

Ecology of a Geologist's Embodied Creativity

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Purpose

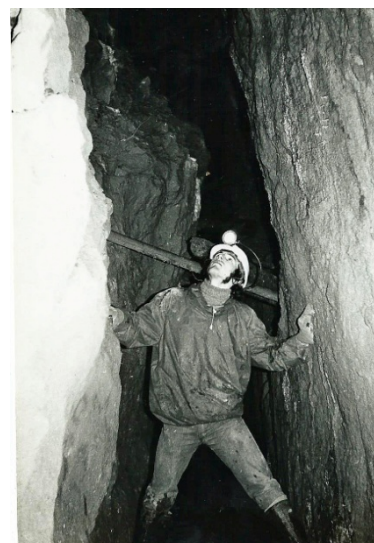
In the first half of my career I was a geologist. I was a university lecturer and a researcher, and I worked on mineral exploration projects in Saudi Arabia. Then I moved into higher education as a field of study and have spent the last decade developing my own theories about learning^{1,2}. Most recently I have been developing the idea of 'learning ecologies' as a way of explaining how we learn through interacting with our environment and the circumstances of our life. In this article I have tried to show how the idea of a learning ecology might apply to the work of a field geologist. I don't think that we teach geologists to think about what they are doing in this way so I would be interested to know whether the idea of a learning ecology makes sense and/or is useful to geologists and to the development of geologists in higher education. More generally I am interested to know whether knowledge workers in other disciplines could use this framework to explain how they interact with their environment when they go about their work.

A pragmatic view of creativity

Over the last few years I have come to realise that personal creativity is a matter of perception, connection and integration: of connecting and integrating perception, imagination and reasoning to connect, integrate and evaluate existing ideas to produce and develop new thoughts, and to connect and integrate thinking and action, mind and body as we interact with our environment and the unique circumstances of our life. It's a highly situated and ecological view of creativity and through our purposeful interactions our perceptions change as new patterns, possibilities and insights emerge that only make sense to us as we see and create new meanings. All we need is a reason and motivation for interaction and our uniqueness as an individual inhabiting a unique set of circumstances, will do the rest.

The questions posed in the #creativeHE on-line discussion³ on the role of the body in creative processes and practices, encouraged me to consider something that I had previously often taken for granted - the role of my own body in my own processes for learning that also enable me to use my creativity. As the conversation unfolded I surprised myself by focusing on the early part of my career when I trained and then practised as a geologist. Being a field geologist involves quite a lot of physical effort and labour as the body is used to physically interact with the landscape and the rocks in it, or in the case of a mining geologist, interacting with the rocks and structures deep underground (right). Perhaps this made it easier for me to visualise how my body might be involved in a creative process in a disciplinary or work context.

One of the questions posed in the on-line discussion the way our bodies inhabit particular spaces that encourage our creativity. In this article I want to explore the idea that when we are involved in a significant challenge, our mind and body does not just inhabit a physical environment, rather, when trying to learn and achieve something significant, we create what I call a learning ecology that enables us, as a whole person to

