Building Creative Capacity Building in University Graduates: What we can learn from boids and voids

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Abstract:

This paper draws on recent computing and social organizational research to open up new possibilities for constructing learning environments that optimise opportunities for university students (and, indeed, their teachers) to work as members of dynamic creative teams. Given that the challenge of setting up a learning environment that fosters such a complex mix of relational dynamics is not a simple matter of ensuring that people feel good about themselves, the paper canvasses two areas of research that can be usefully bought together to provide principles on which to build learning environment for 'high flying' creatives.

The first is research that synthesises computer animation and biological behaviour to understand how 'birds of a feather flock together'. 'Flocking together' allows birds (boids are the computer animated variety) to fly higher and exhibit greater scheduling and routing capabilities than each bird can do alone. The means by which this extra capacity is achieved can tell us a lot about how we might do better in a team environment than we can alone. The second is the sociological research that inquires into how good ideas get picked up and moved about in organizations, that is, how a novel idea, produced in one specialist cluster, can be transported across 'holes' (voids) in the organization to and integrated with the work of different, even unrelated, clusters of specialists.

Insights from these two different domains of research – one focusing on the 'micro' dynamics of a team of a few people, and the other focusing on the macro dynamics of working across teams, are combined to develop principles for building a learning environment that can optimize creative high flying.

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Introduction

Rather than begin with a preamble about the need for creative capacity in our graduates, I am going to presume that participants in this conference will have already canvassed that issue and/or have ample opportunities to do so in these few days. I want to move straight to the issue of how to construct learning environments that optimise opportunities for university students (and, indeed, their teachers) to work as members of dynamic creative teams.

My stress on the importance of working as part of a team follows Mihalyi Csikszentmihalyi's insistence that it is the community, not the individual that we need to focus on when investigate how creativity gets fostered[1]. His thesis involves two key aspects of the environment in which we live and work – ie, the culturally or symbolic order he calls the *domain* and the social order he understands to be the *field*. He sees these two aspects interacting with a third component – namely how humans interact. It is at the *intersection of these interactions* that creative enterprise emerges.

Norman Jackson is a researcher who has taken Csikszentmihalyi's ideas further, adapting them to specific field of educational practice such as 'history teaching', drawing attention to all the complexity of the social and cultural environments in which such teaching takes place[2]. Importantly his research shows that creative capacity building is not simply about having a strong teacher/student relationship or 'gifted' students who like being together, but about a deeper more complex set of relationships between the people the ideas and the opportunities for learning provided by the physical environment.

Management consultant Thomas Stewart[3] adds a further layer of complexity to 'community learning' in drawing attention to the importance of 'emptiness' in the generation of ideas that add value to an organisation. He argues that, without space between one field of expertise and another, their can be no creation, because every space for thinking is already occupied. He is critical of managers who "try to design for everything", arguing the importance of keeping the space of not knowing open - "I don't know either; what do you think?" Without space for thinking differently, an organisational leader (think academic teacher) can soon become deaf to the new and potentially value-adding ideas that arise within and outside their business (think discipline), and blind to the possibilities that exist for moving ideas around to best advantage their organization (think university).

To understand the sort of environments that make not just for group work or team-based work but for dynamic high flying teams, we cannot simply rely on the motivational power of teachers or organisational leaders, or merely hope that individual genius will emerge of its own volition. We should bear in mind John Howkins' insistence that creative productivity requires *both* the separateness of individual talent *and* the togetherness of team collaboration, all working as seamlessly as possible within and across processes of production and distribution[4].

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[1] Csikszentmihalyi, M. (1999). Implications of a systems perspective for the study of creativity. In R. Sternberg (Ed.), *Handbook of creativity* Cambridge: Cambridge University Press, 313-335.

[2] Jackson, N. (2006) Making Sense of Creativity in Higher Education, in N. Jackson, M. Oliver, M. Shaw, J. Wisdom (Eds) *Developing creativity in higher education: An imaginative curriculum.* London: Routledge, pp197-230.

