associate Professor in Mathematics Education)

"These are great resources. It's great to have access." (Primary school teacher)

"Thank you for your important work. We will share this on udeskole.dk and through a newsletter." (Danish Udeskole Network)

In addition, three teachers asked if they could be added to a mailing list to be kept up to date with the project's developments.

Feedback from the PLC

Participants in the PLC were also invited to provide feedback on the resource at the end of the project. Overall, they were highly positive about the resource:

"*There are some brilliant, brilliant lessons and definitely a lot I'll be trying."*

"The resources were excellent."

"The resources make it so much easier. It's so much more attractive… having the lessons nearly planned out."

In particular, the participants welcomed the level of detail in the activities, and claimed that that this would ensure that they would be accessible to teachers who did not have a background in outdoor learning. They also liked that the resources provided the opportunity for flexibility, so that activities could be tailored to meet the needs of individual children.

All of the participants referred to several other colleagues who had accessed the resources and were excited to try them out with their classes:

> *"A teacher in another school said to me, I am just looking forward to trying out those resources."*

> *"Some other teachers in the school were like the video was good, I watched the video and the resources look great… It's definitely caught on in my school."*

All participants indicated that they thought it would be beneficial to develop a similar resource for teachers of younger year groups:

> *"You need to make something similar for Key Stage 1… These [resources] should be available for all ages, not just older primary."*

One of the participants further suggested that having a webinar series to introduce the resource and activities might be helpful, particularly for teachers who are new to outdoor learning. Having an easy-to-access guide on teaching mathematics outdoors might encourage and inspire less confident teachers to 'have a go'.

Chapter 4: Conclusion

Outdoor learning is a pedagogical approach used to enhance learning, promote engagement and improve pupil health and wellbeing. However, there is a lack of research on how outdoor learning can be effectively implemented on a regular basis by primary schools (Marchant et al., 2019). Providing teachers with access to resources that link the curriculum with the outdoor environment has been shown to increase opportunities for outdoor learning (Waite, 2022).

This project aimed to build teacher capacity for outdoor learning in mathematics through cross-border collaboration. The researchers worked in collaboration with a professional learning community of teachers to create a web resource freely accessible for all teachers to support their provision of outdoor learning experiences in mathematics. The project has resulted in a range of important benefits, as detailed in the sections below.

Project outcomes

Development of a resource for outdoor learning in mathematics

The main outcome of the project was the development of an online resource to support teachers in their planning and delivery of outdoor mathematics activities in upper primary classes (see Appendix A). The resource provides a wide variety of ideas for progressing learning in a range of mathematical topics within Number and Algebra, Measure, Shape and Space, and Handling Data. A sample activity from the number strand is included in Appendix B. The development of mathematical processes is promoted throughout all activities and there is a strong emphasis on the use of real-life contexts and connecting learning across the curriculum. The resource also offers practical advice on 'how to get started' with teaching mathematics outdoors and includes guidance on the use of resources (both natural and commercial). As detailed in chapter 3, website statistics indicate high levels of user engagement (1200 unique users at the end of May 2024). Feedback has been very positive, with many comments including requests for more lesson activity ideas.

The project will support capacity building for outdoor learning in mathematics across primary schools, both North and South, and further afield.

Development of cross-border professional relationships

Another important outcome was the establishment of cross-border professional relationships between the lead researchers and the teachers in the professional learning community. This project

has resulted in a new collaborative partnership between the two researchers, with important benefits for both institutions involved.

The teachers participating in the PLC also benefitted in a professional capacity from collaborating together to inform the development of the resource. Data analysis shows that they welcomed opportunities to develop their capacity to provide outdoor learning opportunities in mathematics. They report making changes to their own practice by increasing their use of outdoor learning in mathematics.

Teacher education

The project promoted greater knowledge and understanding of how the outdoor environment can be used to support mathematics teaching in the primary school. The main outcome of the project is the development of an online resource to support teachers across the island of Ireland in their planning and delivery of outdoor mathematics activities. Findings will be used to inform mathematics education courses in Initial Teacher Education and Continuing Professional Development in both institutions. It is also believed that the resource could be used to support school-based professional development learning.

