Space in schools: Teaching physics through dance

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Abstract

'Into Our Skies: Space in Schools' is a cross-curricular approach to teaching science through dance developed as a response to the COVID-19 pandemic and home schooling. The 6-week scheme of work used movement and dance as a tool through which pupils aged 9-11 could explore concepts of Earth and space, alongside a set of practical classroom activities. Surveys conducted with teachers who used the scheme of work concluded that the science learning achieved in the dance aspect of the programme was equal to the more traditional classroom activities. Meanwhile, 80% of teachers reported an increase in curiosity in the pupils in the dance session, and the same proportion saw an increase in participation among pupils who would normally not engage in science lessons. At an age when attitudes to science are becoming fixed, this cross-curricular approach could be vital in increasing the achievement of pupils and maintaining their interest in science.

Keywords: Widening participation, STEAM, cross-curricular, primary, space

Introduction

The *Into Our Skies: Space in Schools* project is a 6-week scheme of work, which fully covers the English National Curriculum *Earth and Space* topic for ages 9-11. The scheme uses movement and dance to engage pupils with the curiosity and excitement of science through interactive educational dance videos, and embeds the learning through classroom investigations.

This resource was developed, in collaboration with dance artist Lucy Starkey and composer/sound engineer Lee Affen, during the COVID-19 pandemic. One motivation was research by Canovan and Fallon (2021a, 2021b), which revealed that primary teachers found it difficult to provide science lessons during the first lockdown, with a large proportion struggling to adapt the curriculum for online learning.

Research shows that young people's science aspirations could be fixed by the end of primary school (Archer *et al,* 2020). The large-scale ASPIRES study, which tracked a group of young people from ages 10-14, found that from the age of 10 only around 15% of young people aspire to be a scientist (Archer *et al,* 2013). The authors note that *'Longitudinal tracking indicates that the majority of young people's aspirations are quite consistent from the age of 10 to 14, remaining within the same broad categories (science; STEM-related; non-STEM)'* (p.1).

In today's world, where science is responsible for some of the most advanced and critical technology, it is vital that we inspire and encourage young children to explore the subject of science. The *Raising Aspirations in Physics* report (Institute of Physics, 2014) found that *'children from disadvantaged families are less likely to take physics'* and recognised that pupils from certain backgrounds may not have role models to identify with. For young people from low-participation backgrounds, their only exposure to science may be through the school setting. For many, COVID removed or downgraded this provision, at a critical time for children's interest in the subject, meaning that the window of opportunity during which to engage them may have been lost. Canovan and Fallon, who studied primary science during this period, state that the move to home learning created conditions with the potential to lead to *'a widening of*

differences in science learning amongst primary-aged pupils, with those from more deprived backgrounds, already at a disadvantage in normal educational conditions, put at an even greater disadvantage' (Canovan & Fallon, 2021b). The authors' follow-up study (Canovan & Fallon, 2021a) found that a lack of science catch-up activities in primary schools *'risks science learning loss being forgotten'.*

The *Into Our Skies* project sought to move away from traditional teaching methods and approach the teaching of science from a more physical and creative perspective, whilst meeting National Curriculum guidelines for *Earth & space.* The project aimed to spark curiosity about science among young participants, an objective that has been identified by Ofsted as desirable for science learning (Ofsted, 2013) and which is held by psychologists to enhance learning (Gruber *et al,* 2019).

A similar cross-curricular approach was explored in a 2017 drama-based study by Oxford Brookes University and the Primary Science Teaching Trust (McGregor *et al,* 2017), which used drama in primary science to support children's understanding of concepts by *'enacting scientific processes'.* Teachers reported that it made *'science real'* and more effectively included children who traditionally felt excluded from science. Another study, McGregor (2012), reported that drama made science appear less elitist and more fun, with 70% of children surveyed saying that it improved their understanding of difficult ideas. Indeed, an 'outstanding lesson' from a 2011 Ofsted report was one where children acted out the life cycle of a butterfly using movement.

