Art-based approaches to support learning in science

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We acknowledge the Wadawurrung people as the traditional custodians of the land on which this symposium takes place and acknowledge elders past, present and future.
“Much of the history of science could be written in terms of making new things visible—or familiar things visible in a new way” (Norton Wise, 2006, p. 75).

Visualization is often thought of as grasping a concept or model in visual / spatial terms.

But .... it also entails:

• Not just rule-based procedures, but also creative reasoning processes that are “spontaneous, unconscious, sublinguistic, involuntary, automatic, effortless” where students imaginatively sample and synthesize options (Magnani, 2015).
• Interplay of values, aesthetics, feelings in science learning (Jacobson & Wickman, 2008).
• “Embodied cognition” (Barsalou, 2008).
Scientific discovery is driven by the invention of new representational and material practices: this entails a growing appreciation of an aesthetics of visualisation.

Climate network visualization revealing the backbone structure of strong statistical interrelations (links) between surface air temperature time series (nodes) all over the globe with features including the tropical Walker circulation and surface.
Thus visualization in science learning entails:

- Students being inducted into scientific practices for constructing, testing and sharing knowledge claims using visual means.

- Creative meaning-making by multiple reasoning and interpretive processes.
What do photographers have to say about the science of light and vision?

“One should not only photograph things for what they are but for what else they are.” – Minor White

André Kertész
Kertés invites us to look freshly at images and shapes - to think more deeply about phenomena.
The aim: to go beyond appearances, to encourage us to think more deeply

What is the science?
What is the art?
What is the difference?

James McArdle

Man Ray
Mirror effects
Refraction
The art and science of the spectrum

• Your task is to produce a photograph, or display of photographs, for this exhibition.

• Your equipment: an iPad, and the ‘Keynote’ software. Lenses, mirrors, water, glass blocks, candles and objects, sheets of perspex ....

• The exhibition is for the general public. Your aim is not to produce a ‘text book illustration’ of optical or infra red phenomena, but something that will intrigue or surprise, so that we will wonder ‘what’s going on?’

• Stick with one type of effect and explore it in depth.

• Explore the science – what is going on? Produce a brief description, including diagrams if necessary, to explain the science to the audience, and also the art.

Optical phenomena – reflection (multiple reflections, partial reflections, distortions), refraction, imaging, total internal reflection.

Infrared phenomena – body temperature variation, heat in a candle or other object, temperature rise in a collision.
From your displays:

What did you learn from this process?
What aesthetic senses came into play?
Where is the art?
Where is the science?
How would you fit this into a unit of work on optics?
How would you establish science learning through the art process?
"It was science that made it artistic and you can’t work out where the real mannequin ends and the virtual image begins.”
“The reflections in the mirror give a virtual image because they are so close together, they’re touching from the angle where the picture was taken. And the refraction with the golf ball in the glass of water makes it an egg shape and you can see the virtual images in both the mirrors – yea it’s pretty cool.”

**The relationship between science and art:**
“I think art and science have things in common, like in some ways science is beautiful like it can be- I think everything can be seen as art and I think science can sometimes be seen as art. Like how light is shown(shone) and how light travels is art.”
“With art, you’d want to know the science behind it to make a cooler picture - if you were an artist.”
Teacher comments about advantages of art/science links

“Science is all about understanding the structure/properties of materials and applying this knowledge to make artefacts and solve problems. There is a lot of design work in the arts, planning, sketching, trialing. Science is part of making designs work properly. Science and the arts are complementary.” (science teacher)

“In the arts, students let their guards down and are more willing to experiment.” (science teacher)

“We need to multi-skill our students as communicators and problem-solvers who have a sense of connection to place.” (arts coordinator)

“Both the arts and science are concerned with symmetry and abstraction.” (science teacher)

“In class I now always ask in every topic where would we use this?” (science teacher)
Art meets science: Zoos Victoria — Australian Endangered Species
15 year-old students in groups of 2 or 3 students select an endangered species, make a trash puppet of their chosen species, and present to youngsters at Melbourne Zoo in a suitcase theatre to advocate for their species.

The **Theatre** must be:

- Readily transportable, easily constructed, sturdy for re-use in multiple locations.
- Have appropriate backdrops and props to support audience understanding of species.

The **Trash Puppet** needs to:

- Have good characterisation including features to attract and charm audiences.
- Mimic the locomotion, movements and sounds of the species.
- Incorporate adaptations of the species to its environment.

The **Narrative** (5 minutes) needs to include:

- The essence of the species and its interactions with its environment.
- Threats to its survival.
- Solutions including audience actions.
Student interview responses:
Value of art in learning science

“It was amazing to combine creative work with all our science research.”

“You need to learn how to work it out. It was nice to, not take a break, but do something creative with your hands.”

“Whether the art helps depends on your animal. Our animal didn’t move much.”

“The art process was useful for learning and communicating science and showing habitat.”

“The art was useful because making it in person was good because it’s life-size and an engaging way to communicate.”

“It made it a lot more interesting and fun in creating something.”

“It challenged our creativity, it was a good relief from everyday schoolwork, learning the science behind how a frog leaps, (but the project) lagged a bit.”
Implications for students’ visualisation and learning

1. Teachers need to identify authentic purpose(s) and audiences for creative products or imaginative ways to inquire and solve problems related to science topics.

2. Students need extended opportunities to apply scientific knowledge and aesthetics to experiment with design development, invention, refinement, and testing of visualizations.

3. The purposes for, and means of, visualizing claims, models and applications of scientific knowledge to real-world problems need to be discussed explicitly.
An example of STEAM in high school exploring MURMURATION
Work in progress
Building the murmuration
Creating 3D bird elements
Layering the work
Final murmuration