[3] Stewart, T. (1996) The Great Conundrum: You vs. the team, *Fortune*, 134, Nov, 165-166.

[4] Howkins, J (2002) *The Creative Economy: How people make money from ideas*. London: Penguin.

Boids and Voids

Given that the challenge of setting up a learning environment that fosters such a complex mix of relational dynamics is not a simple matter of ensuring that people feel good about themselves, I suggest that there are two areas of research that can be usefully bought together to provide principles on which to build learning environment for 'high flying' creatives.

The first is research that synthesises computer animation and biological behaviour to understand how 'birds of a feather flock together'. We know that 'flocking together' allows birds (boids are the computer animated variety) to fly higher and exhibit greater scheduling and routing capabilities than each bird can do alone. The means by which this extra capacity is achieved can tell us a lot about how we might do better in a team environment than we can alone.

The second is the sociological research that inquires into how good ideas get picked up and moved about in organizations, that is, how a novel idea, produced in one specialist cluster, can be transported across 'holes' (voids) in the organization to and integrated with the work of different, even unrelated, clusters of specialists.

Insights from these two different domains of research – one focusing on the 'micro' dynamics of a team of a few people, and the other focusing on the macro dynamics of working across teams, can be combined to make a good learning environment for creative high flying.

I will deal firstly with research on the flocking of bird objects - 'boids'.

Boids

Computer modeling expert, Richard Seel's (2006) inquiry into the emergence of new patterns of behaviour and forms of engagement in organisations serves as a convenient starting point for investigating the value of computer modelling-meets-biology research for 'growing' dynamic creative teams[5]. Seel draws on recent developments in complexity theory, particularly experiments with computer programs to endorse the idea "simple interactions between simple agents [can]…give rise to surprisingly complex behaviour"[6]. He points to three conditions in particular – *connectivity*, *diversity* and *rate of information flow* – that are shown to be important as a result of computer simulation research and observations of physical systems.

Seel concedes, as other researchers of human social behaviour do,[7] that there is more complexity in human interaction than in other natural systems. Nevertheless, there is still much that can be learnt from 'complexity' research about how to optimise creative team development. Complexity theory can, according to UK educational researcher Paul Tosey, provide a "radical and innovative frame for professional educational practice"[8] by drawing on computer modelling of the behaviours of natural systems, in particular by observing and attempting to replicate flocks of birds as 'neighbours' or

[5] Seel, R. (2006) Emergence in Organisations - http://www.new-paradigm.co.uk/emergence-2.htm

[6] Ibid, p.1

[7] See for example Stanislav D. Dobrev (2005) Career Mobility and Job Flocking, *Social Science Research*, 34, 800-820.

[8] Tosey, P. (2006). Interfering with the interference: An emergent perspective on creativty in higher education. In N. Jackson, M. Oliver, M. Shaw & J. Wisdom (Eds.), *Developing creativity in higher education: An imaginative curriculum,*London: Routledge, p.31.

flockmates. In doing so, we can learn the simple rules of interaction that allow for very complex forms of group engagement.

Computer simulations of bird objects (*boids*) tell us about the behavioural principles that allow flocks or swarms to perform with more capacity (e.g. flying higher and faster and avoiding obstacles more easily) than the capacity of any one flock member allows[9]. One of the myths that is exploded in engaging with this scholarship is the idea that there *are* no rules when it comes to creative 'high flying', and indeed, that there *should* be no rules, i.e., that the best way for creative students to learn is just for others (including teachers) to get out of their way. Computer simulations of flocking demonstrate that there *are* behavioural rules that allow single biological entities to operate optimally by forming more complex behaviours as a collective. Such simulations need rules. The important issue in this paper is the nature of the rules and their operation.

A related and important aspect of nature's team behaviour is that it does not come about as a reaction to 'control and command' from outside[10]. When applied to dynamic team environments, this principle puts paid both to the idea that there are no rules to high flying but also to the idea that having rules means that someone must be in absolute control. The 'enhancing' constraints that make for a sense of collective direction are not imposed by a leader. Leadership, in the sense of heading a flock, changes constantly, and 'command and control' is *not* the means by this change occurs.

