

FROM VAPOROUSNESS TO VISIBILITY: WHAT MIGHT EVIDENCE OF CREATIVE CAPACITY BUILDING ACTUALLY LOOK LIKE?

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ABSTRACT

The paper seeks to warrant the authors' claim that creative capacity building can, at least in substantive part, be made visible through empirical processes of inquiry. To do so, the authors present methodologies and findings from two research projects they have conducted into creative capacity building, the first of which tracks student networking capacity and the second of which identifies cognitive playfulness as a creative learning disposition. The findings are argued to be instances of relevant evidence gathering in terms of warranting 'teaching-for-creativity' claims. By making student networking activities visible, and by examining cognitive playfulness as a learning disposition, the authors point to new uses for digital tools, not just as a means for disseminating information or storing it, but for designing smarter pedagogical processes and smarter processes of inquiry into the sorts of thinking and doing that constitute creative capacity.

INTRODUCTION

It has only been relatively recently that we have moved closer to understanding what might count as evidence of creative capacity building in action. This means that we have yet to be able to state with any degree of confidence that certain pedagogical practices or social processes or learning ecologies are more likely than others to be effective in optimising students' creative capability. This lack of confidence can be traced, in turn, to a long and somewhat tortured history of attempts to achieve consensus about what creativity itself is, let alone how to foster it in formal learning. What we present in this paper is a claim that creative capacity building can, at least in substantive part, be made visible through empirical processes of inquiry. Put another way, it is now possible to capture meaningful empirical data to warrant claims that we are teaching for creativity.

In what follows, we elaborate on how this might be done by presenting the methodology and findings from research we have conducted into creative capacity building, the former focused on tracking student networking capacity and the latter on identifying cognitive playfulness as a creative learning disposition. Both projects get under the skin of creative student thinking-and-doing without rendering simplistic the complexity and multiplicity of ways that creativity manifests itself. We present the findings of projects demonstrating instances of relevant evidence gathering, not as definitive in terms of the sort of evidence that could warrant teaching-for-creativity claims.

'SEEING' CREATIVITY

Over a decade ago, creativity researchers John Feldhusen and Ban Eng Goh (1995) were less than sanguine about the possibility of ever achieving any consensus around creativity as a concept, in saying:

It is not yet clear that insights derived from very highly creative individuals who have achieved world class recognition for their creativity activity, performance or products will generalise to the lower level of creative or adaptive behavior of people in general or youth in particular. This is a perennial and ubiquitous problem in all psychological and sociological research. (p.232)

The unsurprising conclusion that Feldhusen and Ban Eng Goh (1995) drew from their extensive study of creativity research is that creativity is multi-dimensional, and therefore evidence of its presence or absence as a learning outcome would need to take multiple forms – everything from individual 'cognitive processes, motivations interests, attitudes and styles' to 'the products, presentations and performances' that are achieved through the learning (p.240). This moved us away, thankfully, from the temptation to conflate 'creative' with 'gifted and talented', the latter category being unhelpful if we are to see creativity as everyone's business. In doing so, it also moved us away from methodologies that depend on one-shot or simplistic pre- and post- testing of an individual's 'smarts'.

Since the mid-nineties, we have seen a breakthrough of sorts from the widely held view that creativity is too multi-dimensional to be amenable to empirical scrutiny. This came with the insistence of both Teresa Amabile (1996) and Mihalyi Csikszentmihalyi (1997) that creativity is better understood as a process that occurs outside an

individual rather than a mysterious individual capacity. Now that creativity has been exteriorised theoretically, it has become possible for independent observers to agree that what they are observing is or is not creative. For over a decade, then, we have seen a growing consensus that creativity is amenable to being systematically observed over time. This has paved the way for developing criteria for formalising such systematic observations into an evidence base through which the processes of building creative capacity can be made less vaporous and more visible.

UK educator, Anna Craft (2006) has pursued lines of inquiry that continue this trend away from seeing creativity as idiosyncrasy and exceptionality. Craft provides a firm demonstration of just how much the focus of creativity research has been democratised. She insists that we are now working in a different 'climate' of engagement with creative capacity, a climate characterised by a new breadth of emphasis on: ordinary creativity rather than genius; characterising rather than measuring; social systems rather than the individuals; and, encompassing views of creativity that include products, without seeing these as necessary or essential (Craft, 2006, p.27). The idea that creativity may be characterised through a multiplicity of instruments is good news and bad news for educators, just as it is for employers who want formal educational reporting to tell them precisely what potential employees can do as potential 'creatives'. It is good news as a de-mystifying development for building evidence. It is bad news because that evidence is not readily reducible to a standardised test.

