Chapter

Thinking, Alternatively: The Application of Art, Philosophy and Holistic Practice in the Teaching of Science, Technology, Engineering and Mathematics (STEM)

Christine Challen and Kay Sidebottom

Abstract

The challenge for education in contemporary times is how to combine rich subject knowledge with conceptualization, whilst also supporting curiosity, criticality and creative problem-solving through application. More importantly is the embedding of well-being in curriculums to ensure the evolution of being, becoming, and thriving subjects towards enhancing life-long learning. This chapter will explore the potential of interdisciplinary working across philosophy and the humanities to develop the kinds of critical education required. Using practical examples, we will demonstrate how educators can think in interdisciplinary ways, within the constraints of formal curricula activity. We will explore opportunities for 'thinking, alternatively' across STEM subjects, focusing particularly on the role of art and philosophy. Drawing on posthuman thinking and the work of Deleuze, Guattari, Dewey and others, we consider philosophy to be an active and creative practice which can work to open new ontological positions and modes of thought. We consider how art can work with science, not as a tool in the service of understanding scientific concepts, but to reimagine what science is, what it can do, and to break down nature/culture binaries. We aim to show how transdisciplinary educational practice can aid human and non-human well-being, through reframed relations within and without the classroom.

Keywords: STEM, conceptualisation, arts, philosophy, interdisciplinarity

1. Introduction

"Imagination is more important than Knowledge" Albert Einstein

"Where is the wisdom we have lost in knowledge?"

"Where is the knowledge we have lost in information?" (T.S. Eliot, The Rock)

The complexity of our current worldly condition - an entangled, relational set of human and environmental predicaments such as climate change, digital revolution, environmental degradation and the rise of zoonotic pandemics - requires new conceptual understandings of the world and consequently, different framings of education and schooling. Braidotti ([1], p. 1181) terms this contemporary phenomenon as the 'posthuman predicament'; a convergence of multiple technological, ecological and democratic challenges which, although often dealt with separately, need to be understood as connected and intra-acting. Posthumanism as referred to here is essentially a final call to '...mark the end of the self-reverential arrogance of a dominant Eurocentric notion of the human, and to open new perspectives' ([2], p. 3). The *post* means 'after' humanism, acknowledging the benefits of humanism (particularly around struggles for equity via identity-related civil action), but recognising the limitations of it regarding the reification of what is typically encoded as 'Man': that is, white, male, European, able-bodied, neurotypical, straight and so on. Posthuman thinking thus requires us to go beyond, or *after* humanism as we augment and reposition the voices of those overlooked and oppressed by Enlightenment ideas of 'humanity.' It also turns towards the body as an important and often overlooked site of learning, calling us to start our understanding from our own situated, embodied contexts in acts of the politics of location [3] which do not universalise but understand both teachers and students as individuals with facing different, often intersectional, modes of oppression.

Despite the irrefutable complexities of current times, the compartmentalised way in which educational disciplines are currently taught within English education continues to reflect humanistic, Cartesian binaries and dualisms which fail to account for our predicament, or to create new systems of knowledge which allow us to deal with the various issues differently. The siloed nature of education is further entrenched via neo-liberal practices of measurement, comparison and competition which do not allow for complexity and nuance in either practice or judgement. The emphasis is on pedagogical activities which will have a significant impact on students' measurable outcomes; not those that impact individuals emotionally or relationally [4]. Within these spaces it is difficult (and in fact counter-cultural) for teachers to find room for consideration of deeper ontological or epistemological questions around education in the current times. Alongside this sits a culture of anti-intellectualism, whereby subjects such as art, literature and science are downgraded into the kind of knowledges that can be memorised and regurgitated to suit prescribed tests rather than studied deeply and meaningfully. Thinking, in an age of academic and expert distrust, is seen as the practice of the elite (that is, the preserve of those at the higher echelons of the educational system); yet we are in a time that calls for new ideas and approaches to complex ethical dilemmas more than ever. 'Think, we must' as said Virginia Woolf ([5], p. 60); but in accelerated educational consumer cultures of product, customer and service, time and space for these activities is increasingly eroded.

