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We're all in this together: new principles of co-present group learning

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Abstract

Currently, education systems overwhelmingly convey the powerful message that learning is essentially an *individual* phenomenon. Teaching, assessment and certification practices almost invariably centre on learners as individuals. Compulsory formal education (that is, schooling up to mid-adolescence) promotes the near-universal 'common sense' but unquestioned assumption that learning resides in individuals. This assumption follows through into vocational and university education. Yet 'learning to become' an adult, a worker and a citizen typically involves a further assumption: that whenever a group of individuals learns, this group learning is nothing more than the sum of learning acquired by the particular individual members of the group. This latter assumption is not only false – it also directly hinders understanding of how group participation is a powerful means of generating, sharing and applying knowledge for the benefit of social groups and communities, indeed, for the "common good".

Whilst there is no doubting the importance of learning by individuals, this paper demonstrates that over and beyond that, *groups provide daily experiences that stimulate distinctive and valuable learning* that is other than the learning by the individual group members. Firstly, we briefly introduce some basic principles of *complexity theory*, and show how, together with the concept of a 'co-present group' (between 2 and about 12 individuals), these ideas will enable us to identify novel understandings of the communal becoming and learning that occurs both within such groups and from the mutual interactions between such groups.

We argue that because of the widespread societal focus on learning as an essentially individual activity, the powerful learning that can arise both within co-present groups themselves and from their mutual interactions with one another has largely gone unnoticed. We demonstrate the explanatory value of these novel understandings of communal becoming and learning by providing two major case studies in which group learning was and continues to be absolutely crucial to the attainment of satisfactory outcomes. Both concern major recent international events: the 2018 Thai cave rescue of a trapped football team (a very localised experience, but one that has reconfigured future cave rescues world-wide), and the COVID-19 pandemic (an ongoing world-wide challenge to humanity).

Complexity theory and co-present groups

Complexity theory is key to appreciating the hitherto unrecognised power of group learning. Complexity theory describes the workings of *complex systems*. Many familiar systems are *simple* rather than *complex*. The states of simple systems can be specified readily and their operations described in linear terms using Newton's Laws. This is so even if the simple system is very intricate or complicated, e.g. a state-of-the-art submarine or a Boeing 747. Genuinely complex systems are something very different. They elude understanding and description via linear mathematics and Newton's Laws. In a complex system, 'the causal categories become intertwined in such a way that no dualistic language of state plus dynamic laws can completely describe it.' (Rosen, 1987: 324). Put more simply, a complex system is 'a set of inter-related elements ….in which …the whole is greater than the sum of its parts.' (Byrne and Callaghan, 2014: 4) (Although, as will become clear, this formulation needs careful interpretation).

The crucial feature of complex systems is that their complexity arises from the *relations* between entities, rather than from the entities themselves. In contrast to simple systems, complex systems are characterised by multiple non-linear relations between the entities within the system. It is the interaction of these non-linear relations that can give rise to new structures or qualities which, though constrained by the original relations of the system, are not wholly predictable from them, nor reducible to them. This phenomenon, known as *emergence*, is a characteristic feature of complex systems. Thus, any understanding of complexity must include a careful investigation of the *relations (interrelationships) between entities*, rather than just the traditional focus on the entities themselves, i.e. the *relata*. However, this does not mean that the entities (or relata) are irrelevant. What complexity thinking insists is that it is *the processes of the relations between the relata* that are crucial. Hence, for complex systems, structure is not a mere assemblage of entities. Rather, it is emergent from these processes of the relations between entities.

