Chapter 8 Art and design and creative science

Chapter Aims

By the end of this chapter, you should be able to

- Explore the relationship between art and science education
- Explain the key role observation plays in developing science ideas and how art can support this
- Use a range of art techniques and methods to develop children's scientific attitudes, skills and understanding

Introduction

Art, craft and design embody some of the highest forms of human creativity. (Department for Education 2013 p. 1) and in primary schools children are encouraged to be creative in the Arts domain of art, design, drama and music. Liu and Lin (2013) report the integrating the arts and science curricula is one way to foster scientific creativity. In this chapter, we will be focussing on how art and design can contribute to meaningful and creative learning and understanding in science as well as enhance skills and attitudes.

Artists throughout time and from many different cultures have long used the natural world to inspire their work and document the world as they see it. Vincent Van Gogh's famous painting of the sunflowers is but one of his many depicting flowers. Other work

includes irises and almond blossoms; emphasising his particular interest in flowering plants and trees. Claude Monet dedicated a series of paintings to water lillies and his Poppies in a Field captures the beauty and simplicity of nature. His Corner of the Garden at Montgeron captures the ever-changing nature of light and colour. More recently, nature photography has grown in popularity and it is devoted to capturing natural elements such as landscapes, wildlife, plants, and close-ups of natural scenes and textures. Textile artists also draw inspiration from the natural world and there are some beautiful and creative works of art in this style, for example Rembrandt's Three Trees. This is Rembrandt's largest and most striking etched landscape.

Not surprisingly, when we reviewed a comprehensive guide to teaching art in primary and secondary school (Hume 2008), of the 30 or so activities which could be integrated with science, all but 5 were related to plants or animals in the natural world. What this chapter aims to do is to ensure that such integrated work is meaningful and focused on scientific outcomes, including developing knowledge and understanding across the science programme of study as well as skills and scientific attitudes.

Science and art enquiry

Science education literature offers two contrasting approaches to creativity in the context of art (Kind and Kind 2007). On the one hand, there is the acknowledgement that art is by nature a more creative subject so by integrating art and science it allows science to be more creative. In this vein it acts as a 'tool' for making 'the rational' science education more creative (p. 6). On the other side, is the appreciation that art and science

share similar creative processes, both in knowledge development and in the nature of the knowledge itself. (p. 6) With regard to the latter, there is a strong link to investigation and enquiry, so long as the focus is not on finding a single correct answer. This type of approach to inquiry based learning in science was discussed in Chapter 3 whereby the teacher had control over what the children were investigating and what the expected outcome was. This was contrasted with an open-ended problem solving approach. This type of enquiry requires divergent thinking; allowing learners to follow various directions to arrive at alternative solutions. It is in this domain that art and science can share similar creative processes.

[start box]

Activity 8.1

Write down at least 5 attitudes or traits which you consider to be characteristic of being creative.

Now consider the following traits and group them as either scientific attitudes, artistic attitudes, both or neither.

Accepts others points of view, adventurous, caring, cautious, confident, conforming, co-operative, critical, curious, decisive, determined, enthusiastic, flexible, fun, hard-working, humble, imaginative, independent, intuitive, objective, observant, open minded, optimistic, passionate, responsible, risk-taking, sensitive, serious, subjective, thoughtful.

Was there much overlap between science and art? Looking at the groups, which one is most creative according to your list of creative attitudes? What does this say about your conceptions of creativity in science?

[end box]

Science process and attitudes

Key scientific attitudes include curiosity, a respect for evidence, willingness to change, flexibility and sensitivity. Ultimately, scientists have to be curious about the world around them and about how it works. Children are naturally curious and full of questions and it is important to encourage this. Evidence is the foundation for developing scientific knowledge and understanding and scientists have to be prepared to change or review their ideas in light of new or alternative evidence. Finally, scientists should be sensitive to the natural and man-made environment when carrying out their investigations. This has an effect in the primary classroom when studying plants and animals in the local environment. On a bigger scale, it is about scientists being ethical and moral in their work. Harlen (2006) offers some useful strategies for developing attitudes to science in the primary classroom.

