Duncan Hawley

Beyond awe and wonder: using powerful knowledge to release 'hidden' physical geography

Duncan highlights the significance of powerful knowledge for teaching physical geography that lies beyond the obvious.

Type 'Geography school awe and wonder' into Google search and thousands of results are returned. Click to open any of these and typically you land on the geography department pages of a school website. Below are three quotations plucked at random from searches, each found in the opening statements about geography in the respective schools:

> *Geography will give young people a sense of awe and wonder for the world around them.*

> *Our aim in the department is to highlight the 'awe and wonder' of Geography.*

> *A sense of 'awe and wonder' is created through studying the world around us, for example by looking at impressive natural features, which contributes to students' spiritual development.*

This brief trawl reveals that 'awe and wonder' is endemic in geography teacher-speak. Further, it appears that awe and wonder are taken somewhat for granted; something students experience passively; and that the role of the teacher is simply to facilitate awe and wonder experiences.

Future geographies

Young and Muller (2010) set out three curriculum 'scenarios', all of which can be present in school geography, sometimes even in the same curriculum at the same time.

Future 1 reflects a traditional, fact-based curriculum, which treats knowledge as 'given' and 'fixed'. It is a curriculum of transmission: teachers are the givers and students the receivers. There is little dialogue or engagement.

Future 2 reflects the 'progressive' curriculum that emphasises skills and competences. Students 'learn to learn', but the subject discipline may seem arbitrary. Future 2 can look like a curriculum of engagement, but the engagement is with the pedagogic activity, not the subject.

Future 3 is concerned with active pedagogies, but also in the shifting ideas and arguments that create powerful disciplinary knowledge, rather than inert or given 'facts'. Future 3 curriculum thinking is the foundation for Geocapabilities (2019).

Figure 1: Future geographies curriculum scenarios.

In 2001, reacting to a style of geography teaching that was heavily weighted towards 'delivery of knowledge' – the 'Future 1' curriculum (Figure 1) – Simon Ross advocated encouraging students to develop aesthetic responses to their environment:

> *… awe and wonder can be defined as experiencing an appreciation of place beyond its immediate measurable components … it is about feelings, impressions and experiences, about 'being' in a landscape and feeling part of it, and, ultimately, it* should *lead to a greater understanding of our true sense of place in the world.* (Ross, 2001, p. 86; emphasis added.)

However, the danger of this 'Future 2' interpretation is that it may rest on an illusion which lies in teachers believing or assuming the experience of awe and wonder is in itself sufficient to lead to greater understanding. Lambert (2016), Bustin (2019) and GeoCapabilities (2019) advocate a 'Future 3' approach: taking students beyond their immediate experience through engagement with powerful knowledge. Without powerful disciplinary knowledge the geographical understanding that lies in awe and wonder experiences will be inaccessible to most students.

Powerful knowledge and physical geography

Awe and wonder are very often associated with physical geography phenomena and these can be an effective way of grabbing students' interest and attention – they provide a 'wow' factor. To understand how powerful geographical knowledge can extend their use in physical geography it is helpful to examine Ross's 2001 definition and consider what sort of 'feelings, impressions and experiences' (p. 86) comprise awe and wonder.

> *Awe is a feeling of reverential respect mixed with fear or wonder. Wonder is a feeling of amazement and admiration, caused by something beautiful, remarkable, unfamiliar, unexpected or mysterious.* (Dictionary.com, 2019)

Powerful knowledge has the capacity to move students beyond the emotional and obvious and achieve enduring understanding by providing new ways of thinking about the physical world (Figure 2). The role of the teacher is to use their expertise to unpack the powerful knowledge lying behind the awesome and wonderful, and recontextualise it in teaching approaches that open up new ways for students to 'interpret' what they see or experience.

Robert Frodeman (1995) likens this interpretive approach to viewing a famous work of art but not seeing anything of great significance until an art expert introduces a set of concepts for 'reading' the artwork, when the piece seems to undergo a striking change. Thereafter, the ability to probe deeper reveals the significance in artworks and an understanding of why some works are highly regarded (and famous).

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Powerful knowledge and physical geography

Type 1 offers new ways of thinking about the physical world, using 'big ideas' such as: energy, Earth systems, cycles, tectonics, landscapes, deep time, evolution

Type 2 offers ways of analysing, explaining and understanding the physical world (developing substantive concepts), using ideas to:

- analyse – e.g. pattern, flows, distribution, scale
- explain – e.g. weathering, water balance, glaciation
- generalise – e.g. models, interconnections between system components.

Type 3 offers insight into knowledge-making ('how do you know?'), knowledge that gives students some critical power over their own geographical knowledge; how knowledge is developed and tested in geography; is it believable – and why?

Figure 2: A typology of powerful knowledge and physical geography, adapted from Maude (2016). Maude outlines five types of powerful knowledge of which only the first three are given here.