There are two kinds of complexity: Restricted complexity and general complexity. *Restricted complexity* applies to complex systems that involve a collection of relatively simple components interacting in relatively simple ways to produce diverse *possible*, even novel, emergent outcomes, e.g. sand dune formation, bird murmuration patterns. However, when complex systems include humans, restricted complexity is applicable only if the people involved are treated as interchangeable variables rather than as distinctive individuals, e.g. traffic flows, voting behaviour. Tracking the current COVID-19 pandemic involves models based on restricted complexity. Different models involve different assumptions about the processes of the complex system that is the pandemic. Similarly, economic forecasters are currently divided about the eventual economic impact of the pandemic, again reflecting different assumptions about the ongoing processes of this very complex system.
General complexity, on the other hand, goes well beyond rule-based interactions between simple components of a complex system. It deals with cases where the agency of the unique individual humans that are part of complex systems, together with the causal powers of their social interactions, ensure that novel, even *unpredictable*, outcomes are likely to emerge from the processes of these complex systems. (For more on complexity see Hager & Beckett, 2019, Chapter 7). Groups of people working jointly on projects of all kinds are examples of complex systems that commonly achieve novel, even unpredictable, outcomes. That is, as well as the valuable learning that individual group members may experience, the *group as a whole also learns*. We call such learning groups "co-present groups" (for elaboration see Hager & Beckett, 2019, Chapter 6).

There are five key – and widely unrecognized – features of the novel learning that emerges from group activities:

1. Learning is distributed across the group.

This means that no individual group member is able to fully comprehend everything that *emerges* from the group's interactive processes.

2. Learning emerges from the group's activities themselves.

It is not 'applied' from outside.

3. Emergent learning cannot be specified in advance.

Thus, group learning is often genuinely novel, creative and innovative. It is also inclusive, contextualised, and participatory.

4. Learning is typically beyond any individual's learning.

Accordingly, groups can achieve learning that is beyond any individual acting alone.

5. Emergent learning is not restricted to just a particular group.

This is so because *interactions* between groups, and also between individual members of particular groups participating in yet other, often overlapping, groups, are both very powerful mechanisms by which further creative and innovative learning can and does emerge.

The following sections illustrate how complexity thinking offers novel understandings of how learning emerges from group activities.

Wild Boars case study

In 2018 world attention was transfixed for several weeks on the search for and subsequent rescue of the Wild Boars football team trapped by rising flood waters in a northern Thailand cave complex. The bravery and resilience of their rescuers, including an international group of expert cave divers, was justly applauded, particularly as the eventual happy outcome had been widely regarded as near impossible. This successful rescue provides a vivid example of an unprecedented outcome emerging from the interactive, coordinated efforts of a series of small co-present groups. Several detailed accounts of the eighteen-day rescue operation are readily available (e.g. Challen and Harris, 2019; Gutman, 2018). The following, necessarily brief, account focuses on matters that are particularly relevant to the main concern of this paper, i.e. to better understand the crucial group learning that emerges from the productive interactions of co-present groups as they work to achieve a common purpose.

Where and how the team was trapped

The twelve boys and their coach were trapped in 'chamber 9', located 2.5 km from the cave entrance and about 1 km below the entrance to the cave complex. Of this 2.5 km, several sections (totaling about 1 km) were fully underwater in conditions of nearly no visibility and with many rocky, narrow 'wriggles' to be traversed. Initially, the fate of the boys and their coach was unknown. For the first three days the Thais had mounted their own rescue effort. The Thai Navy SEALs were experienced divers, but *not* experienced cave divers. Hazardous underwater conditions and the sheer force of the rising floodwater halted their progress at a T-junction some distance inside the cave complex. International cave diving expertise was urgently co-opted. This expertise resulted in first contact with the trapped football team on day nine of the search operation. Fortunately, all of the boys and the coach were alive, in reasonable health, though very cold and hungry. Groups of divers soon brought food, warm clothing, medical attention/supplies and oxygen (the air within the cave was steadily diminishing). However, the difficult major problem remained: how to rescue the football team whose members were non-swimmers with no diving experience, let alone any cave diving experience?