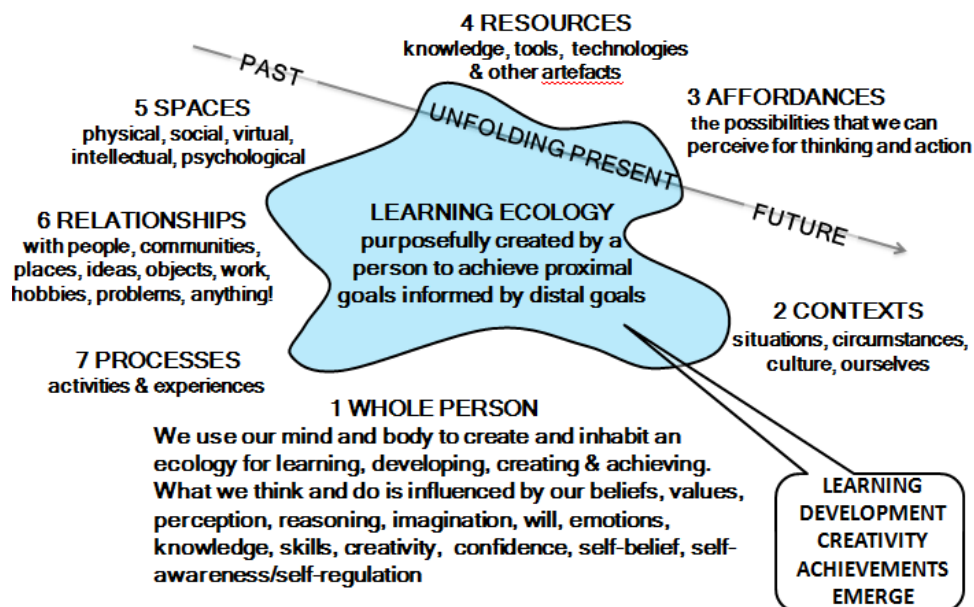


physically, intellectually and emotionally interact with a complex environment that is physical, social, intellectual, emotional and possibly virtual in its nature.

What's a learning ecology?

A person's learning ecology is simply the interactive relationship between them and the things in a particular physical and/or mental space that exists or is created by a person in order to learn, develop and achieve something². The idea of learning ecologies encourages us to think more holistically and more dynamically about the way we inhabit and relate to the world we perceive - real or imagined. Applying the idea of ecology to learning, personal development and achievement is an attempt to view a person their purposes, ambitions, goals, interests, needs and circumstances, and the social and physical relationships with the totality of the world they inhabit, as inseparable and interdependent³. Figure 1 shows the important components of a learning ecology².

Figure 1 Important components of a learning ecology (Jackson 2016).



So what does the idea of a learning ecology mean in the context of being a field geologist? and how does the idea of embodied creativity feature in a field geologist's ecology for learning when he is trying to achieve something significant?

Geologists are 'knowledge workers' in the sense that they use their brains and bodies to develop particular sorts of knowledge in order to understand the geology of the earth. As such they contribute to what Beau Lotto calls man kinds need and desire to flourish^{4:77}.

We are all just brains in bodies and bodies in the world with one goal.. to survive, and in the case of modern day humans, to flourish ^{4:77}

One of the ways that a geologist develops this knowledge is to put himself in the field to make a geological map. Such meaning making can be an academic exercise eg to study the geology of an area or specific rock formation. It can be training exercise eg a geology student engaged in an independent mapping exercises or it can have commercial value eg to explore for economically useful rocks or minerals or to provide information for a

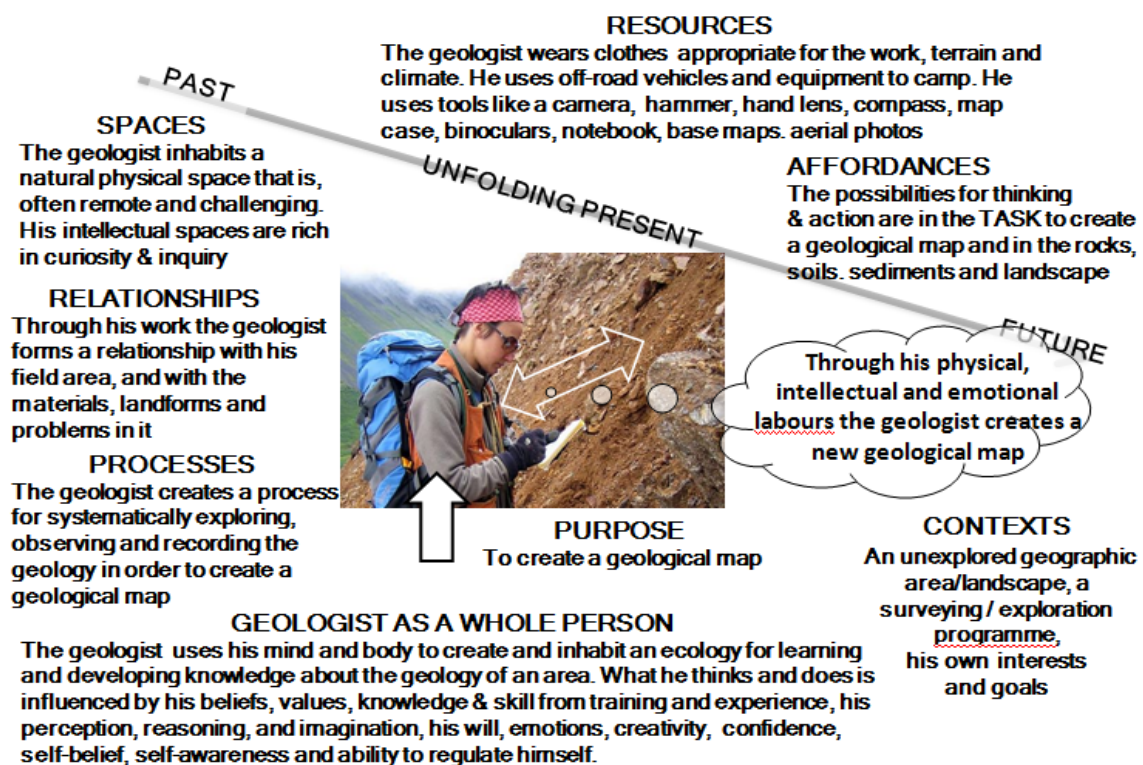
construction project. While a certain amount of knowledge can be gained through remote sensing techniques the only way of discovering the 'truth' about what is on the ground is to physically go into the field environment and walk over the ground, observing, recording and making sense of what is encountered.