While it is not necessary or desirable here to elaborate on the historical development of theories about what makes for a valid evidentiary base, it is important not to underestimate the powerful reach of the scientific tradition of validation through measuring test results. It is a tradition that ties any worthwhile claim about evidence to the measurement of phenomena through laws that allow generalisable explanation or prediction. The core business of this tradition is to offer principles, practices and types of evidence through which credibility is established using numbers and their interpretation. As a discipline, quantitative inquiry questions any approach that researchers might adopt if it falls outside this logic of validation. Scores are used to make comparisons between like others, and this makes them important for educational leaders and policy-makers who want to know how individuals and groups compare when ranked in terms of a particular skill – say, literacy or numeracy. This ranking provides a rationale for funding certain projects and refusing or cutting funding to others.

As we have noted, this tradition is formidable when it comes to warranting any and all scholarly claims. It weakens the credibility of 'alternative' approaches by marginalising them as 'cases where the common interpretation and validity inquiry do not hold' (Moss, Girard, & Haniford, 2006, p.112). Writing about the power of this tradition to frustrate attempts to assess creativity as original conceptualisation, Rob Cowdroy and Erik de Graff (2005) argue in essence that measurement obliterates any chance of 'seeing' creativity at all:

Pressures for conformity with conventions of assessment in other fields of education, and reinforced by global quality assurance demands for objectivity, uniform standards and transparency, reinforce focus of assessment on the demonstrable execution and the tangible product and preclude assessment of *creative ability*. (p.511)

Yet while the hegemony of quantification continues to be an irritant for those of us who refuse the idea that measurement is the only true means for knowing the world, we nevertheless cannot simply sidestep powerful traditions of quantitative inquiry if we are to build a teaching-for-creativity case. If we believe that certain pedagogical practices, e.g. peer-to-peer student networking and co-editing, are more likely to build creative capacity than, say, giving monologic lectures, then we can and should do more to warrant such claims

empirically. We can provide credible ‘scientific’ evidence of creative capacity building in action, as we demonstrate in what follows.

CREATIVE CAPACITY BUILDING AS A SOCIAL PROCESS

Before it is possible to design methodologies relevant to such inquiry, we need to return to the sticky matter of defining creative capacity. As argued above, scholarship has now moved away from seeing creative capacity in terms of artistry alone, and increasingly acknowledges it as an ability to produce ideas, which can be turned into valuable products and services. In broad terms, there have been two traditions of thinking about the nature of the processes that make for more creative capacity – that it is either an outcome of individual processes of intuitive, subjective ideation, or an outcome of social processes with generic applicability. These traditions of thinking are reflected, in turn, in two ‘generations’ of understandings held by contemporary teachers. Our research into the beliefs of award-winning academic teachers (McWilliam & Dawson, 2007) shows that many teachers hold a mixture of ‘first generation’ (individualistic) and ‘second generation’ (social, pluralistic) understandings, with the latter providing a stronger platform for developing and documenting effective teaching and learning strategies (Table 1).

| First generation creativity concepts | Second generation creativity concepts |
|---|---------------------------------------|
| ‘Soft’, serendipitous, non-economic | ‘Hard’ and an economic driver |
| Singularised | Pluralised / team-based |
| Spontaneous / arising from the inner self | Dispositional and environmental |
| Outside the box or any other metric | Requires rules and boundaries |
| Arts-based | Generalisable across the disciplines |
| Natural or innate | Learnable |
| Not amenable to teaching | Teachable |
| Not amenable to assessment | Assessable |

Table 1: First and second generation creativity concepts, adapted from McWilliam & Dawson, 2007, p.4

While popular notions of creativity continue to reflect first generation understandings, second generation creative capacity is being acknowledged by increasing numbers of educational scholars worldwide as an observable and valuable component of social and economic enterprise, and as fundamental to an increasingly complex, challenge-ridden and rapidly changing economic and social order. In Mihalyi Csikszentmihalyi’s terms, creativity is increasingly held to be *no longer a luxury for the few, but...a necessity for all* (Csikszentmihalyi, 2006, p.xviii). A further important perspective has been added through Csikszentmihalyi’s insistence on the community, not the individual, as the higher order unit of analysis when seeking to foster creativity. This proposition challenges conceptions of creativity that are limited to individualistic psychological traits, and this has pre-empted a shift in scholarly interest from the creative individual to the creative, dynamic team, the latter being enabled, as a result of their internal social dynamics (i.e. their capacity to ‘flock together’) and their robust social networks, to generate more creativity than they could achieve as separate individuals. It is this second generation conception that we see as amenable to interrogation through ‘scientific’ means.