Findings will also be disseminated widely in order to share research and practice with other teacher educators and the wider education community. The researchers have already presented on this research at the *Educational Studies Association of Ireland* conference in Spring 2023. The researchers intend to present their findings at other conferences such as *Mathematics Education Ireland* (MEI) 2025, and will continue to work together to produce a journal publication about this project.

Future generations of children

The project will have important benefits for outdoor learning provision across primary schools both North and South, and further afield. The influence of the current generation of policy makers and practitioners will be pivotal in shaping provision for the future generation of children. Ultimately, the children of the future are the intended beneficiaries of this project. It is believed that this project will enhance their knowledge, skills and understanding in mathematics as well as promote their engagement in learning, and improve their health and wellbeing.

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Appendices

Appendix 1: Screenshots of the online resource

Extract from home page.

OUT AND ABOUT: OUTDOOR ACTIVITIES FOR KEY STAGE 2 MATHEMATICS

These activities have been designed to support and enhance the teaching and learning of mathematics in the outdoor environment in upper primary classes. They offer ideas and suggestions for progressing learning in a range of mathematical topics with a strong emphasis on the use of real-life contexts and connecting learning across the curriculum.

For further information on how to get started with teaching mathematics in the outdoor environment, and using the resource, click on the 'Getting Started' button.

ACTIVITIES AND RESOURCES

Click on the links below for a range of engaging outdoor maths activities and resources.

GETTING STARTED

CLICK HERE

NUMBER AND ALGEBRA

CLICK HERE

MEASURE

CLICK HERE

SHAPE AND SPACE

CLICK HERE

HANDLING DATA

CLICK HERE

ACKNOWLEDGEMENTS

CLICK HERE

Selection of activities available on ‘Number and Algebra’ topic page

NUMBER AND ALGEBRA

ART GALLERY

Using addition and multiplication facts to calculate the value of a picture created with natural resources

LET'S VISIT 'SIX-LAND'

Using natural resources to explore grouping and exchanging in different number bases

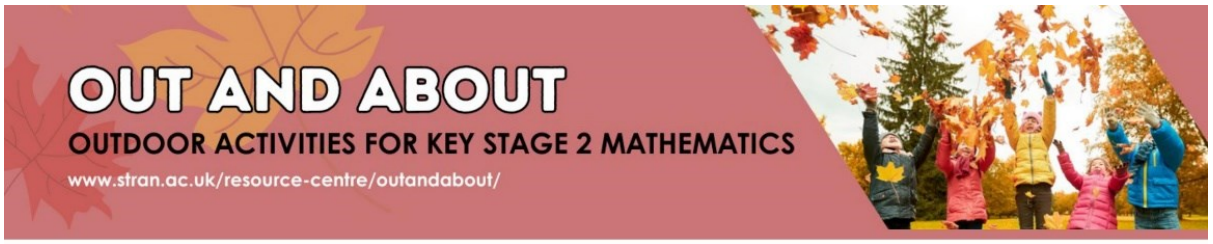
ROUNDING RUN-AROUND

Using an outdoor number line to explore rounding (whole) numbers to the nearest 10

FRACTION GALLERY

Using natural resources to represent a fraction as part of a shape

Appendix 2: Sample activity (Art Gallery)



NUMBER AND ALGEBRA

Art Gallery

Learning focus

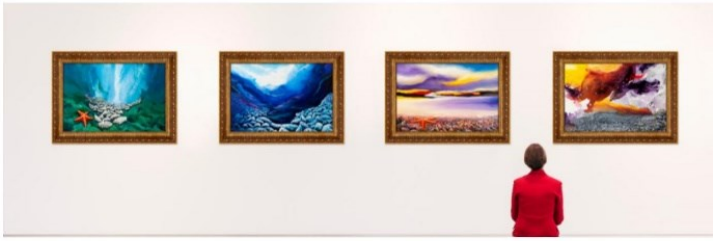
- Recall multiplication table facts up to 10 × 10
- Find the sum of three numbers
- Explain calculation methods

Key vocabulary

- Value
- Worth
- Calculate
- Multiply
- Add
- Total
- Expensive
- Most
- Least
- Afford

Resources

- Natural resources such as sticks, stones and pine cones
- Chalk



Activity

Introduce this activity by discussing what children already know about an art gallery.