Challenges/dangers of cave diving in this particular situation

Vital for successful cave diving is control of the panic reflex, which is a natural reaction to unexpected, life-threatening situations. Cave divers engage in "slow methodical pre-visualisation" (Harris 2019) of possible dangerous situations. They train exhaustively to avoid panic in such situations. Part of this self-control is maintaining a low heart rate whilst diving. As well, control of the emotions is crucial for logical decision-making. Also vital for cave diving is the continual proper operation of the breathing equipment, such as the facemask, mouthpiece and airways. In a panic situation, it easy for any of these to be dislodged, thereby resulting in drowning since there is no available air-water interface. The very strong current flows through narrow openings

with little or no visibility in the Wild Boars entrapment situation only exacerbated these dangers. The underwater death of an experienced Thai SEAL, only days before the actual rescue, served to underline these perilous circumstances.

Various other rescue plans were tried and either failed or proved to be impractical

These included: finding or creating a cave entrance/exit higher up the mountain; pumping the water from the cave complex to enable a safe rescue; following contact being made, pumping oxygen into 'chamber 9' via a cable until the floodwaters receded sufficiently to allow a 'dry' rescue; and postponing the rescue till the wet season was over.

The final rescue plan

Eventually, as the rescue operation unfolded over the several weeks, the final plan became the only viable option, albeit one with an extremely low chance of complete success. This final plan emerged from a lengthy process in which the many challenges and issues that it entailed were progressively taken into account. Its progressive refinement drew upon the diverse expertise of many different contributors, including the expanding number of internationally renowned cave divers who were being progressively co-opted into the rescue operation. These included Richard Harris, a veteran Australian cave diver, whose expertise as an anaesthetist became a lynch-pin of the rescue operation.

The ultimate rescues were accomplished by an 18-member group of rescue divers (5 of them Thai Navy SEALs, the other 13 being international cave divers). Harris sedated the boys and coach in turn as their time for rescue approached. Their arms and legs were then bound. They were told that they would wake up to their family greeting them. This 'packaging' of the team members also protected the rescuers as they made their cautious progress through various flooded, narrow, rocky spaces on their precarious journey. The 18 divers formed into sub-groups responsible for different segments of the journey, typically 'one boy per diver' when underwater, with other divers acting as stretcher-bearers across the drier segments, with each rescue journey taking about three hours.

Though the expert divers were clearly the crux of the rescue effort, they were but part of a much larger group that contributed to achieving the best possible outcome. This very large group involved hundreds of volunteers working cooperatively with diverse official rescue personnel providing behind-the-scenes support to the overall rescue. It included, for instance, personnel testing the feasibility of possible alternative rescue plans; medical personnel ready to treat the team members as they were rescued; military support personnel; specialised equipment technicians; political liaison staff; diverse media representatives; and cooks and kitchen hands (food was provided *gratis* by multiple donors).

The Wild Boars rescue provides vivid instances of each of the five key features of the often-overlooked novel learning that emerges from group activities:

1. Learning is distributed across the group.

The Wild Boars rescue involved multiple instances of significant learning emerging from group activities. Some of it was distributed across the large and diverse group that functioned effectively to carry out the ultimate rescue. Other crucial instances of such emergent learning occurred across the multiple sub-groups that performed various specialised aspects of the rescue effort. A clear example of large group emergent learning was the

innovative and successful rescue plan. It progressively emerged from the continual interactions of many and diverse co-present groups.

Examples of emergent learning within specialised sub-groups included the rehearsals of rescue roles, e.g. testing equipment on volunteer children, practising swimming underwater with volunteer non-swimmer children. Likewise various sub-groups practised effective coordination of their own activities with those of other relevant sub-groups within the rescue operation sequence.

The *distribution* of this kind of emergent learning across the group or sub-group means that no individual group member can fully comprehend everything that *emerges* from the group's interactive processes. Each group member's own experiences and perspectives significantly shape what they understand, and take, from group interactions.

2. Learning emerges from the group's activities themselves.

The Wild Boars cave rescue was a paradigm example of emergent learning as it set a new international benchmark for cave rescues by greatly exceeding what experienced experts had thought was possible. Of course the rescue also involved the application of established knowledge, such as judging the appropriate amount of anaesthetic for each particular football team member. However, it was the overall joint efforts of the various sub-groups and their mutual interactions that resulted in vital new knowledge emerging.