NETWORKING AS A CREATIVE CAPACITY

As a result of the scholarly transition discussed above to move beyond a highly idiosyncratic and exclusively artistic notion of creative capacity, we are now seeing an emerging consensus that the core skills required for enacting creativity include: originality, imagination, communication, seeing connections, problem solving and team and individual leadership (Burt, 2004; Jackson, 2006; McWilliam, 2008 In press; Robinson, 2000; Tierney, Farmer, & Graen, 1999). Plucker *et al.* (2004) have attempted to name the central imperative or construct at work here as 'the interaction between aptitude, process, and environment by which an individual or group produced a perceptible product that is both novel and useful as defined within a social context' (p. 90). Their emphasis on interactivity prioritises an individual's ability to build social networks and to optimise their value, i.e. one's ability to be an enterprising and agile networker.

Networking ability is fast becoming recognised by other key researchers who are investigating creative capability. Sociologist Ronald Burt (2004), has provided strong evidence that individuals whose own networks are robust, can bridge other diverse networks and interest groups and so 'are able to see early, see more broadly, and translate information across groups' (p. 354). This in turn provides them with 'a vision of options otherwise unseen' (p. 354). Burt sees this 'translating' or 'brokering' function as value-adding creativity, not just because of the extent which translators are able to move knowledge around in value-adding ways, but because they build and expand 'boundary-spanning relationships' (Geletkanycz & Hambrick, 1997, p. 654) within and outside the existing environment.

The importance of networking to creative capital is endorsed in our research (see McWilliam & Dawson, 2008), where we draw an analogy between the flocking behaviour that allows biological organisms to fly higher and faster and the social behaviour humans engage in to produce creative capital. The capacity to flock together in productive ways is one that can be consciously fostered in and through the right sort of learning environment. Such a learning environment will be characterised by a number of paradoxical elements, among which we include connectivity with diversity and co-invention/co-creation with separation.

We are by no means alone in arguing the importance of characterising creative capacity as a highly developed form of social agility. Uzzi and Spiro (2005), for example, provide numerous examples of the value of sustained network interactions involving enterprising and agile teams of people blending social and cognitive capacities to achieve much more collectively than they could individually. This agility, they argue, prevents team efforts from collapsing into intense *homophily* or what the business discipline refers to as un-creative 'group-think'. By implication, teaching and learning for creative capacity building would be evidenced by student activity beyond their immediate class or group, linking with disparate groups, ideas, literature and products, in order to make new connections, to innovate and to translate knowledge through networking.

MAPPING STUDENT NETWORKING CAPACITY

The social network research undertaken by Ronald Burt (2004) demonstrates that, when individual actors on the edges of a social network are able to link other previously disparate groups, they exhibit greater degrees of enterprise and agility than peers positioned within small team networks (Figure 1). While separate small team networks potentially exhibit varying degrees of group-think, these individuals link across the network gaps, or what Burt has termed 'structural holes', to re-invigorate the community with new ideas, products and processes. This is further supported by Rodan and Galunic's (2004) demonstration that individuals who can access a diversity of disparate small team networks are more enabled than others to promote the introduction of new ideas and knowledge, thereby facilitating innovation and creativity.

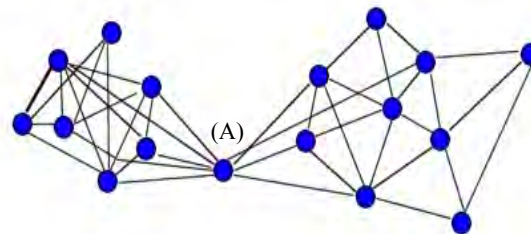


Figure 1: Example social network – illustrating an individual (A) bridging a 'structural hole'.