Practices such as interdisciplinarity, which work towards the integration of differing knowledges and draw on diverse ontological approaches to embrace multiple perspectives can be helpful in allowing new ideas and worldly understandings to be foregrounded. However, as a practice interdisciplinary education can also be seen as pre-supposing and cementing the very disciplinary differences it purports to disrupt. Nina Lykke therefore suggests that we need to move beyond disciplines entirely by embracing *postdisciplinarity*, a term which '... refers to more transgressive ways of producing academic knowledge which destabilise, deconstruct and disrupt the

hegemony of distinct disciplines and the classic academic divides between human, social, technical, medical and natural sciences'. (Nina Lykke [6], p. 333). Whilst the current constraints of 'education-as-usual' may restrict teachers' ability to truly move beyond disciplines in this way, we argue in this chapter that trans-disciplinarity - the synthesis of subjects and removal of boundaries through the transversal merging of science, arts and humanities - can help us to reimagine 'subjects.'

In this chapter we explore the challenges and opportunities for working in trans-disciplinary ways across STEM subjects, focusing particularly on the role of art and philosophy. Drawing on posthuman thinking and the work of Deleuze, Guattari, Dewey and others, we consider philosophy to be an active and creative practice which can work to open new ontological positions and modes of thought. We then consider how art can work with science, not being employed as a tool in the service of understanding scientific concepts and ideas, but to reimagine what science is, what it can do, and to break down nature/culture binaries. In doing so we aim to show how trans-disciplinary educational practice can aid human and non-human well-being, through reframed relations both within and without the classroom. We draw on a range of practical examples from practice in order to illustrate our ideas, not in a prescriptive sense but as a jumping-off point for educators' own innovations and experiments.

Also embedded across this chapter are quotations, stories and reflections from creative narratives, poetry and biography. In this way we emulate the practices we espouse by breaking the disciplinary silos entrenched within academic writing. This approach is diffractive, in that it allows us to read things through other things; in the same way that a pebble when thrown into water with a second pebble will cause the waves to intersect, so interrupting academic writing with creative texts will allow new readings, ideas and patterns of thought to emerge [7]. Diffractive writing, in a similar way to interdisciplinary pedagogy, allows us to be affected in different ways. In adopting this approach, we also encourage readers to take 'lines of flight' [8] in their thinking; we therefore pose the following questions to you, our reader. What other connections can you make, and what other texts or work of art can you connect to the ideas shared here?

2. Teaching in complex times

The challenges of working within an educational system driven by data, testing and results render it difficult to teach outside the boundaries of subjects and disciplines. Standardised tests limit the scope for innovation and moving outside of prescriptive lesson plans. The reality of testing culture is pervasive and damaging; recently a teacher told me (Christine) the following about her daughter: "*She was driven by exam results and exam result day was her Christmas day.*" Meanwhile, outside the artificial process of examinations lie real socio/economic problems that society and the world is facing, and these require deeper, innovative and inter-connective thinking.

An example of the lack of such connections in schools was highlighted recently in my (Christine's) teaching. In the year 10 Science end-of-term assessment paper was a question which asked the pupils to measure the area around each circle of antibiotic resistance in an agar plate (a required practical that children undertake in Biology). Not one of them attempted this question, yet when asked in class if they had learnt how to calculate the area of a circle in maths and what the formula is, they were all able to answer the question correctly. Despite this mathematical knowledge they

failed to make this connection during the test, and in failing to see Maths and Science as inextricably connected, lost valuable marks as well.