Nor was the successful rescue merely an application of the final plan. Unplanned contingencies inevitably arose, requiring critical, 'hot action' adjustments. One instance was a diver and 'packaged' boy setting off too soon on the journey – causing an underwater traffic jam in one chamber. Another instance involved a cave diver with 'packaged' boy temporarily losing the guideline in an underwater section in conditions of zero visibility. Help from another diver was needed to recover the situation.

3. Emergent learning cannot be specified in advance.

The general view amongst the realistic, experienced cave divers was that the loss of at least some boys' lives was almost certain, given the extreme underwater conditions in parts of the cave complex. Thus, the new cave rescue knowledge that emerged was both surprising and unexpected. Equally, when the lessons of the Wild Boars rescue are drawn upon for future cave rescues, they will need to be adapted to the contextual and logistical features of the particular locations in which such rescues are taking place.

4. Learning is typically beyond any individual's learning.

Though it is very likely that every individual member of the large and diverse group that carried out the ultimate rescue would have experienced some significant personal learning, the sum of this learning does not exhaust the learning that the rescue effort engendered. Crucial also was the group and sub-group learning that was generated through the practical judgements arising from interactive shared deliberations on how best to achieve each particular group's purpose. Individual group members can only partially comprehend the totality of this learning. Thus, the eighteen individual cave divers would each have their own particular and limited perspectives of the fine details of the total process of the rescue.

5. Emergent learning is not restricted to just a particular group.

It can also arise from *interactions* between groups, as well as between individual members of particular groups participating in yet other, often overlapping, groups.

Examples of key interactions between sub-groups included the careful rehearsing of how the various sub-groups would operate in the actual rescue so as to smoothly coordinate their respective functions. Another crucial example is the judgements that emerged from various group interactions, in the days leading up to first contact with the trapped football team, that resulted in (what proved to be) the vital participation of noted Australian cave divers Harris and Challen.

In summary, the Wild Boars rescue is an archetypical example of the productive working of a very large group, comprised of numerous sub-groups, all committed to attaining a shared outcome. From the many interactions both within and between the various groups *emerged* the reasoning and practical judgements that ultimately created a novel successful solution to the problem. For the boys and their coach, it was literally a case of emergence in the most desired sense.

COVID-19 case study

COVID-19 is indeed a 'black swan' phenomenon (Taleb, 2007). We offer it as a case of complexity in two ways. *Restricted* complexity provides a theoretical lens for understanding the initial stages of the pandemic, from March 2020, when countries around the world realised that massive behavioral change was required. Entire populations were immediately required to individually isolate in public, and were, in many countries, even quarantined (locked down), into households. A world of globalisation became, in just a few weeks, a world of local and domestic habitation. Restricted complexity strips relations down to groups with behaviors in common, such as flocks of birds and traffic flows, voting patterns, and 'herd immunity'. Agency is not part of this theorization; rather, as the world became aggressively isolationist in the face of the aggressively expanding pandemic, human habitation was reduced to its most atomistic: the household, of one or two, with related family structures (children, the elderly). For months, a locked-down existence with severely defined social distancing when out and about, in public (such as to buy food, or medicine), persisted in many countries. What governments, guided by their respective public health authorities, required was what restricted complexity explains well: the massification of immediate behavioral change which strips out the agentive nature of human life. 'Learning' and 'being' are accordingly reduced to compliance and subsistence, as the initial aggressive advance of the pandemic in early 2020 rolled around the planet. These were essential public health responses to a global threat to human life.