Curiosity

It is in the first attitude curiosity that we see the strongest link to creativity and art. Lunn and Noble (2008), in their research study, focused on re-visioning the image of a scientist and by far the most persistent theme emerging from the research was of the

creative aspect of science. They also noted the recurrence of the word ‘wonder’ in the narratives with the range of scientists interviewed:

> “Wonder” featured in the interview narratives as an aspect of the scientific enterprise. Describing an emotion excited by strange, novel, or impressive objects or occurrences, the noun “wonder” is antithetical to the popular conception of the scientist as emotion free and lacking a spiritual dimension. (p. 801)

It is this wonder, a feeling of amazement, at the natural and man-made world and the plants and animals that live in it that drives science, art and creativity. The first step in the process of scientific enquiry is often an observation, which then leads to a question. However, teachers need to help children to raise questions from observations. One way is to encourage a questioning environment in the classroom. Having lots of objects, including familiar ones, for children to observe and time to observe them is important. Modelling curiosity and questioning are equally important.

Observation

Observation was highlighted as a potential first step in science enquiry as it is often questions and problems that arise from observations which lead to scientific investigations. Usually when we ask initial teacher education students what observation is, we get various definitions involving careful or purposeful looking, seeing, watching and these are indeed aspects of scientific observation. However, observation involves using all of the senses (where appropriate) not just the eyes. Touching, smelling, hearing and tasting as well as seeing the world around us should all be encouraged in

the primary classroom. The foundations of scientific observation are developed in the early years and Ofsted (2012) report on good practice where a "child-minder successfully enables children to enjoy experimenting with different types of art, textures and materials to expand their knowledge, interests and curiosity". By using sight and touch to enjoy and create a broad range of art children are beginning to develop their observation skills as well as encouraging curiosity.

However, our observations, and children's, are influenced by our experiences, existing ideas and expectations so they are not wholly objective. Such prior knowledge can affect what we choose to observe, what we actually observe, which observations we regard as relevant and which we deem irrelevant, and how we interpret them (Gunstone 1991) Teachers need to be aware of this and consider this when planning observation experiences. For example, a typical observation lesson might involve observing snails. These are common molluscs and children are familiar with them. After allowing time for the children to observe the snails, we would then ask them to do an observational drawing. It is at this stage, we normally have to prompt them to only draw what they have actually observed. They will often draw more human features like eyes and mouth and draw a cartoon snail.

To avoid this and develop their observation, the children can use magnifying glasses or other tools to focus their observations. Allowing children time to observe is also important. This will allow them to move beyond the obvious observations and to note less obvious features. Figure 8.1 shows the role observation plays in both inductive and deductive enquiry in the primary classroom. Inductive reasoning is more open-ended and exploratory so is an appropriate process to support generative thinking and creativity. However, it should be recognised that these two processes are not mutually

exclusive when investigating science, indeed an initial observation, followed by further observation might lead to a tentative theory which then could be tested more rigorously through a deductive process.

[insert Figure 8.1]

Figure 8.1 Scientific enquiry process – deductive and inductive reasoning with observation as a key role in both processes

It is in the observation phase of the enquiry process that art can really play a factor. By doing detailed observational drawing or painting, macro photography or modelling with clay, children can develop their observational skills and make observations which can then lead to scientific questions and investigations. Stephens and Walkup (2001) recognise that scientific illustrators must be expert at seeing detail and drawing accurately what they observe and must have a strong scientific curiosity and a keen interest in both art and science. When doing observational drawings it is important that children are encouraged to use the full space on the page. This allows them to capture more details. They should also be encouraged to annotate them. Macro photography is in essence close-up photography and has particular value when wanting to study the natural world close-up. The close-up allows us to bring the natural word back to the classroom for much more detailed and focussed observation. Modelling with clay is particularly useful when wanting to show texture in observations.

Further observations may also be required in the data collection stage, whereby careful observations of texture, colour, line, or pattern may be required. Noting similarities and differences are important, and children should be encouraged, in particular, as their

observation skills develop, to note similarities. This is evidence of progression in observation. It is important that the learning stays focused on the science objectives when integrating with art and design and this can be achieved by children predicting before making their observations and then explaining them afterwards. Gunstone (1991) suggested that predict-observe-explain process makes tasks more minds-on.