Have you ever visited an art gallery? Where did you go?
What did you see?
What is the purpose of an art gallery?

Display images of the work of a famous artist such as Andy Goldsworthy.

What is the same about each picture? What is different?
What shapes can you see? What patterns can you see?
What materials has he used?
What might you use to create a similar effect?

Explain that children will work in small groups to create their own pictures for display in the outdoor 'art gallery'. They will use natural resources to create a picture and then they will determine the value of their picture. To begin with, use three different natural resources (such as sticks, stones and pine cones) and limit the number of each to a maximum of ten. Assign values to each resource: sticks (10), stones (5) and pine cones (2). This will restrict the multiplication challenge to multiplication facts up to 10 × 10.

Allow sufficient time for children to collect the resources required and then give each group approximately 2 minutes to create their picture. Once the pictures are complete, each group should then calculate the value of their picture and record it using chalk on the playground. Encourage them to show their working out.

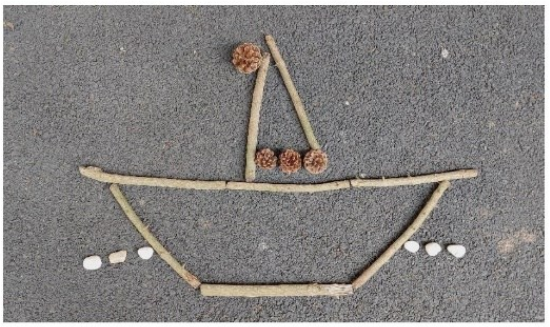
Take time to walk around the 'art gallery' to view the 'exhibits'. Invite each group to share their creative work with their peers for

constructive feedback. Draw attention to the different methods they used to calculate the value of their pictures. Encourage children to use appropriate mathematical language when explaining their methods.

Teaching point

Children may record their working out in different ways. Some may record each calculation, step-by-step; others may use a table.

See examples below for a picture which uses 8 sticks, 6 stones and 4 pine cones:



Example 1

8 sticks – 8 × 10 = 80

6 stones – 6 × 5 = 30

4 pine cones – 4 × 2 = 8

Total value = 80 + 30 + 8 = 118

Example 2

Sticks	Stones	Pine Cones	Total value
8 × 10 = 80	6 × 5 = 30	4 × 2 = 8	80 + 30 + 8 = 118

Ask questions which focus on their understanding of number and place value. (Use pounds or euros as appropriate.)

Which picture is the most / least expensive? How do you know?
Which pictures cost more / less than £100? How do you know?
Which pictures could I afford if I have £250 to spend?
What change will I get from £120 if I buy this picture?
What happens to the value of the picture if I add ··· (one more stick/stone/pine cone)?

Taking ideas further

This activity could be adapted for different multiplication table facts by assigning different values to the sticks, stones and pine cones.

The activity could also be adapted to explore decimal fractions. For example, sticks could be used to represent tens, stones could be used to represent ones, leaves could be used to represent tenths and pine cones could be used to represent hundredths. Again, limit the number of each resource to a maximum of ten. Children could record the value of each picture in different ways. For example, a picture which uses 5 sticks, 3 stones, 8 leaves and 2 pine cones is worth:

£53.82 or fifty-three pounds and eighty-two pence

Children could order the pictures from the most expensive one to the least expensive.

Children could explore the work of other famous artists/sculptors.

Assessment opportunities

Are the children able to:

- Quickly recall multiplication facts within 10 × 10
- Calculate the total of three numbers using mental or written methods
- Record their calculations clearly
- Explain their thinking using appropriate mathematical language

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