Like all knowledge workers geologists have to develop a foundation of factual, theoretical and practical knowledge and skill before they can practice. Their perceptual history involves many hours of study - reading, listening to lectures, writing essays, handling rocks in practical laboratories often peering down microscopes, and days of field experiences so that they can understand and interpret rocks in the way other geologists do. The signature pedagogy of their discipline enables them to think and act like a geologist and this state of being is developed through their experiences of being a geologist.

You and all your subsequent perceptions are a direct physiological manifestation of your past perceptual meanings and your past is largely your interaction with your environment, and thus your ecology ^{4:83}

A geologist might take on the task of creating a geological map where none exists or creating more detailed maps where maps already exist, perhaps at a different scale. Ecologically, we might represent this scenario through a map of the geologist's interaction with his field area, his past perceptual history and his emergent thinking and emotions as he engages with his challenge in an unfolding present (Figure 2).

Figure 2 Mapping a field geologists ecology for learning and producing a geological map



In creating and inhabiting his ecology for learning he draws on his past experiences and knowledge of how to tackle similar problems. Prior to going into the field he gathers existing information about an area he intends to map. He acquires relevant resources, like geographical maps if they exist or aerial or satellite photographs if none exist. These are

the essential resources and tools he needs to record observations about what is found and enable him to use such information to create a new map.

He develops a plan for mapping the area, estimating the time and resources he will need for example he needs to work out where he will live in the field, how much food and water he will need, how he will get to his field area, how he will move around once there, how he will communicate and many other things he will need to consider.

Once he is in the field, the feedback he gains from interacting with the landscape, rocks and soils will shape his future actions. His body has to work hard to find rock outcrops and identify boundaries between different types of rock. His ability to perceive the geology is dependent on his physical and mental ability to see the rocks he is interested in, to see and measure the structures and the relationships between different types of rocks, to take samples for further analysis, and to record his observations on a map. All these things are dependent on his past and current perceptions.

Our brain evolved perception to allow us to move. A fundamental part of being human... is *responding*. Our lives are inescapably enmeshed in our environment and all the sundry things, both living and inanimate [eg rocks], that fill it. Which means that we are only ever reacting, acting and reacting then acting again....^{4:59}

His work involves performing particular routinised actions - like locating the position of a rock outcrop on a geographic map or aerial photograph (now made easier with GPS navigational aids), measuring the dip and strike of bedding or other structures in rocks, breaking rocks and examining fresh surfaces with a hand lens and perhaps testing them with dilute HCl, photographing and sketching rock outcrops and annotating sketches with observations, and where there is little outcrop examining the soils. The mental processes of perceiving, imagining and reasoning are intermingled with the physical process of finding the pieces (rock outcrops and structures) and sensing (observing, feeling, measuring) the materials, and recording (often sketching or photographing and making notes) of what has been perceived possibly with associated imaginative speculations.