However, although restricted complexity explains the way down and into the pandemic, it does not explain the way up and out of it. *General* complexity does so, superbly well. In the first section of this paper, we outlined its main features, and chief amongst these is the recognition of agency in human relationality. General complexity locates agency right amidst groups, not primarily in individuals. Groups generate learning and form identities (that is, senses of 'beings') through their purposeful decisions that are constituted in their shared activities. Our first case study – the Wild Boars retrieval from the cave in Thailand – showed the significance of shared human agency in generating purposeful decisions within a group (of 18 diverse diving experts) when the desired outcome, the safe emergence of the boys and their coach, looked very unpredictable, even, most unlikely.

As the world emerges up and out from COVID-19, general complexity helps put the spotlight on widely under-recognised features of human experience that now could become central to a 'new normal' for learning and identity formation ('being'). We address this in three ways, and then show how these reflect the five key features of general complexity discussed above.

How daily life is rebounding

Social distancing (such as maintaining gaps of 1.5 metres between individuals) and public hygiene (using sanitiser often) are two common daily constraints that force upon us consideration of 'group-mindedness' – where am I at any point in the day and with whom? And with how many? These simple behavioral changes, backed up by smartphones equipped to assist 'contact tracing' nonetheless have opened up agency in ways that could not have been specified in advance, and that do not reduce to any single individual's learning. Populations of restaurants and shopping centres are fluid crowdings of individuals. Because these crowds are 'on the move' and we know our exposures to each other are temporary, we have developed the expectation that we each and all should participate in a 'new normal' way of socialising in public. That is, we expect that the groups of which we are even temporarily members (when, for example, shopping), will 'have a mind' for common, public health, from which a consequence is a mindfulness of our private individual health. Acting alone, that is, individualistically, will not be well-regarded in the time of emergence from the COVID-19 pandemic, which could itself continue for several years, especially if no vaccine is found. Even in mid-2020, in the USA, beset by poor leadership and divisive politics, some states, such as Florida, have become susceptible to a second 'spike' in case infections and a resurgence of COVID-19 related deaths, because social distancing and contact tracing have not been rigorously observed for long enough. Individualistic freedoms, aggressively pursued in some parts of the USA, thus threaten or provoke worse health outcomes than the first wave of infection produced.

By contrast, in the ubiquitous, daily round of human experience, *acting less individualistically*, that is, in a group-minded way, carries the shared expectation that learning this 'group-mindedness' is a public-regarding norm.

How the workplace is evolving

As the central business districts of the world's cities emptied, and as the COVID-19 virus aggressively forced workers in main industries to relocate to WFH (Working From Home), two aspects of working and careers were thrown into great prominence: gender and technology. Women, and many men, who are parents, found their 'worker' selves entwined with parental responsibilities (since schools and childcare had also closed). Even with the provision of on-line learning by schools and teachers, for their students, this 'homeschool' day still fitted within the hours of the traditional 'office' workday. Men and women have probably experienced these entwined WFH responsibilities differently. Some evidence is that men have worked on a desk in the seclusion of the front room of the home, whilst women, even in the same household, have grabbed a corner of the kitchen bench or table, and continued domestic chores and care-giving such as homeschooling (panel commentary, *The future of work*, 2020). If so, the overlapping expectations of time and space have increased pressures principally on women as WFH and 'homeschooling' and domestic chores, each intensified, as lockdown-type life continued.

Simultaneously, information technology, and social media, rose to the new expectations: online meetings with (e.g.) Zoom peppered the working day, but the working day was no longer constrained by the traditional 9-5pm lived experience in a building in the central business district. Just as 'space' had changed from a street and a building to a chair and a table (or a bench space), so had the measure of workplace 'time'. These new relationships were experienced on a daily, and intimate, basis. Instead of several hours a week given to a public transport commute into the traditional workplace, along with the heavily gendered traditional expectations of the 'corporate look', women in particular found themselves with a more fluid, but no less intense, workplace.