Graham and Brouillette (2016) found that students in high-poverty schools exposed to even minimal STEAM (Science, Technology, Engineering, Arts and Mathematics) lessons showed greater improvement in standard assessment tests than those exposed to STEM-only teaching. Meanwhile Burnard *et al* (2018) concluded that including the Arts gave children *'a more positive view of engagement with STEM subjects'.*

So why dance? The positive benefits of dance participation on physical and mental wellbeing post-pandemic are known (Roncaglia, 2021) and, at a time when young people are facing the *'perfect storm of an obesity crisis and a mental health epidemic'* (One Dance UK, 2020), dance, with its ability to nurture physicality and creativity in a non-competitive environment, is a *'vital and incredibly effective tool' (ibid.)* in addressing the needs of young people.

There is a small amount of literature directly related to the teaching of science through dance. The 'Dance of Science' project (Valls *et al,* 2019) provided professional development to science teachers to integrate science and creative dance. They found a shift in the teachers towards a more constructivist approach (autonomy, interest, experimentation), and teacher-reported benefits included pupils being able not only to retain information better, but also remember it in more depth.

Meanwhile, a Forbes review article by Amsen (2019) on several projects combining dance and science showed that the practical nature of learning through dance encouraged deeper questioning of scientific ideas in all children. However, the author concludes by noting that it was unclear whether participating students had successfully learned scientific concepts.

In more general terms, there is also a body of evidence showing that incorporating physical movement can enhance learning. A large scale study review of 850 articles by Strong *et al* (2005) found strong evidence to support the conclusion that *'physical activity has a positive influence on memory, concentration and classroom behaviour'.* Meanwhile, a further review by Madan and Singhal (2012) finds that *'motor actions can enhance memory for specific information'* and concludes that *'our minds and our bodies are more connected than previously thought'.*

With the above in mind, the aim of the *Into Our Skies* project was to use dance to engage pupils who would not otherwise think of space science as 'for them', via the creation of a fun learning environment. The questions that this paper seeks to answer are threefold:

1. Do primary teachers see a programme that includes dance as a useful addition to the school space science curriculum?
2. Is there any evidence of improved factual learning via the incorporation of a dance element?
3. Can such a programme spark curiosity and/or improve participation among those who are normally not engaged with science?

Method

The resource

The *Into Our Skies* scheme of work is based around a 6-week teaching term and, in response to COVID-19, was designed to be delivered either in school or as home learning. The scheme was designed as an 'off-the-shelf' resource with teachers free to use some/all of it as required. The scheme of work included:

- 3 interactive educational dance videos using movement to explore key science concepts;
- 3 bespoke soundtracks;
- 6 hands-on classroom investigations using only household items that could easily be carried out at home. These included a complete PowerPoint for the teacher/parent and support notes with a starter activity, pupil activity and extension activity; and
- Support notes for the dance videos to help teachers/parents develop pupils' movement and give explanation of the science that is demonstrated at each point.

The schools

Designed with pre-publication knowledge of the work of Canovan and Fallon (2021), our scheme of work was publicised on social media sites and through existing teacher networks and has been available to download since August 2020[1]. By December 2020, we had 187 registrations, 148 from schools, plus home educators, trainee teachers and others from across the UK (see Figure 1).

Participating schools had intakes ranging from the highly affluent to the very deprived, as measured by percentage receiving pupil premium, an extra payment made by the government to schools to support disadvantaged learners. Distribution by pupil premium mirrored the national picture fairly well, indicating that we had engaged a representative cross-section of schools in the programme.

The evaluation

To evaluate our scheme of work and the role of dance in teaching a STEM subject, we contacted the teachers who had registered for the scheme and who had agreed to complete an evaluation. Our survey contained a range of multiple-choice options, along with free-text questions to gain more information. We received a total of 44 responses from teachers, 30% of the total pool. Of the schools that replied, the majority (42/44) were located in England, hence any results speak to the English education system rather than elsewhere in the UK; this in part could be due to the fact that the scheme of work was created based on the English National Curriculum. As respondents were self-selecting, it is possible that they were more positive (or negative) about the programme than the cohort as a whole. Following this survey, we conducted a second, more in-depth round of surveys with a small pool of three participants.