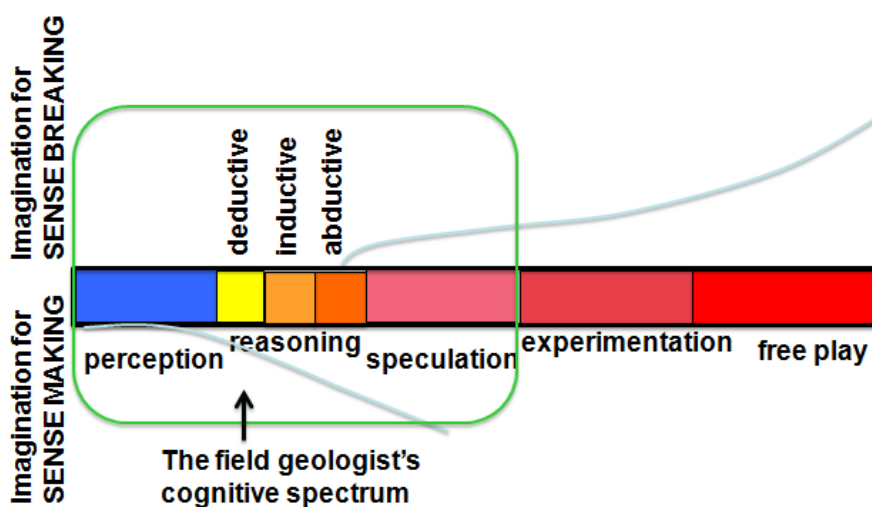


Figure 3 The cognitive spectrum⁶
The typical cognitive spectrum of a field geologist is represented by the green domain

His thought processes move backwards and forwards along the cognitive continuum⁶ (Figure 3): perception (observation informed by knowledge gained through study and

experience), imagination (conceptualisation of what is observed in order to create possible meanings) and reasoning (the critical evaluation of what is observed in order to evaluate possible meanings and make judgements) and reflecting on what has been seen and understood to try to make more or different senses of it.

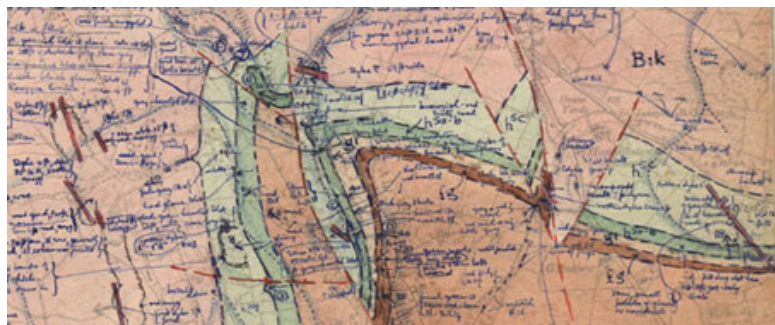
Making a geological map is like solving a giant jigsaw puzzle where most of the pieces are missing. The geologist's learning project is one of continuous inquiry driven by his curiosity and need to understand. His project requires all forms of reasoning and the use of imagination to speculate and project from the known into the unknown to try to visualise and make sense of the patterns and the stories he is seeing in rockscape. This is the nature of the intellectual space he creates for himself while physically interacting with his environment.

This act of 'making a map' is also an emotional experience. He experiences joy in the work he is doing: he loves the challenge and he likes solving the puzzle which sustains his motivation. But he can also experience feelings of frustration when he has to spend hours searching for answers but cannot find them. At times its uncomfortable. In his field area it rains a lot so he is constantly wet and it's not easy to keep his field slips and map dry. And it can be painful as slipping and falling is part and parcel of the scrambling over the loose rocks and occasionally as he pushes himself to climb a cliff he feels anxiety and fear.

These complex sensory experiences and intense interminglings of the physical, mental and emotional states of being enable him to form deep relationships with his work and the objects of his work - his landscape and the rocks in it. His emotions contribute to the investment he is making in his own meaning making process and encourage a sense of inner resilience as he pursues his goals in what is a fairly inhospitable environment.