What more do we need to know about networking, then, in order to evaluate it as a value-adding pedagogical activity? Malcolm Gladwell (2002) author of *The Tipping Point: How little things can make a big difference*, identifies three types of nodes within a network that can influence the uptake of ideas and the explosion of new trends. Gladwell suggests that the uptake of ideas or the achievement of systemic change is not reliant upon significant numbers of a population simultaneously enacting change. He argues that rapid growth and uptake is accomplished by a few individuals demonstrating exceptional behaviour. Gladwell categorises these exceptional individuals within a network as 'connectors', 'mavens' or 'salesmen'. Connectors are described as having contact with vast numbers of additional nodes. Mavens are defined as information specialists or discipline experts with a predilection for dissemination. Finally, Salesmen are persuaders who encourage adoption and action. Gladwell's description of a Maven is comparable to Burt's discussion of brokers who bridge structural holes and thereby link discrete small team networks or what we have called elsewhere local neighbourhoods of flockmates (McWilliam & Dawson, 2008). In both contexts, these 'linking' individuals are pivotal for evaluating, translating, adapting and then disseminating ideas and information. This means that highly productive networks can be characterised by the dynamics of the relationships that exist among individuals working constantly to build and exploit social nodes and links. Moreover, these nodes and links are amenable to observation, given the right methodological tools.

The study of social network analysis (SNA) provides an established methodology for evaluating and monitoring the development of individual and team creativity. Steven Tepper (2006) suggests that SNA as a methodology has the capacity to identify the key individuals and small team networks associated with creative outcomes. By

implication, then, we see the application of SNA within the field of education as enabling the provision of explicit evidence of creativity as a learning outcome, a graduate attribute, and can also evaluate the specific pedagogies designed to foster creative capacity.

The challenge that arises once this principle is established is how best to observe team networking activity within the learning environment so that educators may adapt and alter their specific learning and teaching activities to evaluate whether and how it is actually occurring. The vast majority of HEIs internationally and nationally, have the tools to do this because they have substantially adopted Information and Communication Technologies (ICTs) to enhance flexibility and access for student learning. These ICTs have largely taken the form of Learning Management Systems (LMS) such as BlackBoard and Desire2Learn. A key feature of these systems is the ability of students to interact with peers and staff via computer-mediated communications (CMC) such as discussion forums and online chat.

Additionally, because the LMS automatically logs data related to student online interactions, there is an opportunity for extracting explicit information about the student social network. Dawson (2006a; 2006b; 2007) has demonstrated the value of data-mining institutional LMS for enhancing teaching practice. This work highlights the benefits associated with analysing LMS data in order to establish pedagogical lead indicators that can assist educators in assessing teaching practices in a proactive and timely manner. In this regard, LMS data can be a pedagogical design tool, not just an evaluation tool.

More recently, Dawson (2008, in press) has investigated the capacity for extracting LMS derived data to form a representation of the student social network (Figure 2). While Dawson relates the SNA findings to students' perceived sense of community rather than creative capacity *per se*, the study does demonstrate the usefulness of ICT data in informing and guiding educators in the implementation and evaluation of their teaching practice. Furthermore, the study demonstrates that it is possible to extract LMS data to form opportunistic representations of the student social network. As the data is tracked over time, an examination can be generated of the evolving social network and the individual position students occupy within the network at key trigger points. This data can then be used to inform the implementation of the creativity-centric pedagogical practice. As a feedback mechanism, this type of observation makes for proactive, scalable, ongoing, unobtrusive and naturally occurring pedagogical activity as a result of the events and interactions in the online environment.

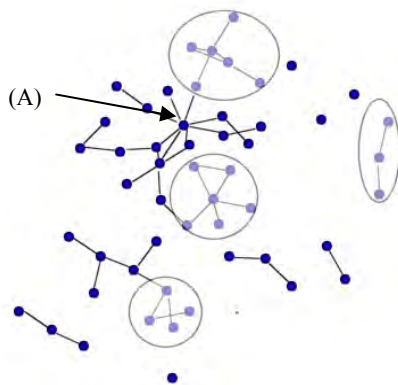


Figure 2: Sociogram of student discussion forum interactions. Clusters of small team student networks and a student (A) occupying a linking position are illustrated.

The generation of the student sociograms allows for the identification of individual students linking potentially disparate clusters into a networked community. McWilliam and Dawson (2008) have described these individuals as 'border crossers'. Border crossers demonstrate the enterprise and agility required for bridging the network gaps and introducing new knowledge, ideas and processes to the larger network. The identification of these individuals and the changing dynamics of the social network can differentiate some of the creative capacities developing within the student cohort. Educators can use this evidence to alter their learning and teaching activities and then observe any effective changes in network behaviour.