Appropriate 'flocking' behaviour is generated within 'local neighbourhoods' of 'flockmates' through the provision of timely information and the self-management of:

- separation – the capacity to steer to avoid crowding others
- alignment – the capacity to steer towards the average heading of the local flockmates
- cohesion – the capacity to steer to move towards the average position of local flockmates

These deceptively simple capacities are three dimensional in terms of behaviour, in that they are simultaneously focused on member/member, member/external *and* member/colony orientation[11].

The rules for maintaining an optimal ecological assemblage of flockmates can tell us a lot about 'high flying' learning environments. Each flockmate is aligned with and responsive to those flockmates in their immediate vicinity, as well as being appropriately separate from those same flockmates. This may come as something of a surprise to those who understand 'mass collaboration' as necessarily obliterating or subsuming individual space. In fact, it is best done by respecting and maintaining space.

What can be learned from this is that, while creative teams need to be attuned to the needs and interests of their 'flockmates' in the common project, team-based student 'self-management' functions optimally when it does not interfere with or obstruct others. In Seel's terms, "too much connectivity…can inhibit

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[9] See Craig Reynolds (1987). Flocks, herds, and schools: A distributed behavioral model. *Computer Graphics, 21*(4), 25-34. and also (nd). *Boids: Background and update*. Retrieved 27 April, 2007, from http://www.red3d.com/cwr/boids/

[10] Thompson, K. (2006). *Enhance team performance by consistent individual behaviour*. Retrieved 27 April, 2007, from http://www.bioteams.com/2006/03/22/enhance_team_performance.html

[11] Thompson, K. (2006). *Enhance team performance by consistent individual behaviour*. Retrieved 27 April, 2007, from http://www.bioteams.com/2006/03/22/enhance_team_performance.html, *op cit*, p.3

emergence… [in that]…diversity is excluded and groupthink is a very likely outcome"[12]. This means that, despite the good intentions that often accompany the appointment of a 'strong' group leader, the dynamics that flow from this if and when the strong leader 'takes over' might prove to be more of a hindrance than a help. Put simply, space invaders do not encourage high flying.

While 'boid' research works against our commonly accepted notions of 'strong leadership', it also reminds us that 'anything goes' is not a practical alternative for building a creativity-enhancing learning environment. The space of optimal ecological assemblage is not a space of anarchy – it works precisely *against* destructively unpredictable conduct on the part of individual flockmates. The necessary 'randomness' is always systematic, scanning for and reporting information of potential value – it is *patterned*, not chaotic.

Some embryonic work has already been to apply these principles derived from non-human biological 'teams' to human teams at work within organisations. According to management expert, Ken Thompson, the principle of "systemic randomness"[13] in bio-team behaviour can and should be applied to organisational teams, by encouraging individuals within them to be systematically involved in random interactivity, constantly on the look out for something 'interesting' pertaining to their shared projects and sharing it in a timely way within and for the group.

Thompson acknowledges elsewhere[14] that there can be differences between human teams and some biological teams in terms of sheer scale of numbers of members, with human teams rarely exceeding fifty in number, and typical large organisations rarely exceeding ten thousand members, while biological 'teams' or colonies can number up to a million or more. He points out that humans "tend to organise themselves into smaller independently managed sub-units"[15], or to extrapolate from 'boid' research, various 'local neighbourhoods of flockmates'. This purposive activity has the effect of reducing vulnerability to individual member failure, while at the same time generating the sort of "swarm intelligence" that makes for "amazing scheduling and routing capabilities" well beyond any individual capacity.

