Centring Humanism in STEM Education

Chapter Three: Evholution Infused Science Education Empowers Students to Navigate their Way in the Current Global Storms of Change

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Introduction

Several years ago, I was teaching the constellations of Orion and the Southern Cross to Grade 7 learners to be used for night navigation on a survival camp. I showed them a simulation of what the night sky would look like on the camp, and they drew the positions of the stars while chatting distractedly among themselves. A week later, on the first night of the camp, two girls came running excitedly up to me shouting, 'It's real! It's real!', while pointing up to the sky. Their joy at recognising Orion's belt led to them wanting to find the Southern Cross. They jumped up and down and hugged each other with excitement when they found it. They then asked me how to use the stars to find north, as we had discussed in class.

The girls' "discovery" that the star constellations we learned about in class is real, struck me as significant. It seemed to me that even when we teach science, our rigorously tested facts and understanding of our world, students do not approach it as though it is real. While the learners were drawing the positions of the stars, it later occurred to me that they were simply doing what the teacher told them to do, and they would have probably been able to reproduce something close to that in a test. Yet, it had no bearing on their relationship to reality or the world. My conclusion was that learners simply no longer believe what they learn in class.

A key aspect of the survival camp was for the learners to experience many of the basics of historically traditional life, like fetching drinking water, washing in a river, digging their own toilets, cooking and cleaning. Despite much initial moaning and resistance, by the end of the camp most

of the learners did not want to leave. Many of them were crying to stay even though a monster thunderstorm had collapsed and soaked most of the campsite on our last night. What were they crying about? In our feedback session as we prepared to go home, one boy gave his answer by saying this,[1] 'My whole life I've feared nature. After these three days, nature now feels more like home than my actual home. I feel like I've been a prisoner in my house my whole life." His sentiments were echoed by many of his peers.

The boy's reflection on the survival camp, where they had no modern conveniences in meeting their daily needs, reinforced that it is not only education that is removed from reality, but that many students live lives removed from nature. Because nature is our true home, the world that gave birth to us through evolution and which continues to nurture us, this alienation should be of great concern to everyone involved in education. In physical sciences education, this is of a direct concern as it is the laws of nature and the laws of matter and energy, that we study.

The wish for transdisciplinarity in education

The impulse towards transdisciplinarity in higher education is all about giving education a broader context, a context that when assembled into a meaningful whole gives one a picture that more closely resembles reality. When viewing the world through the lens of a single academic discipline or paradigm, we know that we are limiting our perspective, however, we do it to get to the detailed basis of what that perspective can bring. The gifts of this approach are evidenced all around us in the power and precision of our modern technological tools. The problem with this approach is that we may end up having limited concepts that ignore important elements from broader reality. We may then feel trapped in our own thoughts in the same way as the Grade 7 boy felt himself to be a prisoner in his own home. The Grade 7 boy was expressing, in his way, what academia is often seeking through transdisciplinarity, to feel a liberation of being and knowledge through experiencing ourselves in the world from multiple significant perspectives. Such an experience enables one to feel a greater intimacy

1 I cannot recall his actual words, but what he said made a deep impact on me, so I remember the essence to be exactly this.

with ourselves and our world, where one's sense of personal meaning unites with their scientific rational understanding. Students at the survival camp possibly felt the way that they were interacting with nature, the world that gives us everything, hence, it reflects our true nature.

If a simple trip into nature can achieve this to some degree for Grade 7 students, where have we gone wrong in our current approach to education, and how can we get back on track?

Let us start at the beginning, before formal education

Here in South Africa, until about 300 years-ago, everyone lived very close to nature. Everything in our world came from our surrounding world. We made our homes from stone, earth, wood or grass. We ate the food that lived in our environment and drank the water from our rivers. We lived according to the weather and the seasons. The people that we grew up with were the same people that we knew until we died. Our family and community remained relatively constant our whole lives.