The intellectual, emotional and physical enterprise of a geologist is focused on trying to solve a three dimensional puzzle with only bits of information and lots of gaps. He tries to understand the relationships between one type of rock and another and develop understanding of the geological history of the area. It's an ecological problem! Perceiving, conceptualising - the building of working hypotheses to explain the geology, and reasoning go hand in hand and as a hypothesis forms the body is involved in helping the geologist to evaluate it. The geologists body gets his senses and his mind to the places he needs to be in order to find the evidence that confirms his hypothesis or not. He has to get himself into the physical spaces that have the highest potential for solving his problem. While this is essentially a logical process experience has shown me that there is much intuition involved in this process. Sometimes it just feels right to do something without really being able to immediately explain why.

The geologist records his observations on a field slip (right) and in his notebooks. The process enables him to relate and synthesise disparate pieces of information to create a clearer and bigger picture of his puzzle and enable him to



search more selectively for missing pieces.

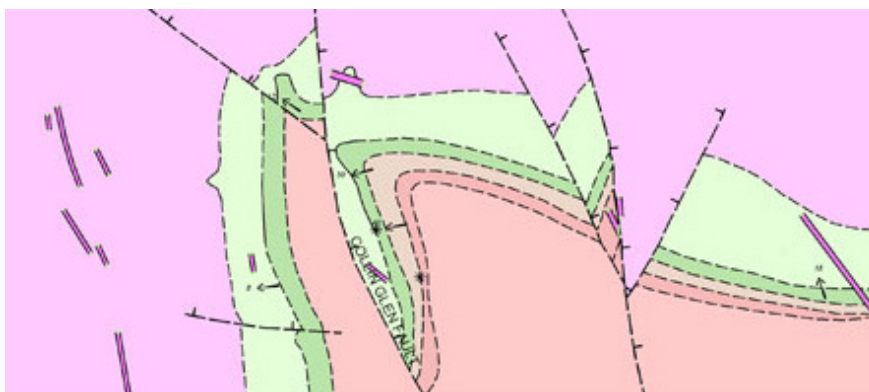


Once back at camp, there is further pondering and reflection on what has been seen as the day's observations in notebooks, digital photographs or video, are revisited and plotted on a cleaner base map like the one on the left.

These analytical and conceptual processes continue after the field experience as samples are analysed and understood better. New artefacts and data are produced through these analytical processes. For example, geologists use microscopes to study the mineral composition, textures and structures of the rocks they have sampled using thin sections (30 microns thick). Thin sections (right) produced are important artefacts from natural materials that reveal the beauty in the rocks and minerals and enable those materials to be understood, characterised and classified and improve the accuracy of the geological map the geologist is producing.



The elements of a geologist's cognition and bodily actions work together in a merry dance through field, laboratory and office environments and the knowledge and understanding that is developed is communicated (maps and reports) which are the creative outcome of this process. The final process of making a map is the geologists way of communicating his understandings to other geologists or people working in related professions like civil or mining engineers or hydrologists.



Producing the digitised map and accompanying report are the creative artefacts resulting from his learning ecology. Producing the map is essentially a drafting process in which information is carefully transferred from field maps and

notebooks onto a new base map and digitised. The process of reworking this information can stimulate further integrative thinking. But there is also an artistic element in the making of a map as pens or digital tools are handled and used to create the map. The final product is a beautiful object containing a story, explained in the image, the key and in an accompanying report, about the geological history and mineral resources of an area. The

map is also a tool that can be used to make decisions about how a landscape and its resources might be used and managed.

An ecological concept of personal creativity

I began by offering a pragmatic concept of personal creativity: a matter of perception, connection and integration by a unique individual in a unique set of circumstances involved in the problems, challenges and opportunities he cares



Personal creativity is

'the emergence in action of a novel relational *product* growing out of the uniqueness of the individual on the one hand, and the materials, events, people, or circumstances of his life'

Carl Rogers (1960)

about. This view of creativity is consistent with Carl Rogers⁷ representation of creativity where the creative products of the geologist's physical, intellectual and emotional endeavours (his learning and his geological maps and reports) grow out of his purposeful interactions with the particular circumstances of his working life. In this way the geologist contributes to his own flourishing and to the flourishing of his society.

Acknowledgements

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