Taking photographs to enhance student teachers' learning of primary science

● Morag Findlay

In a primary science lecture with 100 students and one lecturer, how many cameras are there? The answer is at least 202, on the grounds that almost everyone will have a smartphone or tablet with two cameras and some people will have more than one device. The big question is, how can we utilise this plethora of cameras to learn to teach science? This article discusses the use made of cameras by a lecturer and students to enhance learning in primary science classrooms.

Using photographs of flowers to teach primary science

Asking primary pupils to take photographs of science falls under the heading of Information and Computer Technology (ICT). Primary ICT is approached from a range of perspectives in the literature. For example, Harlen and Qualter (2014) and SCORE (n.d.) discussed the use of digital cameras in teaching primary science. Others have used cameras with children to explore their ideas about health and wellbeing (Reeve & Bell, 2008). In May 2016, the Ordnance Survey (2016) ran a competition with Digimap for Schools to allow primary schools to upload annotated wildlife photographs to maps. This could be an example of

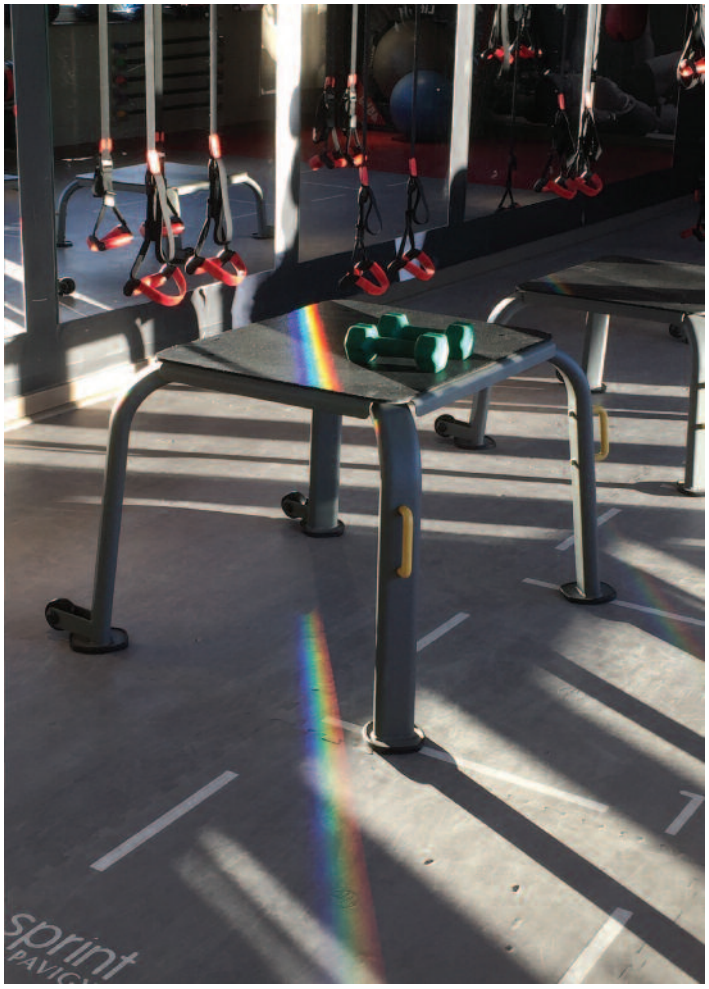

Photo 1: Rainbow at the gym

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seamless learning (Wong & Looi, 2011), where pupils have one or more mobile devices each and use these to learn about a topic in a range of formal and informal settings.

However, this article will discuss the role of smartphones in helping student teachers to learn to teach science. Several authors have written about primary teachers' self-efficacy in using digital technology in general (Funkhouser & Mouza, 2013; Lemon & Garvis, 2015; Tondeur *et al,* 2012), but little has been written specifically about the use of smartphone cameras. This investigation asked student teachers to use their smartphones to take pictures of the science around them, because taking photographs seems to be a ubiquitous part of modern life, and therefore the student teachers should have the self-efficacy and agency to do this in contrast to their possible lack of confidence associated with teaching primary science (Harlen & Holroyd, 1997; Rice, 2005).