The stories that helped us to make sense of our world were also related to the things of our world. Animals and demons as well as gods and helpful nature spirits were all beings to whom we related. Globally, all indigenous communities made sense of their world in similar ways, with stories that gave life meaning and understanding. These stories also ensured the health and sustainability of their identity, community and environment. The local river whose nature spirit needed certain gifts in order that the people would be given gifts in return (such as the Ganges in India [Kumar 2017]), or the mountain that should be looked upon as sacred ground (such as Mount Ruapehu in New Zealand [Davidson 2022]) were common types of indigenous relationships to the world of nature. It meant that people understood that their own attitudes and behaviour had a direct impact on the behaviour of nature in a more personally intimate manner than how this is understood through our current environmental understanding. Their systems of knowledge and the application of it in daily life remained intact. Perhaps it was a taste of this that made my Grade 7 class reluctant to leave the camp.

With modern scientific thinking, we now know many aspects of how our

actions impact on nature, however, we are still a long way from the intimacy with nature with which indigeneity gifted our ancestors. Even the God/s of our religions have become delocalised and abstracted. And yet the power of our religion's God/s to unite large numbers of people who have never and will never meet is unmatched.

In the modern day there are many people who claim to have human-like communication with animals (Breytenbach 2015; Del Monte 2020; Fitzpatrick 2013; Hafen 2013; Loy 2016; Mackay 1998), and a great many others who claim to have communication with or visions of, the nature spirits that stand, invisibly for most, behind the phenomena of nature (Baan, 2013; Bloom, 2012; Borges, 2012; Crombie, 2018; Dispenza, 2019; Mayer, 2021; Mirkin, 2021; Mutwa, 1964; Pogacnik, 2012; Power, 2019; Sadhguru, 2009; Weirauch, 2004; Wilhelm, 2022). Despite this, not many people are tempted to return to an indigenous way of life. These indigenous understandings of the world helped individuals to maintain their intimacy with their immediate environment, but our new religious, scientific and nationalistic ideas offer us other gifts.

Over the years indigenous groups became larger and more powerful because the stories that they shared had a more universal basis. These ideas were beyond the local river and mountain whose spirits helped the group survive and thrive. These larger ideas seem to have eventually become those that support our current national, political and religious identities (Harari and Perkins 2014). Religion and nationality enabled individuals to unite behind ideas that gave life meaning beyond indigeneity.

Science carries a tested and proven universality of ideas into the wisdom of humanity, however, these ideas usually lack the narrative story element behind which people can unite with a sense of belonging and meaning. Instead, they require the individual to temporarily step away from their ideas surrounding identity, and to place the evidence and facts as objects for their examination. The mental effort required to grasp the ideas of science demand a rational, evidence-based objectivity that has the potential to grow one beyond even religious and nationalistic ideas as evidenced in the international contributions to the development of science.

This chapter is about science education, and how an evholutionary educational approach can give students the needed universal scientific facts

while not robbing them of their religious and indigenous sense of meaning and belonging. To be able to do this, this chapter must first present an understanding to why science has the depersonalising effect that it does, and then to explore the theory of evholution that underpins the research reported upon here.

Science as an objective, left-brain activity

When one tries to be objective, one must push the object of observation away from themselves so that their previous ideas do not interfere with their ability to examine evidence scientifically. Scientists from all backgrounds can then engage with this evidence rationally, without their differing cultures and beliefs interfering with their work. It is this approach that has made science universally testable, understandable, acceptable and useful. This approach has been recognised as taking place predominantly in the left side of the brain, which is why it is often referred to as left-brain thinking (McGilchrist 2019). Right-brain thinking is usually associated with being creative, intuitive and subjective. Even though we use both types of thinking in our scientific activity, in the science classroom we are predominantly focused on training our students to develop skilful left-brain thinking. It is likely that this is in fact our primary task in science education.

The objective facts of science then become the perfect material for our work. This is because we can use these objective facts to test if our thinking is correct or not. One's thoughts and understanding either align with the observable evidence, or they must be wrong. This challenges one to engage with the facts from different perspectives until we have identified the underlying principles that explain what we see. Further, anybody can then check their new understanding with new evidence, testing and refining scientific thinking and understanding. The value of being able to distance oneself from their personal perspective and to develop the universal language of science has led us to being able to communicate across almost all cultural and language barriers. It is such a powerful type of thinking that Comte (1976) regarded all other ways of knowing as inferior, and Kant (2019) regarded it as the gift that gave birth to what the author called a new age of enlightenment.