Further illustrating the siloed understandings of knowledge in education, on August 3rd, 2023, Katherine Birbalsingh (Head Teacher of Michaela School, London and former adviser to the UK government on social mobility) tweeted the following:

> *You want kids to read? Make them read. Constantly. Break it down. You want kids to add and subtract? Do maths. Constantly. Means no phones. No yoga. No gardening. No chatter and lack of attention.*

Birbalsingh, known as '@MissSnuffy' on the social media platform X (previously known as Twitter) is well-known for her provocative stance regarding the promotion of traditional education. The tweet here exemplifies in many ways the emphasis in contemporary English teaching practice on Cartesian dualisms between mind and body. Rather than seeing activities such as gardening as having educational, as well as therapeutic and environmental value, they are seen as extraneous to the 'real' and valid practices of maths and reading. By establishing such false binaries however, we risk students being unable to think divergently across disciplinary boundaries; struggling to integrate maths within other subjects, or failing to understand maths as a life skill which could be equally applied in calculating gaps when planting seeds, measuring wood for planters, or estimating growth and harvesting times. The examples provided here demonstrate that there is a real need for strategies to be embedded which allow for deeper thinking, so that knowledge can be adapted to different situations and subjects. As Eliot states in The Rock ([9], p. 147) '*Where is the wisdom we have lost in knowledge? Where is the knowledge we have lost in information?* So, how can this be done effectively in practice?

Rainbows, Bikes, and Lego

What is a rainbow? This is a simple question that often begins with very young nursery/early primary-aged children producing pictures of colourful semi-circles. As they move up into higher primary, or secondary school, this visualisation can be developed into connections with physics and the diffraction of white light, understandings of meteorology/weather, and maths through an appreciation of the angles of diffraction of the light colours. English Literature and History can also be embedded through the introduction of songs, poems and stories, mythology and magic around the concept of the rainbow and the infamous "pot of gold" at its end. By drawing together nature, science and culture, multiple understandings of a common phenomenon can help children to understand the ways in which knowledge is not siloed but relational, contextual and mediated.

Another example which I (Christine) undertook as part of a STEM transition from year 6 primary to Year 7 secondary was titled "The Beat of Life." In this session the pupils created a heart out of clay using straws to illustrate the arteries' veins. Some decided to sketch and label a heart from the power-point picture and one of these is framed on my living room wall as it was so good (**Figure 1**).

The children then had to create a storyboard of how the heart relates to health, exercise, poetry, poems and literature and if time allowed write a rap called 'The Beat of Life'. The pupils thoroughly enjoyed these sessions and were enthused about being able to think differently about science. One of the parents said to me after it "I hope the teachers at my son's secondary are as engaging and passionate about their subject as you. He has learnt a lot today".

I have also used sweets to get the pupils/students to create different body systems. This is easy to implement in practice a selection of sweets and get the pupils/students to be creative

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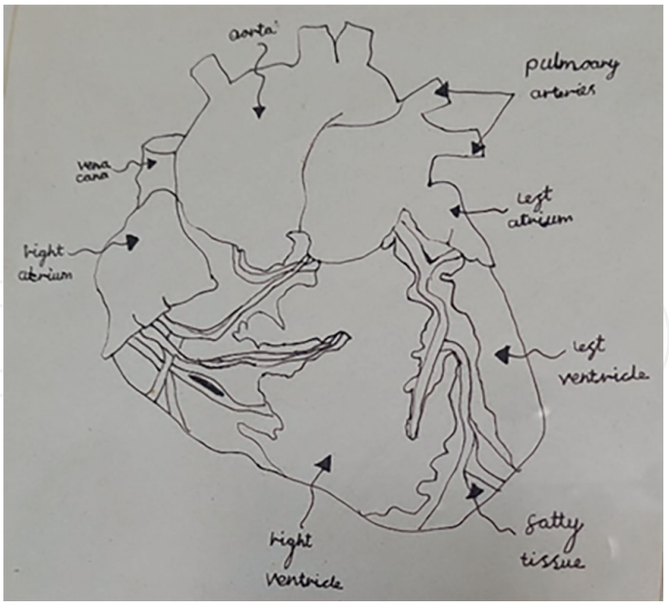

Figure 1.
Framed pupil heart sketch from "beat of life session."