The internet has made it possible to harness such "swarm intelligence" more powerfully than any technology we have yet seen. Swarming mass collaborations on the internet are shaking up orthodox business operations through enhancing their members' capacity for:

- give and take (creating shared distribution computing capacity)
- finding needles in haystacks (connecting to other like minds through shared interests rather than personal relationships)
- participation through passion (co-inventing with others on the basis of shared passion rather than focusing only on profit as motivation).[16]

Swarming mass collaborations can teach us more about setting up and sustaining 'high flying' formal learning environments. While there has been much interest and investment in ICTs for learning, we

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[12] Seel, R. (2006) Emergence in Organisations - http://www.new-paradigm.co.uk/emergence-2.htm, p.3

[13] Thompson, K. (2006). *Enhance team performance by consistent individual behaviour*. Retrieved 27 April, 2007, from http://www.bioteams.com/2006/03/22/enhance_team_performance.html, *op cit*, p.3

[14] Thompson, K. (2006) Mass Collaboration and Virtual Crowds, http://www.bioteams.com, accessed 18 April 2007.

[15] Ibid, p.1

[16] See Hof, R. D. (2005). The power of us: Mass collaboration is shaking up business. *BusinessWeek*, June 20.

have made scant headway in understanding what sorts of collaborations are now possible, and whether and how they might be systematically fostered in formal education. In Seel's terminology, we have much more to learn about how ecological settings and pedagogical approaches can be "tuned" to predispose young people to creative thinking and doing.[17]

Biological research[18] shows us four types or "degrees" of collaboration in nature that can improve our understanding of how what people do when they are working in teams differs from other sorts of interactive behaviour. They are:

- solo work – members doing the same things at different times
- crowd work – members doing the same thing at the same time
- group work – members doing different things at different times (sequential)
- team work – members doing different things at the same time (concurrent)

This allows more nuanced understandings of collaborative activity than simply speaking of 'team-work' as though it were a 'one-size-fits-all' set of activities, behaviours or events. It also directs us to think about matters of size and scale. Is there an optimum number of individuals that could be expected to work concurrently (ie, do different things at the same time) while maintaining cohesion and alignment? What sort of structure would enable a self-managing 'local neighbourhood' to form and be sustained through its capacity to maintain sufficient separateness and sufficient connectedness across time and space?

As I conceded earlier in this paper, the move from bio-ecology to human interactivity is not a simply matter of taking what avian or any other species do and applying it to human behaviour. While this fact does not negate the value of learning from natural systems, it reminds us that we need to know more about optimising learning environments than we can learn from 'boids', if we are to set up principles for organising learning environments within business organisations, as well as within and outside universities.

The social scientific research of both Stanslav Dobrev and Ronald Burt is helpful here. Stanislav Dobrev is helpful because his empirical research into career mobility carefully builds a bridge between the spatial proximity of birds, and the socio-demographic behaviour of networks of people pursuing similar careers[19]. He finds that there are patterns of human behaviour like "job flocking" that may be explained through ecological dynamics – ie, that ecological proximity can homogenise behavioural outcomes rather than the other way around.

Put simply, individuals do not have to be connected through inter-personal ties to 'flock together'. They can and do connect as 'birds of a feather' do. Nevertheless he also cautions against using ecological models without placing them alongside other theorising of complex social processes. So we can't simply presume that we will fly higher if we attach ourselves to a high flying crowd or profession.

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[17] Seel, R. (2006) Emergence in Organisations - http://www.new-paradigm.co.uk/emergence-2.htm, op cit, p.3

[18] See Anderson, C. (1998). *The Organisation of Foraging in Insect Societies.* Unpublished Ph.D. Thesis, University of Sheffield, and also Anderson, C., & Franks, N. R. (2004). Teamwork in ants, robots and humans. *Advances in the Study of Behavior, 33*(1-48).

[19] Dobrev, S. (2005) Career Mobility and Job Flocking, *Social Science Research*, 34, 800-820.

Voids

Ronald Burt's research[20] is one study that can be usefully placed alongside Dobrev's "job flocking" study to provide a macro perspective to add to the behavioural rules that operate to maintain flockmate behaviour within natural systems. Burt seeks to understand the mechanism by which 'brokerage' of creative ideas works to generate social capital within an organisation. In doing so, he provides us with a way of linking the idea of local teams as 'neighbourhoods of flockmates' to the macro-structures of organizations, and how they enable or constrain the "vision advantage"[21] that comes from translating 'good ideas' into real value.