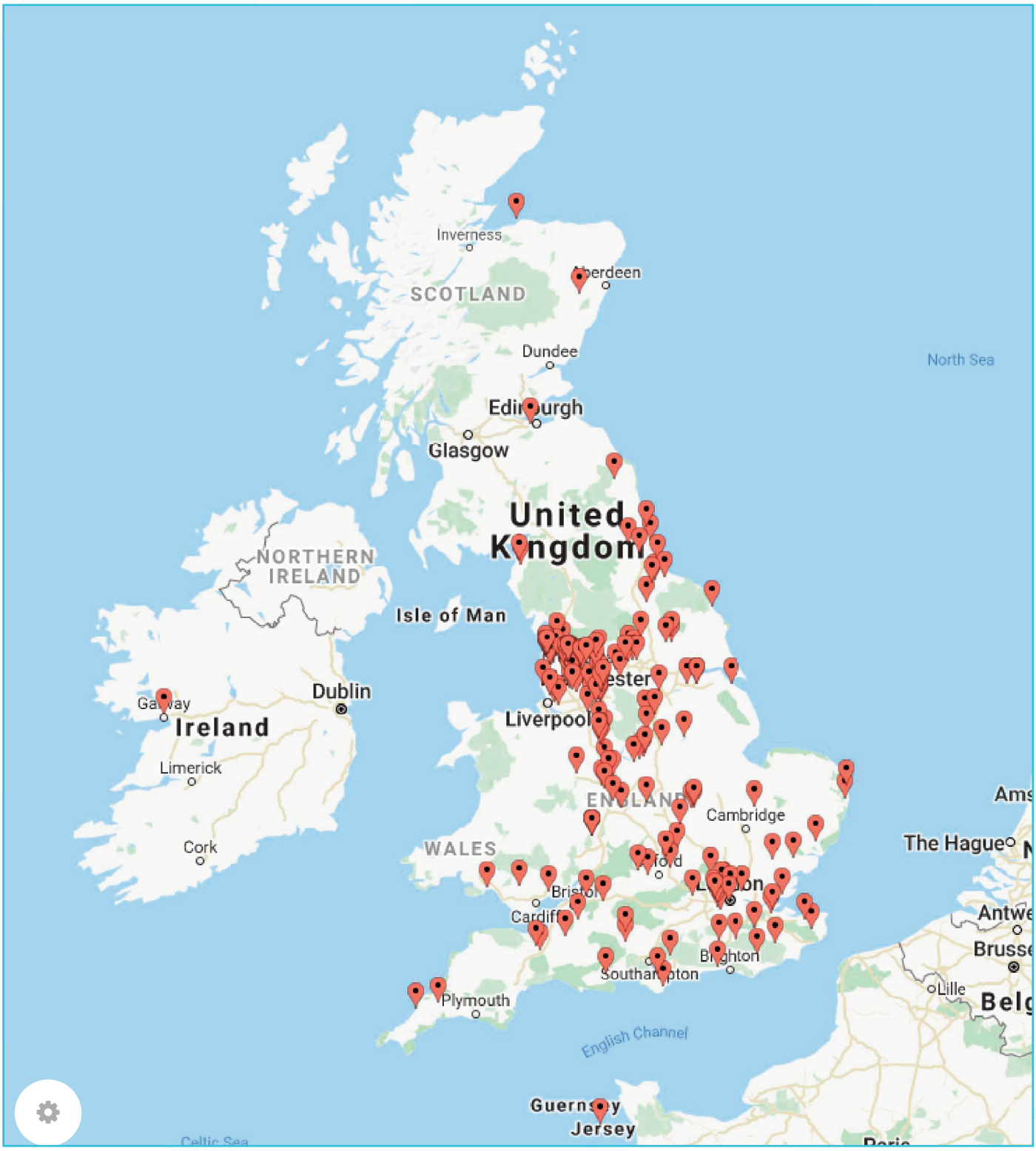
Results

In general, *Into Our Skies* was well received by teachers. Of the 44 participants who completed our initial survey, 91% rated the materials as 'good' or 'very good', with none selecting a negative response (although it is acknowledged that those with negative views would have been less likely to have completed the survey). Meanwhile all respondents said that they would recommend some or all of the scheme of work to another teacher.