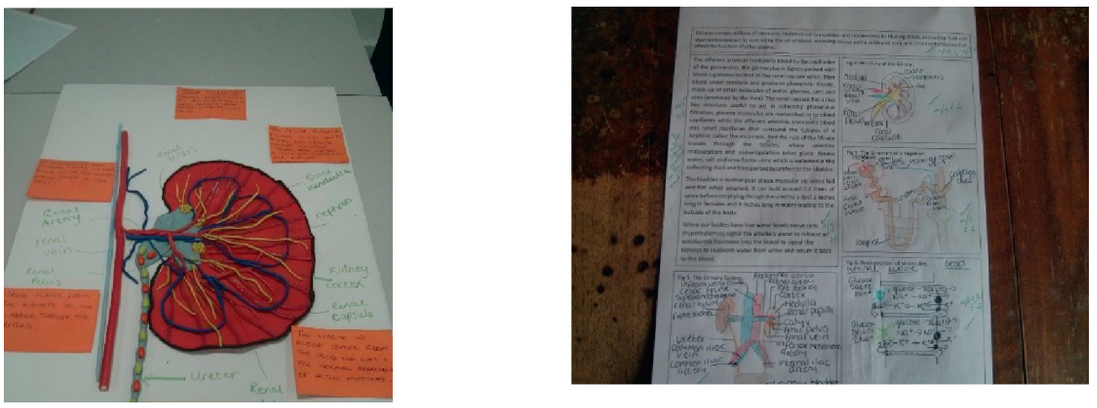

Figure 2.
Candy anatomy of the kidney and student assessment showing how this has been used to assess learning.

as shown in the diagrams below. Further it has huge successful results as the students used this in assessments to recall the different organ systems and their parts to obtain high grades of merits and distinctions (**Figure 2**).

In more recent times I have also used Lego to support the engagement of pupils in science/medical topics. In February I attended a workshop session which involved building a mini heart from Lego. This was suitable for all ages, young and old, and it made me think of adapting and building intersubject connections in this activity not just for school but University students as well. While being a creative, artistic process, this activity also instilled a spatial awareness of the heart structure; the red and blue colours representing the oxygenated and deoxygenated blood and opening room for comprehending the reality of blood flow between the heart and lungs (**Figure 3**).

These lung miniature kits can be bought from companies such as Brick This (https://www.brickthis.co.uk/), they have full instructions to build and support useful conversations around the blood flow of oxygenated and deoxygenated blood in the heart. This process simultaneously enhances spatial awareness and kinaesthetic learning.

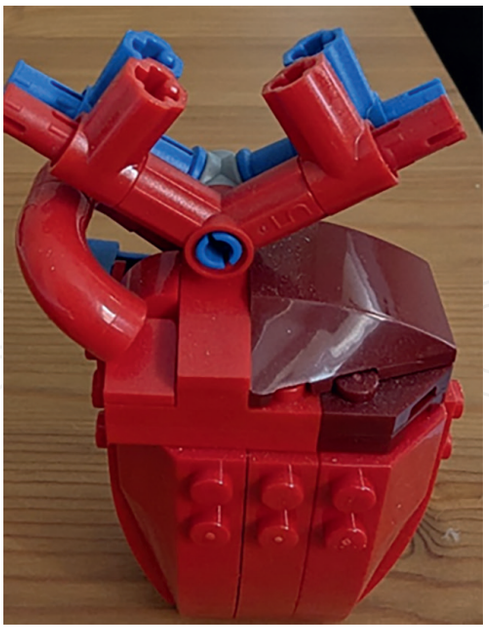

Figure 3.
Miniature Lego heart.

It can be hard to move children accustomed to subject-based teaching into spaces where they are able to think in interdisciplinary ways. One method to enhance this thinking is to provide pupils with a picture of an object such as a bicycle and ask them to identify the different 'subjects' implicit in this. Examples could include physics in the gears/friction tyres, wind resistance, bodies and machine interaction, circle shapes of wheels, and angles of spokes. This simple task unfolds the mind to many different aspects and concepts and is a great way to enhance trans-interdisciplinary thinking.