Case study part 1: The Malvern Hills

The teacher showed a year 8 class the spectacular image of the Malvern Hills in Figure 3 at the start of a unit on 'Landscapes of Britain'. The aim was to provoke an emotional response to the landscape and generate 'awe and wonder'. Students were asked to imagine they were the person in the photograph; what their feelings were and what they were thinking as they looked at the view. Responses varied, but many students expressed some sort of awe or wonder. The teacher picked up on one response – 'Wow, these hills must be high – they stick up above the clouds!' The teacher showed another image of the Malvern Hills (Figure 4), then took the students through a sequence of questions summarised in Figure 5. These were designed to draw out an understanding of physical geography, based on the students' emotional responses to the photo. The lesson then moved on to teaching about the distribution of highland and lowland areas in Britain, linking to a geological map of the British Isles.

Awe and wonder extended by powerful knowledge

It would be easy to think that the teacher's plan to generate awe and wonder using the spectacular image in this lesson was a success. The students' responses demonstrated awareness of some rock names and the ability to categorise them as 'hard' or 'soft'. However, their knowledge

Figure 3: An 'awe and wonder' image: the Malvern Hills emerging from a sea of cloud. **Photo:** © Adobe Stock Photo.

Figure 4: The Malvern Hills rise steeply from the Worcestershire plain. **Photo:** © David Martyn Hunt (CC by 2.0).

Teacher: Why do you think the Malvern Hills stick up?

Student: Because there are hard and soft rock and the hills are made of hard rocks.

Teacher: Can you give me any examples of hard and soft rocks?

Student: Lavas are hard.

Student: Granite is a hard rock.

Teacher: Good … and what about examples of soft rock?

Student: Sand … I mean sandstone.

Student: Clay.

Teacher: OK … What do you mean by hard and soft rocks?

Student: Hard rocks don't wear away … soft rocks wear away more easily.

Teacher: What makes rocks not erode easily?

Student: Because they are tough and hard.

Teacher: OK, so there are tough rocks and soft rocks. The soft rocks erode easily and usually make up the lowland while the hard rocks resist erosion and form mountains or steep hills … and on the coast, headlands are made of hard rocks and the bays between are made of soft rock.

Figure 5: Sequence of teacher questions and student responses to draw out knowledge of physical geography in response to a photo.

was confined to the concrete and obvious – why there are ‘hard rocks’ and ‘soft rocks’ remained a mystery. Their circular ‘hard rock’/‘soft rock’ reasoning revealed few, if any, worthwhile insights. Rather, it showed up the limitations of the ‘Future 1’ approach: the acquisition of factual knowledge that disconnects rather than promotes inferential knowledge. In contrast, ‘Future 3’ and powerful knowledge foster the confidence to think beyond the obvious and interpret rocks and physical landscapes in a different way. What is the powerful knowledge underpinning ‘hard’ rock and ‘soft’ rock, and how can it be used to extend the awe and wonder of rocks and landscapes?

Case study part 2: The material marvel of rocks

The aim was to give students a further ‘wow’ moment: the sudden realisation of the ‘hidden’ geography that takes them beyond their factual knowledge. Granite (and igneous rock) is usually labelled as ‘hard’ rock and sandstone (sedimentary rock) as ‘soft’ rock, presenting a key question to investigate: Are there different properties in each of these rock types that cause them to be a ‘hard rock’ or ‘soft rock’?

Students were asked to compare samples of granite and sandstone and guided to ‘look inside’ the rocks for clues that would help them predict the strength of different rock types and, ultimately, explain the formation of landscapes.

They weighed each rock sample, then placed them in water. They noted bubbles emerging from the sandstone but none from the granite (Figure 6). The rock samples were removed, surface-dried and weighed again. The granite remained the same weight whereas the sandstone weighed more. Students were asked to explain the bubbles and the increased mass of the sandstone.

Most students suggested it was air escaping from the sandstone and being replaced by heavier water, which accounted for the increased mass. They reasoned that the sandstone must have ‘holes’ or spaces in the rock (i.e. pore spaces), whereas the granite must not. Moreover, the pores must be connected. A close inspection of the rock samples confirmed this theory.

To explain how different rock types have spaces within the rock or no spaces, students were asked to look at the shape and arrangement of the grains in each rock and then modelled them using a tessellation puzzle on paper followed by 3-D modelling using marbles (sandstone grains) in a container and a wooden interlocking puzzle (granite grains) (Figure 7)

The grains in the interlocking puzzle held together whereas the marbles fell apart when the container was turned upside down. Scratching the sandstone sample with a metal object, the students were able to scrape grains off the rock, but could not do this when scraping the granite.

Figure 6: Rock types immersed in water to investigate differences in material grain arrangement – (a) granite (b) sandstone. **Photos:** © Peter Kennett/Earth Science Education Unit.