This left-brain faculty has given us the capacity to free ourselves from personal prejudice and see the world through the eyes of others. It has also enabled us to develop the well-tested understanding of our world that is used to create the ever-changing and powerful technologies in our time. Left-brain faculty also gives one the tools to work towards political, economic and environmental understandings that are practical and rational. Despite these extraordinary gifts, even a rational mind can recognise its own limitations in knowing that it only uses one side of the brain, one side of our biologically given mental functioning. It can, therefore, only give us a one-sided relationship to our world.

The intuitive, creative and personal faculty of right-brain experience is what is missing. This is because it is subjective, and was banished from our scientific endeavours for us to become truly objective. If we only live in our objectivity, we lose our relationship to ourselves and our world. It is precisely the personal and subjective realm in which we get our sense of identity and belonging through experiencing relationships emotionally and intuitively. The creative playfulness inherent in right-brain activity gives one the enthusiasm and warmth needed for a meaningful life. It is in fact right-brain activity that is the driving force in how we make most of our decisions (Eagleman 2015), making it a 'sacred gift', while our rational faculties act as a 'faithful servant' in testing them for integrity (Samples 1976: 26). By giving all our attention to our left-brain activity, Samples (1976) posits, we honour the servant and forget the gift. Richard Feynman, a Physics Nobel Laureate and top scientist of the twentieth century, once apologised to his audience for delivering a lecture on science as opposed to giving them an artistic recital that contained the essence of his work (Feynman 1955). Feynman (1955) boldly declared that until we can lift our scientific knowledge into our artistic and creative intuitions, we will not yet be living in a scientific age.

Feynman (1973) also delighted in talking with leaders of different disciplines. The author argued that science has already used and perfected specific methods for its work and could advance in different directions with new approaches. These approaches can easily be found in disciplines where the nature of the work demands different strategies, assumptions, skills and techniques. A current dilemma in physics is the lack of progress in detecting

dark matter and dark energy, the substances that make up over 90 per cent of the universe. Scientists know where the regions of these substances are. They can even detect the shapes of where they reside, but cannot detect them. Billions of dollars have been spent on this project without much success, leading to a sense of despondency in physics (De Sutter 2025). If scientists took a leaf out of Feynman's approach they may make some progress. This approach has great potential for all transdisciplinary research and education. It is the potential of this transdisciplinary approach that the current research sought to test in the science classroom.

Evholutionary justification for balancing the use of one's mental faculties

Reality is multidimensional. An individual needs all their mental faculties and associated understandings from within the many academic disciplines to study and understand reality. For many decades academics have dug ever deeper within their fields to understand its essence. In nature, however, we always find overlapping data blended within single phenomena. For example, a sunset reveals as much about the atmosphere as about the behaviour of light and of lovers. When we use our diverse human faculties in the science classroom, we help students experience a whole and monist understanding of reality that mirrors the evolved intimacy of natural phenomena. A monist understanding is achieved when we recognise that all aspects of the phenomena are intimately related, and where we welcome and value the varied elements of the phenomena equally.

Evolution [or God if you prefer] has gifted us with the capacity to experience reality in these multiple and varied ways. Evholution recognises that the religious and scientific approaches to reality must be brought into conversation to bring the fruits of these two important ways of knowing into harmony. Evholution, thus, trusts that there are important reasons for our multidimensional perceptions from both an evolutionary and spiritual perspective, in that they must somehow help us to survive and thrive.

Without researched data it is challenging to justify the use of one's broad range of mental faculties and understandings in scientific work, considering how successful the left-brain approach has been. By embarking on the

research journey where students are given the possibility of reconciling their various ways of perceiving and knowing while studying science, we begin gathering theresearched data needed to indicate if there is value in the process.

Research process

In evholutionary science education, scientific phenomena and knowledge is used as a starting point and encourages students to relate personally with it using everyday language, narrative, the arts, characterisation and personal experience. Students are also encouraged to find meaningful relationships between their scientific and indigenous, religious or cultural understandings of reality.