VISUALISING NETWORKS

A current international collaborative projectⁱ between Queensland University of Technology (QUT, Australia) and the University of British Columbia (UBC, Canada) is investigating the application of data derived from student online interactions to inform learning and teaching practices. Early research has led to the development of a prototype social networking visualisation toolⁱⁱ that extracts discussion forum data to build a representation of the learning network (social network analysis). This network visualisation can be generated at any stage of course progression thereby providing a timeline of engagement, or insight into any observable differences after a particular learning activity. Thus, the resource can be adopted to evaluate the impact of implemented pedagogical practices designed to promote student collaboration and networking capacity. Below we see examples of such networks in action.

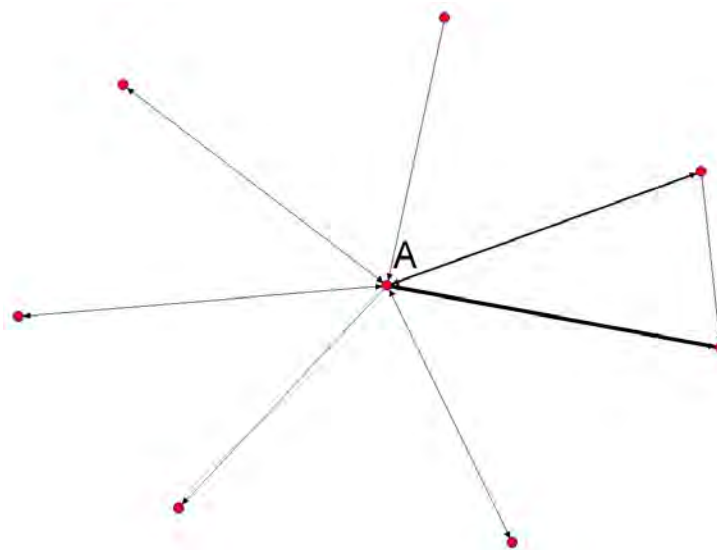


Figure 3: Sociogram of student discussion forum interactions. The sociogram illustrates the minimal level of student social interactions and the dominant role of the instructor (A). Thicker lines depict a greater number of interactions between those individuals.

Figure 3's 'wagon-wheel' social dynamic illustrates the absence of network connections established among the student cohort in the implemented discussion forum. In this instance, the exchange of ideas and information has

been driven by (and therefore focus on) the instructor. This we consider less likely to be productive of students' creative capital than Figure 4, the latter being evidence of a more complex and active student-driven network.