Investigation

There are also opportunities to integrate art and design with science investigations. Working scientifically is a critical aspect of primary science and it should be embedded in all science lessons. Gompertz et al (2011) describe an integrated activity where children had to design an area to encourage birds as part of a whole school gardening project. Over the course of the project the children made bird feeders, designed bird boxes and made periscopes (so they could observe birds from a distance). This is a wonderful example where art and design play a crucial role in enhancing the science learning experience.

Chapter 3 explored approaches to teaching science and enquiry and investigation are crucial aspects of this, particularly if we are trying to encourage creativity. Check out activity 8.2 to challenge your creative ideas around using art when investigating science.

[start box]

Activity 8.2

[Insert table 8.1]

- Choose one of the above areas of science and the suggested investigation. Decide on a learning objective for the investigation. Try to consider both concept and skills development.
- Now think about how you could link it to art and design; brain storm your ideas and consider which medium would be best for the investigation: drawing, painting, photography, printmaking, sculpting or textiles.
- Map out the basic structure of a lesson/scheme.
- Consider how the art or design element contributes to the learning and development in science. If it doesn't, could you adapt the activity to do this?

[end of box]

[start box]

Time for reflection 8.1

Is there opportunity for observation, using as many of the senses as appropriate? Would the children be working with a range of materials or in environments that encourage curiosity and questioning? Are the children getting the opportunity to work scientifically? Are they applying known skills and knowledge in different contexts? Are a variety of responses and outcomes possible from the investigation? Can the children follow their own lines of enquiry? Are the children evaluating their work? Are they communicating their ideas and findings in interesting ways?

These are some of the elements that will raise the creativity level of the investigation.

[End box]

Howard- Jones (2008) suggests that providing students with tasks that require the making of unusual connections will encourage generative thinking. The strategy of having to incorporate unrelated material in an outcome has often been used by teachers to provoke creative thinking. He also refers to the artist Kurt Schwitters who famously created a collage from the contents of his wife's bathroom bin!

Science communication

When most people reflect on their experiences of science, they remember lots of writing. This is a fairly accurate memory and reflects the traditional way science is communicated. The familiar lay out of aim, resources, method, results, discussion and conclusion allows scientists to share what they have done and what they found out, allowing others to repeat it and then refute or accept it. It is a transparent and objective account of the scientific experience. This tradition can be a positive experience for people who enjoy writing and like the structure of scientific writing. However, for others this is a one sure way to turn them off science for good!

The study by Lunn and Noble (2008) focussed on re-visioning the image of a scientist. They quote Dr Wendy Nielsen, a research participant, who talked passionately and animatedly, using a series of colourful metaphors and descriptions, of "slimy" and "ginormous" seaweeds. This was in contrast to her writing and speaking science in a

professional setting, where she follows traditional scientific conventions:

> I will talk extravagantly about things but when put you put me on paper I am very precise. I think it's a kind of a productive tension in the discipline… So it's not ginormous, its 5–7 meters, and it's not disgustingly slimy looking, it's a kind of greenish, greying at the edges. (p. 801)

Luckily for us, we don't always have to communicate science in this precise way. While children can benefit from the experience of scientific report writing, there are lots of other ways that children can communicate their ideas and experience in science. Children can communicate through creative writing e.g. haiku poem; role-play showing how magnets repel and attract; music such as writing and performing a rap. Subramaniam (2013) in a TEDx talk demonstrates using dance to explore the concept of water shortage.

Children can also communicate through collages, comic strips, diaries, drawings and models and this is where art and design can play a big part in supporting science as a creative subject. As mentioned earlier, writing can be a barrier to children's enjoyment and engagement with science. This is not surprising since as well as written language, children also have to contend with complex scientific language. Scientists communicate using a range of conventions, including specialised vocabulary, numbers, graphical representations, symbols and notations. While it is expected that children will develop in this language as they progress through science, it should not be a barrier to them engaging in science and sharing their ideas. By allowing children expression of ideas in

a variety of ways more children can share and communicate their scientific ideas. In this way a creative and varied approach to communicating science is more inclusive.