These examples illustrate how we can deepen learning and engagement and allow pupils to make subject connections. The embedding of building and artwork enhances the social, team-building aspect of learning and supports emotional and mental regulation and expression which can support behavioural and learning subject and emotional barriers for children with special educational needs.

3. Thinking, otherwise

In the challenging, complex landscape of life and in particular education, the idea of freeing the mind, and dwelling in the conscious/subconscious becomes not only appealing but almost a necessity in order to enhance curiosity, innovation and critical thinking. Additionally, it can enable the breakdown of barriers (such as those between subjects and the false binaries between cognition and emotion) and support the development of trans-subject, interdisciplinary connections. In this section we will discuss the role and importance of philosophy in implementing strategies towards the enhancement of these outcomes. Further we will examine the mystique and cyclical nature of time (via texts such as TS Eliot's poem, 'Burnt Norton') and consider how disrupting linear understandings of temporality can influence the ability to think deeply and process information, thereby resulting in novel ideas and discussions.

3.1 Time and the mind

Most would agree that life is run or even "controlled" by time; basic routines are all very much run against the clock. Our modern systems are centred around chronos (linear time) rather than aion (an understanding of time as cyclical, dynamic, insurgent, and connected to nature [10]). As Bridle [11] reminds us, '...the idea of global time - a single, universal standard, divided into hours and minutes, and shifting across time zones - is a recent one.' To imagine time working differently in education (whether it be primary, secondary, college and/or University) feels impossible; teaching sessions all have a set time frame and work to institutional clock rhythms. However, what if we could pause or interrupt time such that we lose that barrier? And how does that impact, not only on mental wellbeing but from an educational standpoint?

The issue of time is discussed eloquently in the late Kate Gross's podcast Private Passion [12]. While she lay gravely ill, Kate talked openly about her struggles with time and how she wanted to pause each moment to enjoy what she called 'the intensity of light and colour.' This has similarities both with the nature writings of authors such as Nan Shepherd and Tove Jansson, both of whom had a deep love of nature and were able to explore as independent spirits with the freedom of no time constraints; Shepherd in the Cairngorms, Scotland, and Jansson in a remote island off the Gulf of Finland. As with Gross, both, in Shepherd's words, 'immerse themselves' in their environments mind, body, soul and senses.

The common theme within the similar yet different scenarios is the desire to fully entangle body and senses with the environment in order to disrupt clock time. However, while Shepherd and Jansson had seemingly no time restrictions, Gross was terminally ill; a 'ticking time bomb'. It is interesting and almost ironic that as soon as the impending knowledge of death lies ahead, we value and want to pause or stop time. However, in life we feel the need to battle with time, unable to appreciate how the sheer enormity of pausing and soaking in the moment allows us to reflect, process and restore. It is as Gross states in her podcast, the need to 'look after our hinterland', not just in terminal illness but life itself.

Taking what Jasmine Ulmer [13] refers to as 'slow ontology' requires us to attune to time in different ways, working with artistic moments of flow, paying attention to the rhythms of nature, and disrupting linear processes which are restrictive and time bound. From an educational perspective this may involve taking learning outside - from closed classroom systems to the open flows of the natural environment - or paying attention to the ways in which learning extends outside school clock time to corridors, playgrounds and homes. These disruptions can be difficult however, particularly in the era of Coronavirus in which the language of speed, acceleration and catch-up is prevalent. In the classroom there is often a constant struggle to get through a dense curriculum or obtain a quick answer to a question so that learning can be evidenced, and the class can move on. The idea of even pausing, giving pupils time to absorb to process information, or reflect individually or with others can feel uncomfortable or risky, yet there is power in that pause regarding deep learning as well as wider human growth concerning being, becoming and thriving.

It is perhaps important at this point to clarify and define the three commonly known states of mind as explained via the Chambers Dictionary [14].