General complexity helps us understand how some main workplaces and careers are evolving, especially for women, and especially given technological innovations. How groups and (quite often) teams are experienced in a WFH environment raises substantial questions for the qualities of interactions that rely on screens and audio. Being (and the 'being' in the sense of having an identity) when 'present' or connected on-line does not establish

a fully-present personal identity. What is lost, in, say, a Zoom meeting, is the intimate and spontaneous interaction that lightens the moment, that sparks a quizzical perspective or that makes a practical judgement easier to crystallise. This quality of engagement, ubiquitous in the traditional building, as a site of meetings and informal conversations, is absent online. Embodied experiences in the 'normal' flow of workplace life are starkly absent in the 'new normal'. The 'eros of learning' (Beckett, 1998) or 'water cooler culture', has shrunk away as WFH and its overlapping responsibilities as a parent, as well as a worker, have emerged. Conversations within and between the technology-driven provision of meetings via Zoom may not provoke the agency of traditional workplaces (where, during a water cooler chat, or similar spontaneous interaction, colleagues could just promise to follow up on something). Yet, when a Zoom screen is filled with equal-sized WFH camera-ready participants, an opportunity for distributed learning, shared decisions, and agreed outcomes to advance, say, a project, seems to be presented. This opportunity is for learning which is beyond the learning of any single individual when acting alone and is interaction-based. In fact, the technology makes this interaction both inclusive and feasible. Distractions such as a long commute, a 'corporate look' and even assumptions about 'dis-ability' and 'expertise' are challenged.

Overall, there is a new type of 'planned spontaneity' about this new WFH workplace. What can emerge cannot often be specified in advance – the group captured together on Zoom for those few minutes or hours could be genuinely innovative, since few of the old hierarchical assumptions carry over unchanged to this new mode of work. General complexity helps us see these possibilities in these new evolving workplaces.

How the search for a vaccine is unfolding

Over decades, basic research into viral pandemics had been marked by 'panic and neglect' under-funding, according to experts interviewed for an important and timely television analysis (*Four Corners*, 2020). However, in these COVID-19 times, one interviewee said, 'we have never seen such a level of co-operation' between public sector research laboratories including universities, private pharmaceutical companies, and major philanthropy (such as the Bill Gates Foundation). The urgency of the search, and the need to reach massive populations around the world with millions of dosages, meeting first the needs that are greatest, are the imperatives held in tension.

Workplace interactions occur in small lab teams working on promising approaches to a vaccine, but not claiming that their approach is exclusive. Rather there are networks of various partnerships, some of which have widened out from labs themselves to include 'big pharma' (e.g. Pfizer, GlaxoSmithKline). Unlike basic research labs, with their uncertain funding, large commercial medical innovation can afford to fund research over long development times. The unpalatable outcome has been that, in the past, vaccines such as for cervical cancer, a disease rife in developing countries, are too expensive for those who most need it. Fairness and equality is advocated by several experts (*Four Corners*, 2020), to avert what can be termed 'vaccine nationalism'.

Groups are fundamental to this work. A laboratory and the adjacent clinical trials (which are also unfolding e.g. in Oxford), is merely one interactive, high-engagement site of innovation, where the bio-scientific learning cannot be specified in advance. COVID-19 is a novel coronavirus in every sense of novelty. It is also aggressive, and there may never be a vaccine (there has never been one found for HIV). Next up from a single site are networks, or coalitions, of such sites where learning is meaningfully shared through overlapping memberships. Next up again are partnerships with stakeholders with different interests – clinical and commercial being the main tension. Throughout this unfolding search, learning is shared as it is distributed across and between each level of activity.

The COVID-19 pandemic provides vivid instances of each of the five key features of the often-overlooked novel learning that arises from group activities:

1. Learning is distributed across the group.

Daily public life has changed. Interactions in and between groups right across each day and night will focus on shared sensitivity to maintaining a 'new normal'. General complexity helps us understand that learning, over and above any individual's learning, resides in the social sphere. We are all in this, together. In WFH, new technology and new perceptions – even images – of group members and the quality of their participation strongly indicates that learning is distributed amongst the group. Gender and minorities' dynamics are up for re-negotiation, as a result of this distributional learning. And in the search for a vaccine, sites, networks and partnerships clearly show 'distributional' learning.