[1] Teachers are still able to register and download the scheme of work from: https://www.uclan.ac.uk/about-us/schools-and-colleges/into-our-skies

Many teachers commented positively on the quality of the resources, which were 'clear' and 'easy to use', and the innovative approach of teaching space science through dance was also commended. In free text responses, more than half of participants commented favourably on this aspect of the scheme, saying that it was an effective delivery method.

Figure 1. Google map showing pins at the postcode of the registered participants.



Creativity and novel approach

Looking more deeply at the responses of teachers to the materials, a number of themes emerge within these positive views. Firstly, there were many comments to the effect that the sessions led to a positive effect among pupils, with teachers describing them as 'fun' and 'engaging'. The interactivity of the dance

elements was key to this; it was *'a far more interesting way to deliver this unit,'* said one participant. Another group commented on the creativity of the approach of mixing dance and space science, calling it 'unique' and 'novel'. Primary school teachers are expected to have a wide skill set, and not every teacher will be confident in both science and dance; responses indicated that the programme supported these aspects, in terms of both science curriculum knowledge and the performance elements. Comments included:

'Dance itself is hard to plan and teach, so the package combining both was an unusual and creative approach.'

'I'd never thought of that before. It challenged me as a teacher to think outside my comfort zone.'

Impact on factual learning

An important question to consider is whether the inclusion of dance led to teacher-reported improved learning among pupils. To address this and other questions, we asked teachers to consider the relative impacts of two parts of the *Into Our Skies* programme, the interactive dance sessions and the more traditional space-based classroom activity pack, when compared to a 'normal' science lesson. The activity pack acts as a control representing any unfamiliar science lesson, and we are investigating whether the dance sessions had reported impacts over and above that.

Although numbers of responses are too small to allow us to draw any firm conclusions, the results are certainly suggestive. In general, both the dance sessions and activity packs were felt to be more effective across all measures than an ordinary lesson, including the amount of science learning achieved. However, we were looking to see whether a bigger boost to learning was experienced following the dance sessions than that following the classroom activities; at first glance, this proved not to be the case, with 71% of teachers saying that the dance led to more learning than a normal lesson, compared to 73% when the comparison was with the classroom activity pack (see Table 1).

This finding might superficially suggest that learning was not incrementally boosted by incorporating a dance element. However, when we delve deeper, the picture becomes more supportive of the role of dance in learning. For a number of measures, including improved participation, curiosity, and length of focus, the dance sessions were felt to be substantially more beneficial than the classroom activities. These findings are summarised below in Table 1:

Table 1. Relative impact of dance and 'traditional' sessions.

	% stating the programme was more impactful than a 'normal' lesson	
	Dance sessions	**Classroom activities**
Level of participation	74%	55%
Length of pupils' focus	68%	57%
Curiosity of pupils	80%	62%
Science learning achieved	71%	73%

As mentioned in the literature review, sparking curiosity in science is an Ofsted priority, and psychology literature suggests that curiosity enhances learning (Gruber *et al,* 2019; Ofsted, 2013). Similarly, actually taking part in an activity and maintaining concentration on it is a necessary condition for learning. It is reasonable, then, to suggest that, while the volume of science content available to be learned is not greater in the dance sessions, the conditions are present in these aspects of the programme to promote

lasting learning that is likely to be retained by greater numbers of pupils. This is consistent with findings highlighted in the literature review in reference to the connection between movement and learning.

This impression is supported by qualitative responses from both our main survey and smaller in-depth survey. The combination of science and dance made the associated knowledge *'memorable and more real'*, said one respondent, while another commented that *'the children retained information a little more'.* This is likely associated with increased interest and engagement with a practical session, but some teachers also noted that it allowed space science, which can be rather an abstract concept when presented in the classroom, to be viewed from another perspective. The workshops provided *'different angles to teach space'*, said one, while another commented that the dance/science interface supported *'the complex ideas of movement in space'.* Examples of the practical ways in which this expressed itself were given by some teachers:

'After completing the dance lessons, the children were dancing round the classroom to remember the order of the planets.'