"Consciousness defines our thoughts and awareness, subconscious is defined as memories, motives, intentions and thoughts which the individual is only dimly aware, but which exert and influence on his/her behaviour and unconsciousness is the

deepest inaccessible level of the psyche in which repressed impulses and memories are present in a dynamic state".

The concept of time and its relationship with the state of mind, is eloquently expressed in T S Eliot's [9]; the first of the four quartets. At the start Eliot states: 'Time present and time past are both perhaps present in time future'. Alluding to the way in which our understandings and experiences echo the past, as well as recognising their connection to the future, Eliot emphasises the need to value time and take account of the present moment. He goes on to describe the moment of fixity of time when he states, 'Allow but a little consciousness, to be conscious is not to be in time' and it is within this state of mind, we can pause to appreciate to immerse process and deepen our understanding, that is so essential to building transdisciplinary subject knowledge and emotional creative human growth. Such rich experiences we have within the present/past are important not only in our human growth and ability to understand ourselves but to help others understand themselves also. Interestingly, Pullman in The Amber Spyglass ([15], p. 97) states: 'In the landscape of your mind' that 'conscious beings make dust'; emphasising the way in which thought, sentience and recognition can allow us to materialise knowledge (dust here being a physical manifestation of creative and sentient acts). This knowledge he describes as not a 'fixed quantity' but something that gets renewed all the time by thinking, reflecting and by gaining wisdom. Further to this, Pullman describes how through these actions of pause and reflection you can pass on wisdom and help everyone else to learn about themselves, thereby enabling them to 'keep their minds open and free and curious.' This understanding of learning as relational and distributed troubles the individualised nature of education-as-usual, in which the 'dust' of knowledge is owned and used as capital.

This social transfer of knowledge supports Kalanithi's ([16], p. 97) view that 'Human knowledge is never contained in one person; it grows from the relationships we create between each other and the world and is still never complete.' This highlights that the human mind cannot necessarily thrive on constant bombardment of learning content by rote subject knowledge alone, and that there is a need for a humanistic aspect, such that the desire for knowledge incorporates a social and emotional aspect as well as subject authority.

3.2 Philosophical practices to disrupt clock time

Deleuze and Guattari [17] suggest that philosophy should be a practice of creativity and development of new ideas, with education thus being not about repetition but creation: 'Philosophy is the art of forming, inventing, and fabricating concepts' (p. 2). Philosophical concepts can be activators, used to reimagine education, or to defamiliarize ourselves from schooling-as-usual. Bringing art and philosophy together with science thus allows for affective understandings and different modes of thought, or lines of flight, which allow newness in and new understandings of the world to be formulated. One such creative practice, which also subverts linear, individualised and time-bound practices of teaching, is community philosophy, or Philosophy for Children (P4C) [18]. Embedding philosophical inquiry into Science education can allow for slow thinking, deep exploration and connection of science to wider social, environmental and cultural issues. This methodology facilitates active listening, mitigates binary oppositional thinking [1], and empowers young people to reflect critically in a democratic way [19].

In P4C a facilitator introduces a stimulus related to a topic (e.g., photograph, video, news clip); students discuss it in small groups and then identify the related

concepts (e.g., justice, health, community). Groups then develop a question (via a democratic voting process), and the facilitator prompts wider discussion. Afterwards, participants engage in active reflection to critically examine how the process unfolded in terms of individual contributions, group dynamics and the creation or enactment of new concepts and perspectives. Such a practice has the potential to deepen understanding of topics such as ethics in science, as well as opening space to deal with complexity, appreciate different contexts and locations, and reimagine new ways to enact ethics in practice.

In a similar example of practice, Science teacher Tait Coles explains in his book, Punk Learning [20] the use of 'Question Formulation Technique' [21] and how it can be employed with pupils to disrupt teacher authority and provoke creative thinking. After introducing a stimulus (for example, an image of the digestive system), pupils are encouraged to create a list of questions about it, no matter how unusual, inappropriate or odd. Working with divergent thinking, rather than replicating the input of the teacher, is shown to foster creative and engaged responses as well as enabling students to work further on the crafting of incisive and thoughtful questions to provoke deeper engagement with scientific concepts. In this way, Socratic questioning techniques, with all their unpredictability, can disrupt 'teaching-as-usual' and open space for exciting perspectives which may well extend beyond the lesson time and walls of the classroom.