Plants, and in particular flowers, are commonplace in the environment and provide an excellent context for teaching and learning about science. After the purchase of a new smartphone, I spent one summer taking hundreds of photographs of flowers, with the aim of using the photographs in a piece of work about Fibonacci numbers in nature. As a non-biology specialist, it was a revelation to start to notice how many different types of flowers there are. Imagine the power of asking a class of students or pupils to take their own photographs of flowers and exploring what can be learned about plants. I found different ways of using these images of flowers to illustrate how skill development in science can be addressed in the primary classroom.

To use the images with a mixed class of thirty primary and secondary Postgraduate Diploma in Education (PGDE) student teachers, I printed the photographs in colour on A4 paper, with nine photographs on each sheet. Small groups of students were given a random selection of photographs and asked to count the flower petals. The results for the whole class were collated, with peaks at 3, 5 and 8 petals giving a nice link into the Fibonacci sequence in nature (1, 1, 2, **3**, **5**, **8**, 13, 21...) (Garland, 1998), and an example of a pattern-seeking investigation (Turner, 2012).

Primary teachers and pupils often assume that all investigations should be in the form of a fair test

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(Turner, 2012; Turner, Keogh, Naylor & Lawrence, 2011). However, in addition to fair tests and pattern-seeking investigations, it is also possible to carry out investigations that observe changes over time, identify and classify, and carry research using secondary sources. My photographs of flowers were used to illustrate two separate lectures given to primary students on a four-year Bachelor of Arts (BA) and a one-year PGDE course. In both cases, the photographs were used to illustrate the different types of science investigation that can be carried out beyond fair testing.

In the first primary science lecture, 140 third-year Bachelor of Arts in Primary Education (BA3) students explored different types of investigation using these photographs. Each student collected a different photograph as they entered the lecture theatre, and then we explored ways to use the photographs with pupils. As well as asking students to stand if they had a particular number of petals in their photographs, they were asked to stand up if they had a red flower, for example. This allowed the students to explore the data that the flower photos represented and to work with aspects of numeracy in a practical way, including a pattern-seeking investigation.

During the lecture, the flower photographs were linked to science topics in the Scottish Curriculum for Excellence (CfE) (Learning and Teaching Scotland, 2010) as well as different types of investigations in the context of 'Science around Us.' After the lecture, the student teachers were set a task to take a picture of 'science around them' on the way to and from university and to link this to CfE and a type of investigation. This task was illustrated by a photograph that I took of an enormously enlarged tick (a type of arachnid) on a poster at a bus stop on my way to the university, and my reflection taking the photograph. An additional challenge was *not* to take pictures of plants or trees, because these had been used to illustrate the lecture.

A similar exercise was carried out after a lecture with a larger cohort of about 300 primary students undertaking a PGDE. The students were given one week to take photographs at a time in winter when there was a great deal of snow lying on the ground. As a result, a high proportion of the photographs taken by the students showed snow or ice, demonstrating a responsiveness to circumstances that could be taken into the primary science classroom.

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Methodology

The student teachers were asked to complete a PowerPoint template that showed their photographs. The templates for the BA and PGDE students differed slightly from each other. The BA students were asked to give science links, topic links and a link to at least one type of investigation. The PGDE students were asked to present a justification for their choice of subject, science links and topic links. The PGDE students were not asked to link their photograph to a type of investigation, as this had not been a major focus of their lecture.

More PGDE than BA3 students completed the activity, so this analysis is based on the 36 BA3 students who submitted photographs and 36 randomly selected PGDE students. This report discusses a very simple visual content analysis (Rose, 2016), which allocated the photographs to the different sub-topics within the main topics of Curriculum for Excellence.

Results

There are five main science topics in the Curriculum for Excellence: planet Earth; forces, electricity and waves; biological systems; materials; and topical science.