2. Learning emerges from the group's activities themselves.

The entire planet is grappling with COVID-19 as a unique, malignant phenomenon. Whilst anti-viral vaccines in the past have been found and some trialing done, this pandemic only partially builds on previous epidemiological knowledge. With the COVID-19 case, we do not know what will yet emerge as a medical solution. What has *already* emerged are novel interactions in new sorts of workplaces, including various clinical approaches in laboratories around the world in various sites, networks and partnerships.

3. Emergent learning cannot be specified in advance.

We simply do not know how these new socially-sensitive daily interactions will pan out – whether for example, public hygiene will become a more rigorous 'new normal' form of socializing (the handshake is dead, perhaps). Just as the Thai cave rescue re-wrote the textbook on life-saving cave diving, perhaps WFH will re-write the learning that managers need for successful leadership in the future, from a model of facilitation and capacity-building, in the traditional workplace, to one more of an orchestration of productivity, with the manager as the conductor of many groups and sub-groups and their interactions. Looking for relational strengths (not so much individuals' strengths) could be the future of managers, and indeed of all participants in groups – more of 'us', less of 'me'.

4. Learning is typically beyond any individual's learning.

General complexity claims that the learning of groups is achieved in its own right (not as the simple aggregation or sum of the learning of the individuals who participate). This is displayed in our COVID-19 examples: on the streets, groups (say, in restaurants) of members of the 'public' will need to know how to enact in that very context, and how to deal with daily practicalities, such as over-crowding, as a group. Some agility will be required, both there, and also in WFH environments, as shown in an overt reliance on practical judgements that 'disembodied' groups make about their situations ('what to do now?', 'what to do next?'). These judgements cannot be reduced to the learnings that the participants acquire. Similarly, vaccine research is permeated with group-owned achievements that rightly require and respect individuals' interactions, but, over and above these, are achievements in and between clinical research groups, as the next point explains.

5. Emergent learning is not restricted to just a particular group.

General complexity helps in understanding how the search for a vaccine for COVID-19 is unfolding. Bio-scientific expertise is found in how the groups (and eventually in the networks and partnerships) relate to each other in the regular work of exploration and development that they undertake. Daily decisions and practical judgements about the way to go on are found amongst the interactions of experts from and between 'relatable' (similar but distinct) workplaces. This 'relating' continues, arising from these activities; in fact, these are foundational for

new and 'next level up' decisions and judgements. Throughout, there is a commonly-shared pursuit of a vaccine needed to address human misery. In normative terms, psychologists call this communal focus the 'attractor'. It is the value-ladenness (or ethic) of all practical work, and it is richly found in this vaccine quest. The 'learning' and the 'being' (taken together, these are the work of being a knowledgeable bio-scientist) are heavily intertwined in this quest. General complexity enables us to see more clearly that authoritative knowledge from which any vaccine will emerge is constructed in the value-laden quality and quantity of interactions subsistent at the level of groups, and also in the consequential combination of these communal interactions.

Conclusion

Our two case studies tell us much. General complexity disavows the guru, the genius and the artist-in-the-garret. Purposeful powerful knowledge *emerges from daily interactions amongst small groups*, and mushrooms up to an outcome which may be the 'new normal' of cave rescues, of daily public socialising, of new WFH workplace dynamics, and, eventually a vaccine we all desperately need. Both case studies have been shown to exemplify five key features of novel group learning. So, we close by recommending these as key *principles* for UNESCO's 'learning to become' initiatives; valuable principles that traverse cultures and nationalities.

We are all *already* in this together. Humans have been in small 'co-present' groups right from birth (such as the mother-baby dyad). Learning and being, in the educational future, should consist in giving explicit attention first-up to cultivating small groups around purposes (such as we already utilise in the judicial work of a jury - typically 12 members). We (not *you* or *me*) will seek, through complex interactivity, vital novel and emergent responses to human challenges. The time has come to recognise, together, this potential that we all possess.

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