In putting forward his views about 'void' brokerage as a creative act, Burt acknowledges the fact that most organisations have structures of clusters in which people's behaviour, opinion and information tend to be relatively homogenous. He explains that the fact that people tend to focus on activities *inside* their own cluster creates "holes" in the information flow between groups – what he calls "structural holes"[22]. Burt is interested in the way opinion leaders can bridge these structural holes within an organisation, because, as he sees it, the capacity to bridge clusters brings with it the advantages of early detection and development of potentially rewarding opportunities – what he calls "information arbitrage"[23]. People whose networks can bridge the structural holes "are able to see early, see more broadly, and translate information across groups" and this in turn provides them with "a vision of options otherwise unseen"[24].

There are, according to Burt, four levels of 'translation' or brokerage through which a person or persons can create value as information arbiter(s). They are, in ascending order:

- by making people on both sides of the structural hole aware of interests and difficulties that exist in another cluster;
- by transferring the best of what is going on by transferring the belief or practice into a language that is accessible to the target cluster;
- by drawing analogies between clusters that are ostensibly irrelevant to each other; and,
- by synthesising the beliefs and practices of two clusters so that new beliefs or practices emerge than are of benefit to both clusters.[25]

What these levels of arbitrage draw attention to is not just the importance of the brokering function to value-adding creativity, but also the significance that attaches to building and expanding "boundary-spanning relationships"[26] both within and outside the organisational environment.

When applied to formal educational environments, Burt's framework implies that operating as 'neighbourhoods of flockmates' is only part of the picture of a creativity-enhancing learning environment. At a meta-level, some person or persons are needed who can span the "structural holes" that exist across different domains. This demands that some person or persons have the desire, indeed the expectation, "to continue to propose ideas" that originate in one place and get taken up in another.[27] Applied to universities, this would see visual arts teachers constantly connecting with biology teachers,

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[20] Burt, R. (2004) Structural Holes and Good Ideas, *The American Journal of Sociology*, 110 (2), 349-399.

[21] Ibid, p.351.

[22] Ibid, p.353.

[23] Ibid, p354.

[24] Ibid, p.354.

[25] Ibid, p.355.

[26] Ibid, p.358.

[27] Ibid, p.390.

nursing teachers on the lookout for new ideas coming from the mathematics department, law lecturers dropping in to see what the IT people are up to.

Taking a reality check

But is this actually happening? In the organisations that Burt studied, the more likely scenario was that leaders and managers were having most of their discussions with a small number of very close colleagues, and very few with those outside their narrow field of operations. This means that the potential value of good ideas in most organisations is lost; the distribution of ideas is shut down by "an inertia model of social convenience"[28]. According to Colin Pidd[29], business consultant and an ex-senior executive in both the private and the public sectors, the challenge of "building a bridge" between leaders is one that remains to be addressed in any significant way among Australian CEOs, many of whom still fail to provide the necessary information or guidance when change is being mooted.

So too in universities, ideas do not usually flow freely across disciplinary clusters. Rather, they stop at the door of a faculty or department, as lecturers retreat to monastic offices and teachers go it alone in their one-to-thirty tutorials. If good ideas are going to be valued in formal educational environments, we need to shake up the monasticism and singularity of teaching and educational leadership.

When we put together the lessons about learning environments that are implicit in the biological 'boid' research and the organisational 'void' research described above, we can derive a set of paradoxical principles for dynamic team building. In summary, they underline the importance of learning environments in which apparently contrary imperatives exist for evoking optimal creative outcomes, imperatives that co-exist despite their apparent incommensurability. They bring together the following:

1. *Connectivity with diversity* – an environment in which it is important for students to be 'plugged into' and mindful of a 'local neighbourhood' and a larger world of potential team members with similar interests or passions – one that allows members to pursue their passions and to contribute to fast-moving flows of information on behalf of others and themselves.
2. *Co-invention/co-creation with separation* – an environment in which the nature, purpose and rules of self-management are understood and internalised, so that members can be *both separate from, and attentive to*, those they work with and rely on for their 'high flying' outcomes. The products of learning are authentic productions of the synergies that exist between the individual member and the team, not merely what is 'required' by external others.
3. *Leading and following* – an environment in which all team members share collective responsibility for timely and appropriate leadership, looking over the horizon for relevant information for sharing with others, while at the same time following the 'steering' of those close by, i.e. exercising 'three dimensional' attention about the local and global, the present and the future.
4. *'Enhancing' constraints and removal of inhibitors* – an environment that minimises command and control' while providing scaffolded opportunities for members to conduct themselves in ways that optimise team (and thereby their own) performance – one in which there are, as Paul Tosey puts it, terms, "good constraints to action"[30].

[28] Ibid, p.390.

[29] Pidd, C. (200) Leaders, Bosses and Bastards: Understanding the Aussie Workforce, *Going Public*, Institute of Public Administration, Victoria, pp.1-4.

[30] Tosey, P. (2006). Interfering with the interference: An emergent perspective on creativty in higher education. In N. Jackson, M. Oliver, M. Shaw & J. Wisdom (Eds.), *Developing creativity in higher education: An imaginative curriculum,*London: Routledge, *op cit*, p.33.

5. *Creating 'holes' and bridging holes* – an environment in which the spaces that arise naturally between specialist clusters are being bridged by those leaders, managers and others whose understand and value the importance of broad social networks within and outside the institution or organisation, and who are deeply committed to information brokerage.

Making connections

The above principles are aligned in many important respects with recent theorising of learning as a connection-forming or network-creating process. In looking to 'boids' and 'voids' to provide a conceptual framework for rethinking the dynamics of a creativity-enhancing learning environment, we pay less attention to the sources of information and more attention to *processes* through which knowledge and information are transferred and translated within and across social groups. In a world in which the capacity to memorise pre-determined content is much less important than the capacity to generate knowledge through co-creation, this is a key shift. It has us focused on developing connections, not defending the citadel.

Connectivist theorising moves us on from behaviourist, cognitive or constructivist notions of learning to focus squarely on the ecologies within which learning networks are structured. As learning designer George Siemens sees it[31], our personal networks are dynamic, capable of organising and adapting in order to allow us to form new connections within what is essentially the "messy, nebulous, informal, chaotic process"[32] of learning. By implication, the work of a designer of learning environments begins with an acknowledgement that the act of learning is "a function under the control of the learner", and will be enhanced if and when the personal networks within which the learner can move with confidence and agility.

Information and communication technologies have a very important role to play in enabling the development of these personal learning networks. As Siemens puts it:

> Blogs, wikis and other open, collaborative platforms are reshaping learning as a two-way process Instead of presenting content/information/knowledge in a linear sequential manner, learners can be provided with a rich array of tools and information sources to use in creating their own learning pathways. The instructor or institution can still ensure that their critical learning needs are achieved by focusing instead on the creation of the knowledge ecology. The links and connections are formed by the learners themselves.[33]

The five paradoxical principles outlined above are highly compatible with this conceptualisation of learning as informal, connection-based, and ICT-enhanced networking. They make it possible to imagine a new structure for the learning environment, instead of being anxious about what happens once we begin to make the overdue transition away from regulation and rigidity. The five principles privilege the ability to navigate within and across knowledge domains, and are less concerned with the ability to memorise facts or present information. At a micro level, they allow us to be explicit about the dynamics involved in building and sustaining collaborative and agile teams, while at a macro level, they allow us to pay more attention to brokering ideas, understanding that this is a much more crucial institutional and social dynamic than we have acknowledged to date.

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[31] Siemens, G (2005) *Connectivism: Learning as a Network Creation*, ASTD's Source for e-Learning, http://wwwlearningcircuitsorg/2005/nov2005/siemenshtm, accessed 30 Jan 2008

[32] Ibid, p10

[33] Ibid, p10

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