All the students realised that the sandstone grains must be ‘glued’ together. They had discovered a fundamental material difference between two types of rocks – interlocking and non-interlocking. This also explained why the sandstone was porous but the granite was not. Asked how a non-interlocking rock might be stronger, the students suggested (i) different strengths of glue; (ii) all the pore space filled with glue (strong); or (iii) just the contact places glued (weak). The teacher asked if a glue could be weakened with water and challenged students

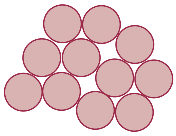
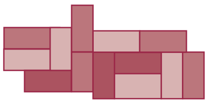
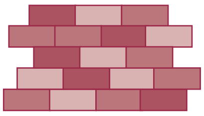
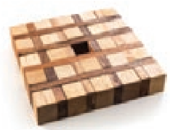
Gaps between the grains	Use several large coins of the same size side by side – you can easily see the spaces between the 'grains'		Permeable rocks	Sedimentary rocks	
Interlocking crystals	Use rectangles of paper, cardboard or plastic side by side – with no gaps between the 'crystals'		Impermeable rocks 1	Igneous rocks	
Interlocking crystals	Use long thin rectangles of paper, cardboard or plastic side by side – with no gaps between the 'crystals'		Impermeable rocks 2	Metamorphic rocks	

Figure 7: Powerful modelling: students model the arrangement of grains in different rock types and make the link with permeability. Diagram courtesy of Earth Science Education Unit.

to predict if this was more likely to occur in an interlocking (igneous) rock or a non-interlocking (sedimentary) rock.

Finally, the teacher asked if students now thought of rocks differently. They were convinced it was better to think of rocks in terms of their strength or weakness than to describe them simply as hard or soft.

The powerful knowledge gained from this extension to 'awe and wonder' gave students new ways of thinking about rocks and physical landscapes. They were now able to move beyond the obvious and conceptualise, infer relationships and predict implications. They understood grain relationships in rocks; how these can be used to reliably classify rocks into different types (igneous, metamorphic and sedimentary); rock 'glue', strength, porosity and permeability; the role of water in weathering rocks; how rocks are formed and how they influence landscape development; and the environmental importance of rocks to groundwater resources, oil and gas and waste storage. Wow!

Conclusions

The 'wow factor' is important for stimulating interest in physical geography and can engender sensory and emotional responses. For a more enduring learning experience both teachers and students need to probe beyond the obvious and release the 'hidden' physical geography. The hidden lies in the abstract and conceptual ideas that emerge from a broader established system of disciplinary thought, which has been termed 'powerful disciplinary knowledge'. Enabling students to make sense of physical geography through the lens of powerful knowledge gives them the intellectual power to develop new ways of seeing and to place aspects of the physical world in a more meaningful context. To release 'hidden' physical geography teachers need to engage with deep thinking about the subject and what this means in terms of powerful knowledge. In turn, this enables teachers to shape the curriculum so as to reveal and encourage exploration of awe and wonder that would otherwise remain hidden or mysterious to the student. | **TG**

References and further reading

All websites last accessed 28/11/2019.

Bustin, R. (2019) Geography Education's Potential and the Capability Approach: GeoCapabilities and Schools. Switzerland: Palgrave Macmillan.

Dictionary.com (2019). Available at https://www.dictionary.com/

Frodeman, R. (1995) 'Geological reasoning: Geology as an interpretive and historical science', Geological Society of America Bulletin, 107, pp. 960–8.

GeoCapabilities website (2019). Available at http://geocapabilities.org.gridhosted.co.uk/geocapabilities/a-curriculum-of-engagement/

Lambert, D. (2016) 'Geography', in Wyse, D., Hayward, L. and Pandya, J. (eds) The Sage Handbook of Curriculum, Pedagogy and Assessment. London: Sage Publications. pp. 391–408.

Maude, A. (2016) 'What might powerful geographical knowledge look like?' Geography, 101, 2, pp. 70–76.

Ross, S. (2001) 'The geography of awe and wonder', Teaching Geography, 26, 2, pp. 86–8.

Young, M. and Muller, J. (2010) 'Three educational scenarios for the future: Lessons from the sociology of knowledge', European Journal of Education, 45, 1, pp. 11–27.

Resources

Outlines of the rock comparison investigation can be downloaded at: https://www.earthlearningidea.com/PDF/Rock_detective.pdf
https://www.earthlearningidea.com/PDF/Modelling_for_rocks.pdf | https://www.earthlearningidea.com/PDF/Space_within.pdf
Visit the Malverns website (2019). Available at https://www.visitthemalverns.org/things-to-do/walking/

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Duncan Hawley is Chair of the GA's Physical Geography Special Interest Group and was GA Consultant to the GeoCapabilities project, exploring the use of powerful knowledge for geography teachers.

Email: duncan.hawley.geography@gmail.com