The research that is being discussed included science experiments, conventional classroom content presentation, classroom conversation, with the use of characterisation, metaphor and poetry to stimulate student's experiences. Probing questions were asked to stimulate students creative thinking. For example, after doing experiments with chlorine the students may have been asked something like, 'If Chlorine walked into the room, what would it look like? How would it behave? What would it be wearing? Would it even be human?' And so on. This approach took the students out of a formal relationship to learning science which is often focussed on students needing to know universally accepted ideas on the work and allowed them to probe their own imagination and intuitions about chlorine, based on the experimental evidence and their previous knowledge of the element. With no right or wrong answers, all responses were respected as valid, and probed for how the associations were made and which aspects of the phenomena they portrayed well, as well as those that were overlooked. The use of metaphor and characterisation was to transform the otherwise often abstract concepts of science into characters of a story with whom they could identify. This calls upon one's full range of sympathies and antipathies, where the scientific dynamics portrayed in reactions and formulae become the basis for the relationships between the characters. This approach changed the students from needing to only learn specific facts and logic, to creating their own personally meaningful content in conjunction with their classmates.

This research is ongoing, however, the research findings that have been reported on involved Grade 11 school students as well as pre-service and in-service teachers, who were taught using the evholutionary educational approach mentioned here (Mirkin 2024). The interventions used with the various groups were not uniform. They took a different form each time to fit in with the given timetable of the school or university classes. Data was gathered from classroom observation and student feedback after the intervention. No specific outcomes were expected. The researcher and students simply commented on the aspects that stood out for them. The feedback was then processed using qualitative thematic coding (Mirkin 2024).

Research findings

The most consistent comment and feedback was on student involvement and engagement. As with much enquiry-based learning research, the findings showed the students became noticeably more engaged during the lesson (Attard et al. 2021), with many students who usually don't contribute in class becoming involved. It was not just an increase in teacher-student engagement, but student-student interactions also increased. Together with this increased engagement, students also felt less tired and needing a rest both during and after the interventions. On one occasion, where the intervention was implemented in three-hour slots, the students were usually so engaged in the work that the researcher needed to remind them that the time was up and that they should finish up and leave. In the intervention sessions, students were observed becoming fresher and more enlivened once they began engaging with the content using their imagination and creativity.

Other observations by the researcher and in the student feedback, include students relating the work to their religious or indigenous understanding. These often resulted in new insights and a deeper meaning for the students. In the process, students have both questioned with doubt as well as deepened the ideas of their background. Some students long-held questions also naturally emerged, where they felt that the usual taboo subjects of religious and indigenous beliefs could be engaged in a spirit

of openness and enquiry, free from judgement. In every such case, the strengthening of personal meaning and engagement was reported, with no single case of a loss of meaning, despite the occasional shift in belief.

These findings suggest that students experience a greater sense of personal meaning and investment in the work, and that they do not suffer as easily from academic exhaustion and burnout, but engage more openly and can feel enlivened during the sessions.

Reflections

In scientific studies one is always focused on treating evidence with objectivity and well-reasoned logic. In evholutionary enquiry, this same approach is taken with the difference being in what is regarded as evidence. In the current research, the subjective intuitions of students were taken as valid subjective evidence, where they were probed to explore the fit between them and the scientific observations. In this process the seriousness of the subjective creative process united with a spirit of objective scientific enquiry. The harmonious working of left-brain and right-brain activity made the experience of learning both exciting and personally meaningful.

Evholution, being a holistic understanding of the holistic and monist intimacy between all aspects of reality, therefore, showed itself as a useful theoretical framework for learning science both at high school and university level, including with in-service teachers. This research showed that evholution offers one a "how" for enriching science education with enabling students to experience a seamless bridge between their objective and subjective learning. It also offers one a "why" in that it gives the framework to see one's position within a greater evolutionary context while offering students an opportunity to engage with their indigenous and religious ground of meaning in a new way. This ground is after-all our inherited domain for finding our "why" in life. By bringing these into a meaningful relationship with scientific facts and the power of the scientific method, students are offered real ground to developing their independent "why" in life.

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