4. Creative practice and STEM

In Eliot [9] stated that 'Art required a form which could impose order and meaning on experience.' He goes on to say that '... all art emulates the condition of ritual'; however, this understanding of art as form and cohesion is challenged by outsider practices such as Art Brut. In Peter Shukie's pedagogical practice as a teacher educator [22]. Peter removes any kind of order in his classroom to allow for 'artistic expression' using raw art. Shukie describes art practice as enacting an 'alternate psychic reality' and questions 'what happens when the foundations of normality are removed' (n.p.). It is interesting to consider this as another state of mind or a process of flow [23], where the loss of inhibitions is neither conscious nor sub/unconscious. Within this state can lie a wealth of creativity, innovation and a sheer sense of being, becoming, and thriving. Some of the great artists such as Van Gogh had mental health issues yet produced work of great artistic talent. Keats in his poem 'Ode to Psyche' describes this as an 'untrodden region of my mind, where branched thoughts, new grown with pleasant pain...And in the midst of this quietness... A rosy sanctuary I will dress.' It is within this level of mind where we lose all barriers and restrictions that we experience total freedom of thought and senses and 'face our own intuitive sense.' Deleuze and Guattari's concept of the 'cosmic artisan' reflects this experience of becoming 'otherworldly,' via informal, creative acts which are undertaken in community. They suggest that this melding together of art, philosophy and science can enable new modes of being in the world: 'In this submersion it seems that there is extracted from chaos the shadow of the 'people to come' in the form that art, but also philosophy and science, summon forth...' ([17], p. 218).

The importance of engaging the 'landscape of the mind' and realising its holistic benefits is eloquently and beautifully illustrated in 'The Queen's Gambit'; a fictional but powerful drama about a girl called Beth growing up in a 1950s orphanage. Whilst dealing with childhood trauma and battling addiction, Beth is determined to learn

chess and ultimately become a World Chess Champion. The social scenes in the film in which the janitor is teaching Beth chess depicts the distributed and relational aspect of learning within the conscious mind. However, Beth also has an addiction to sleeping drugs whereby her delusional mind allows her to visualise the chess board and create moves, allowing winning formulations and connections to be made. The technique used to demonstrate this in the film, where the chess board appears on the ceiling and moves take place, is an excellent way to show what Keats describes as the 'untrodden region of my mind, where branched thoughts, new grown with pleasant pain'; that is, the delusional yet creative subconscious. Additionally, it supports the idea that in this uninhibited mind space we can be ultimately creative and find our true selves. Seeking out such spaces can be difficult within time-bound learning environments, but nevertheless moments of flow; that is, complete absorption in joyful activity, should continue to be encouraged and elevated once experienced.

5. Bodies in relation

Taking a minor turn [24] means seeing difference (be it as appearance, identity, beliefs, culture etc.) as generative and productive. Difference from normative ways of being in education is rarely appreciated in and for itself, but instead viewed as deficit, with 'inclusion' meaning a layering of additional processes rather than a shift in or redesign of the education system. A holistic, affirmative curriculum practice avoids these universal, normative modes of teaching and moves towards process-led activity, which is grounded in care of individuals and elevation of different modes of being and generating knowledge. There is a central role for neurodiversity, not only for students but for teachers too.

Within Science education, Strom and Kayumova [25] suggest that dialogue is vital for building shared knowledges while recognising such different perspectives, identities and locations. Creating communities and turning away from neo-liberal framings of competition and individualism (many of which are engrained in liberal understandings of science itself) thus form part of an engaged pedagogical approach. Science continues to be based around Western epistemologies, and this in turn creates certain 'science' subjects; young people acculturated to ways of enacting scientific endeavour and practice. The authors suggest instead that we move to 'pluriversal praxis' which '…requires embracing an onto-epistemological shift based on relationality, interdependence, embodiment, ethics, and care towards youth, diverse communities, and more-than-human collectives.' ([25], p. 2).