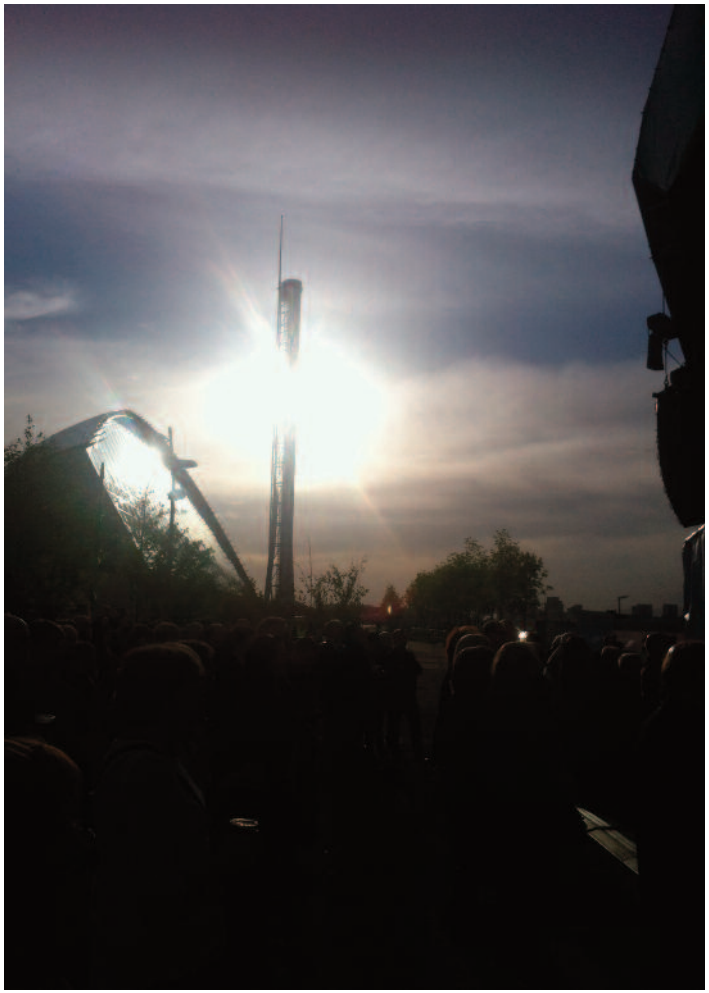

Photo 2: Sun behind Glasgow Science Centre

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Table 1 shows the number of undergraduate BA3 and postgraduate student teachers taking a photograph in each sub-topic:

		BA3 (n=36)	PGDE (n=36)	Total for sub-topic	Overall percentage choosing sub-topic
Topic	**Planet Earth**				
Sub-topics	Biodiversity and interdependence	5	5	10	14
	Energy sources and sustainability	2	6	8	11
	Processes of the planet	5	12	17	24
	Space	11	1	12	17
Topic	**Forces, electricity and waves**				
Sub-topics	Forces	3	2	5	7
	Electricity	5	2	7	10
	Vibrations and waves	2	1	3	4
Topic	**Biological systems**				
Sub-topics	Body systems and cells	0	1	1	1
	Inheritance	0	0	0	0
Topic	**Materials**				
Sub-topics	Properties and uses of substances	1	0	1	1
	Earth's materials	0	1	1	1
	Chemical changes	0	0	0	0
Topic	**Topical science**				
Sub-topics	Topical science	2	5	7	10

Table 1: Number of student teachers photographing each sub-topic.

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The two least popular topics, with only one student teacher picking each, were biological systems and materials. The most popular was planet Earth, with 23 out of 36 BA3 student teachers and 24 of the 36 PGDE student teachers choosing this topic.

Within the planet Earth sub-topics, ten student teachers took photographs related to biodiversity and interdependence related to animals (n=4); fungi (n=1), which I was reminded are not plants; trees (n =2); one bird and one photograph of breakfast cereal. Within the energy sources and sustainability sub-topic, five student teachers took photographs related to renewable/non-renewable energy; and one photograph each of a candle; conservation of energy and gravitational potential energy. The process of the planet sub-topic was the most popular, with 16 photographs related to the water cycle and one to climate change. In the space sub-topic, seven of the photographs were related to the moon and/or tides and five to the wider solar system.