'The children went home and wanted to find out about the stars and visible planets.'

Our in-depth qualitative survey gave an opportunity to explore these thoughts further. One told us that the sessions gave her pupils *'good ideas about the movement of the planets,'* noting that it's *'always hard to do this practically'.* Another reinforced the point, saying that *'space is notoriously difficult to make practical other than showing orbits'.* These results suggest that the combination of dance and space science is an effective and engaging way of imparting complex ideas and may lead to increased learning.

Harder to reach groups

We were also interested to investigate whether a programme such as *Into Our Skies* might have additional benefits for pupils who may be harder to reach, particularly those who are generally uninterested in science. In order to do this, we asked teachers to think about the engagement of pupils who were generally interested in science, and then pupils who were not generally interested. Most agreed that both aspects of the programme – the dance session and the activity pack – were described to be more impactful than a normal lesson. However, this view was more strongly expressed for the group who were normally uninterested in science, as can be seen in Table 2:

Table 2. Relative impact on pupils with different levels of interest in science.

	% stating the programme was more impactful than a 'normal' lesson	
	Dance sessions	**Classroom activities**
Engagement of pupils generally interested in science	63%	63%
Engagement of pupils generally not interested in science	80%	67%

Relatedly, there is also some suggestion that the dance session may support science among pupils who are low prior attainers. Whilst we did not ask about this explicitly, some of the responses raised the possibility; for example, participants in our in-depth qualitative survey suggested that lower attainers or those who had difficulty with written exercises had particularly benefited:

'[It] makes it easier for those that find writing hard.'

'It was more hands-on and enjoyable for those who struggle to access written learning.'

The key to this may be in the comment of another teacher that the activity was *'low stakes and accessible to all'.* It is relatively common for primary-age pupils to perceive science as 'too hard', with the Wellcome Trust finding that around a third held this attitude (Leonardi, 2019). Accessing science via dance may, therefore, be a way in which those who find the subject intimidating can approach it from a fresh angle, which feels more manageable. This is an area which merits further study.

Wider applicability

Although the *Into Our Skies* scheme focused on the interface between dance and space science, we were interested in whether this pedagogical approach might be applicable to other areas. Teachers who had used the resources were largely positive about this idea, with suggestions for further programmes covering a wide range of the science curriculum, particularly forces. Interestingly, others posited that the methodology could work for history, geography and other subjects.

Discussion and implications

It is clear from the above results that our teacher respondents valued the dance-based scheme of work for space science lessons, and it provided a well-resourced way for them to 'break from the norm' in their pedagogy. This result aligns with the findings of the existing minimal literature surrounding dance and science teaching.

However, the more important impacts were on how they described learning and participation and here, also, there is evidence of success. Teachers reported that the dance element led to an improvement in vital preconditions for learning, including curiosity, length of participation and length of focus; they gave examples of enhanced retention of facts and sustained post-session desire for topic information.

There is also evidence that incorporating dance could improve the involvement of pupils who are not normally interested in science, with 80% of teachers reporting increased engagement among this group. As noted in the literature, this is particularly important for the 9-11 age group, which is where pupil science identity begins to be fixed. Some teachers also suggested that the use of dance was beneficial for the participation of less able students.

Taken as a whole, our study suggests that dance-based sessions are a valuable addition to science pedagogy for this age group, with the potential to boost learning and engagement among pupils, including those who are harder to reach. A next step could be to gather direct data on impacts on pupil attainment, as the current findings rest on the views of teachers. It would also be valuable to investigate what type of CPD could encourage teachers to deliver such cross-curriculum STEAM content. In addition, conducting similar research with a larger group of pupils could enable the differential impacts on groups such as those from less affluent backgrounds or ethnic minorities to be investigated.

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