Evagorou and Osborne (2010) describe how language is central in everyday life since it is one of the tools for understanding the world around us. Within classrooms, they recognise language as the principal means of communication. It is the tool to reflect upon our thoughts and share our experiences with others and is thus both a technology for transmitting information and a means for interpreting our experiences. (p. 135) The latter point is critically important in science, whereby we make observations and attempt to interpret and make sense of them. By allowing children to explore their ideas and experiences through a range of media means that they can use language and modes of representations that suit them.

Conclusion

Mesure (2005) suggest that science teaching would benefit from adapting the artistic process of self-expression, including 'risking failure, taking leaps of faith and trusting in a more creative approach when the outcome is not at all certain' (p. 13). Kind and Kind (2007) suggest this might be a way of making teaching meet children's needs, while truly emphasising creativity. The challenge, of course, is to ensure that the teaching still has science as a main focus rather than artistic expression. To achieve this, awareness of the characteristics of scientific creativity and clear goals for the learning outcomes are needed. (Kind and Kind 2007 p. 9) The characteristics of scientific creativity have been explored in chapter 1.

Art is by nature a creative subject and so is science, this chapter has explored the role art and design can play in enhancing creativity in science, both as a tool and as a complementary process. The key role that observation plays in developing science ideas and the crucial role that art could play in this was discussed. The nature of science enquiry and investigation and opportunity for divergent thinking and exploring materials and objects was highlighted by working with a variety of art media.

Further reading

Ainsworth, S., Prain, V., Tytler, R. (2011) Drawing to Learn in Science. Science, Vol. 333 p. 1096-1097

In this short article, the authors put forward an argument for more drawing in science, highlighting a number of benefits, exploring five ways that drawing can enhance learning and teaching in science.

Klopp, T.J., Rule, A.C., Suchsland Schneider, J. & Boody, R.M. (2013): Computer Technology-Integrated Projects Should not Supplant Craft Projects in Science Education, *International Journal of Science Education*

In this paper, the authors recommend that room should be retained for crafts in the science curriculum to model science concepts. They report that more science content was found in craft products than technology-rich products in their study.

Root-Bernstein, R. and Root-Bernstein, M. (2013) The Art and Craft of Science. *Educational Leadership*. February 2013. p. 16-21

This is an intriguing piece of writing which discusses the interactions that occur between the arts, crafts and sciences and makes a strong case for art-infused science education.

Subramaniam, K. & Padalkar, S. (2009) Visualisation and Reasoning in Explaining the Phases of the Moon, *International Journal of Science Education*, 31(3), p. 395-417

Subramaniam and Padalkar suggest that visualisation is an important process in science learning, and point to the importance of developing among students the ability to work with diagrams.

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Evagorou, M. and Osborne, J. (2010) The role of language in the learning and teaching of science in Osborne, J. and Dillon, J. (Eds.) *Good practice in science teaching. What research has to say*. 2nd Ed. Maidenhead: Open University Press

Gompertz, B., Hincks, J. and Hincks-Knight, R. (2011) Science and Technology Outside the Classroom in Waite, S. (Ed.) Children Learning Outside the Classroom From Birth to Eleven. London: Sage p. 94-105

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Liu, S-C. & Lin, H-s. (2013) Primary Teachers' beliefs about Scientific Creativity in the Classroom Context, *International Journal of Science Education*

Lunn, M. & Noble, A. (2008) Re-visioning Science "Love and Passion in the Scientific Imagination": Art and science, *International Journal of Science Education*, 30:6, 793-805

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Stephens, P. and Walkup, N. (2001) *Bridging the Curriculum Through Art Interdisciplinary Connections*. Glenview: Crystal Prodcutions

Subramaniam , S. (2013) Subathra Subramaniam , Transcendence - turning people on to science through dance [Video file]. Retrieved from https://www.youtube.com/watch?v=nqvki2hSDzE