The next most popular topic was forces, electricity and waves, which was chosen by 10 BA3 student teachers and five PGDE student teachers. Of the five student teachers who took pictures to illustrate forces around them, one specifically considered the role of friction in motion. The student teachers who took photographs about the subject of electricity tended to take pictures of electricity being transformed into other forms of energy, via electric lights (n=4) or heaters (n=1). The sixth student teacher took a photograph of a personal computer, again illustrating a use of electricity. The final three student teachers all took photographs to illustrate the use of sound within the vibrations and waves sub-topic.

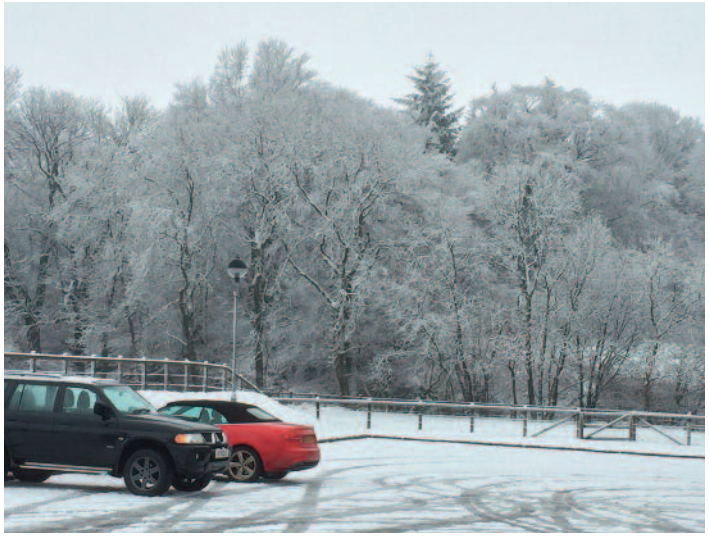

Photo 3: Snowy trees

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The seven student teachers who took photographs related to topical science took pictures of pollution (n=4) or recycling (n=3).

All the student teachers who took photographs were able to link their photographs to specific parts of the Scottish science curriculum. The BA3 students linked their photographs to one or more of the different types of investigation, not just to fair testing. Both the BA3 and PGDE student teachers were able to suggest links between their photographs and several different areas of the curriculum.

Discussion

The three most popular areas of science illustrated by the student teachers were the water cycle; the solar system; and living things, all of which fall within the planet Earth topic and all of which are popular topics in primary school science. The next three most popular areas, with at least 10% of the student teachers taking photographs, were renewable and non-renewable energy; and electricity and pollution, which again are popular choices in primary school science.

Photo 4: The Falls of the Clyde

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The least two popular topics were biological systems and materials, with only one student teacher illustrating each topic. 'Biological systems' covers areas such as the senses, the skeleton and body systems; germs and micro-organisms, as well as inheritance and lifecycles. The materials topic explores different materials that pupils will cover, as well as dissolving; separating materials; rocks; and simple chemical reactions. The unpopularity of biological systems with this group is surprising, as most of the topics, except possibly micro-organisms, are common in primary school science. Possibly the time of year, after a snowfall for the larger group, deterred the student teachers from looking for micro-organisms. Again, the properties and use of materials is also a topic that is commonly explored in primary schools, including the study of dissolving. It is possible that the student teachers found it difficult to obtain everyday examples to illustrate these ideas.

Reflections on the study

Overall, how successful was this task of asking the student teachers to take photographs of science around them, in terms of their science learning? The answer seems to be that the student teachers did not have difficulties in taking photographs to illustrate a wide range of science concepts covered in the Scottish science curriculum. Most of the student teachers were able to link the photographs to more than one area of science, which suggests that asking them to take photographs about 'science around them' may be a useful method through which to explore what primary student teachers do know about science. Taking photographs of science around them may also help primary student teachers to develop their confidence in teaching science and could encourage them to ask their pupils to carry out a similar exercise to enable them to understand the science around them.

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