Further to this, Kayumova and Dou [26] discuss the need to enact 'ethical and sociopolitical accountability' in science. This not only enhances a sense of belonging and engagement, but more importantly '…it helps perhaps even to design worlds in which articulations of nature and culture are intertwined and not separate in ways that we can defend or recreate worlds that relate important and communal dimensions.' Such strategies are necessary for providing an inclusive learning environment such that diverse learners from different cultural backgrounds can experience not only subject knowledge but do this 'outside human experiences' that build new relations with the natural world and new understandings of human/non-human relationality and reciprocity.

Strom and Kayumova also urge us to take account of the body in the classroom, stating that '…embodied onto epistemologies, social and cultural histories, experiences, and performances of different physical bodies (including human bodies) are

central to the nature of social relations, including learning interactions.' Taking a material turn in this way means paying attention to the way bodies move in space and the role (or not) of bodily autonomy, as well as the structure of learning environments, the bodily effects of student-teacher relations, the impact of school rules on the body, and so on.

Francis Bacon was an advocate of the notion that the 'destiny of science was not only to enlarge human beings' knowledge but to improve human beings' life on earth' ([7], p. 28). He also believed that the construction of a better world was achieved through ascertaining the truth about natures' workings. The emphasis on knowledge retention currently seen in schooling frequently overlooks the ethical component of science learning, along with the understanding that learning is a relational and distributed activity. Shifting attention to the body and thereby appreciating inequalities, located and political perspectives and oppressive practices is a vital way of addressing this call for improvement, not only for humans but our more-than-human counterparts.

6. Conclusion

In this chapter we have drawn together philosophical ideas and theory with historical writings and contemporary works to demonstrate how learning-as-usual can be disrupted when we think across disciplinary boundaries and understand the mind/body binary as a false and unhelpful distinction that is engrained in educational systems. By drawing together science education with artistic, social, and philosophical practices, we have suggested here that new connections and ideas can be formulated which are valuable in our contemporary predicament. As Dewey urged us in [27], we must resist the compartmentalisation of subjects as this practice does not reflect the real world as experienced by children both externally and internally:

> *... [the] universe is fluid and fluent; its contents dissolve and re-form with amazing rapidity. But, after all, it is the child's own world. It has the unity and completeness of his own life. He goes to school, and various studies divide and fractionize the world for him. Geography selects, it abstracts and analyses one set of facts, and from one point of view. Arithmetic is another division, grammar another department, and so on indefinitely. (p. 5)*

Although we are necessarily part of systems that uphold disciplinary boundaries, we have attempted to demonstrate here that there are always methods by which we can integrate subjects and reterritorialize fixed ways of teaching and learning. Braidotti [1] urges us to undergo processes of de-familiarisation and dis-identification in order to give us critical distance from the systems that constrain us. Diffracting texts and media of different kinds through our teaching and thinking outside of disciplinary silos are examples of ways in which we can find ways of teaching and learning otherwise. Oppressive practices have become so normalised that we cannot imagine other ways of doing things. Yet when we examine structures, organisations and political systems from a critical distance, or with different understandings of what it means to be human, we begin to see the cracks and even feel a sense of the ridiculous. Owning 'radical space' alongside students is possible, both via the individual process of working ourselves from pain to knowledge, and collective thought and action. We close with bell hooks' important reminder and call to action: 'The classroom remains the most radical space of possibility in the academy' ((1994), p. 12).

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Author details

Christine Challen[1*†] and Kay Sidebottom[2*†]

1 Sunderland University, Sunderland, United Kingdom

2 University of Stirling, Stirling, Scotland, UK

*Address all correspondence to: christine.challen@sunderland.ac.uk and kay.sidebottom@stir.ac.uk

† The authors are equal contributing.

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