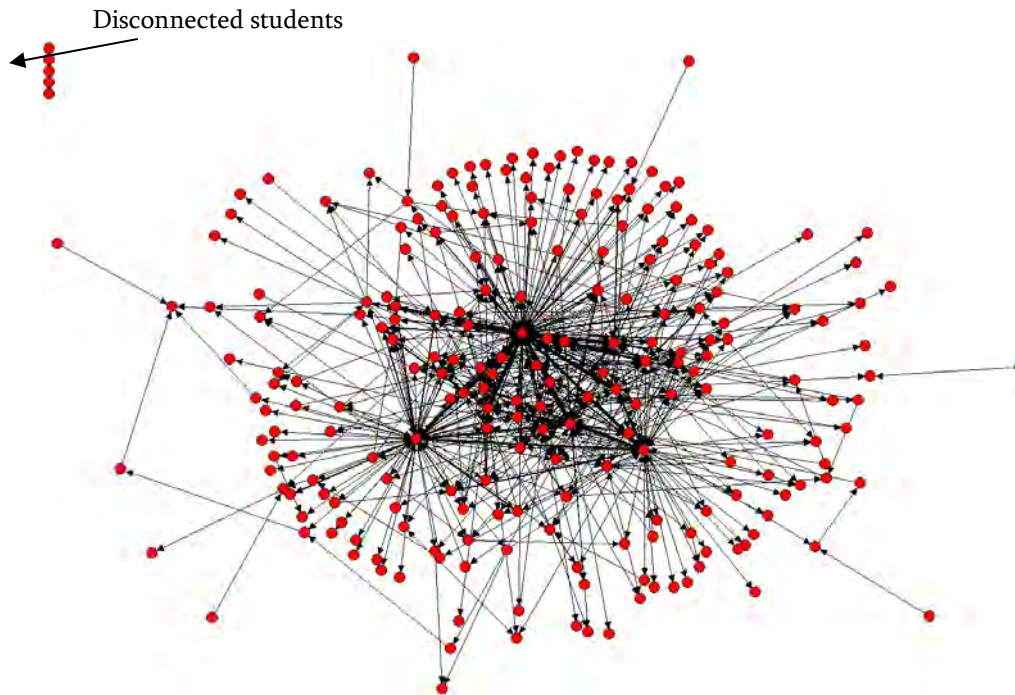


Figure 4: A second sociogram of student discussion forum interactions. The diagram highlights the capacity to identify central nodes driving discussion and dissemination as well students disconnected from the network.

DISRUPTING FLOCKING BEHAVIOUR

A key feature of the social network visualisation is the ability to observe the direct ties individual students generate. This affords educators the opportunity to challenge and implement strategies designed to combat potential occurrences of homophily. As previously highlighted, the development of creative capacity is contingent upon establishing networks of diversity. However, similarities also actively promote connections (McPherson, Smith-Lovin, & Cook, 2001). Similarity in terms of occupations, demographics, and more recently academic performance also problematise the active generation of diversity.

The QUT/UBC project investigated instances of homophily in academic performance within a large first year university class (N= 1026). More simply put, the project examined whether high performing students interact with a diversity of flockmates or conversely establish smaller homophilic local neighbourhoods. The ego-networks (individual ties) for the top and bottom five-percentile groups in terms of academic performance were identified using social network visualisation of the student mediated discussion forums. The preliminary results indicate that homophily in academic performance occurs. High performing students flock with other high performing students (Figure 5). Similarly, low performing students tend to also flock with other low performing students (Figure 6). The ability to identify the flockmates of individual students assists educators in developing learning and teaching activities that can aid in breaking down potential inhibitors to establishing networks and connections with more

diverse peers. That is, teachers can actively intervene to encourage low performing students to extend their networks, rather than simply flocking together or remaining isolated from their higher performing peers.

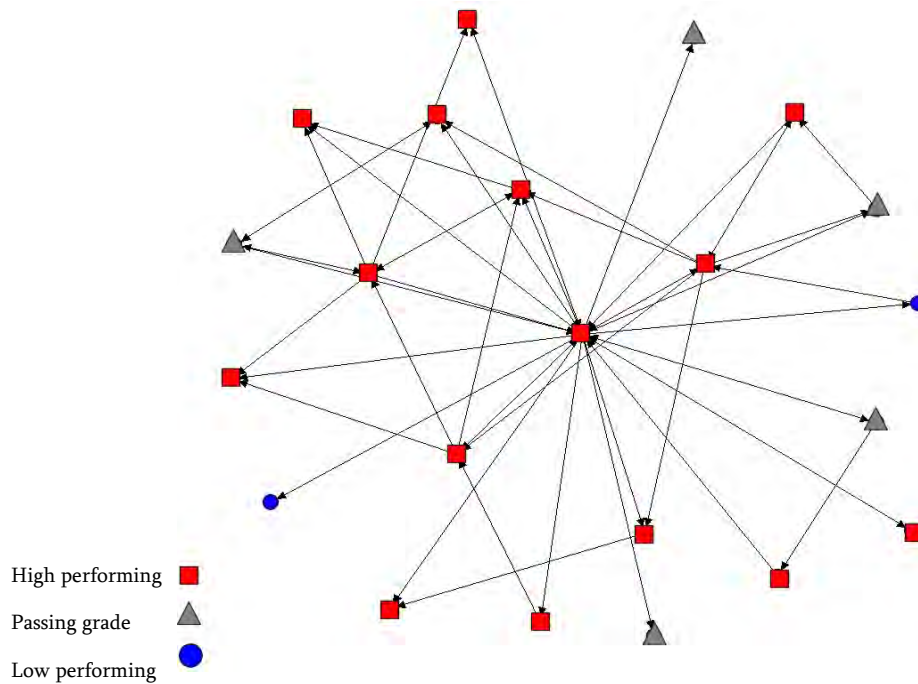


Figure 5: An example of an ego-network of an identified 'high performing' student (95 percentile group).

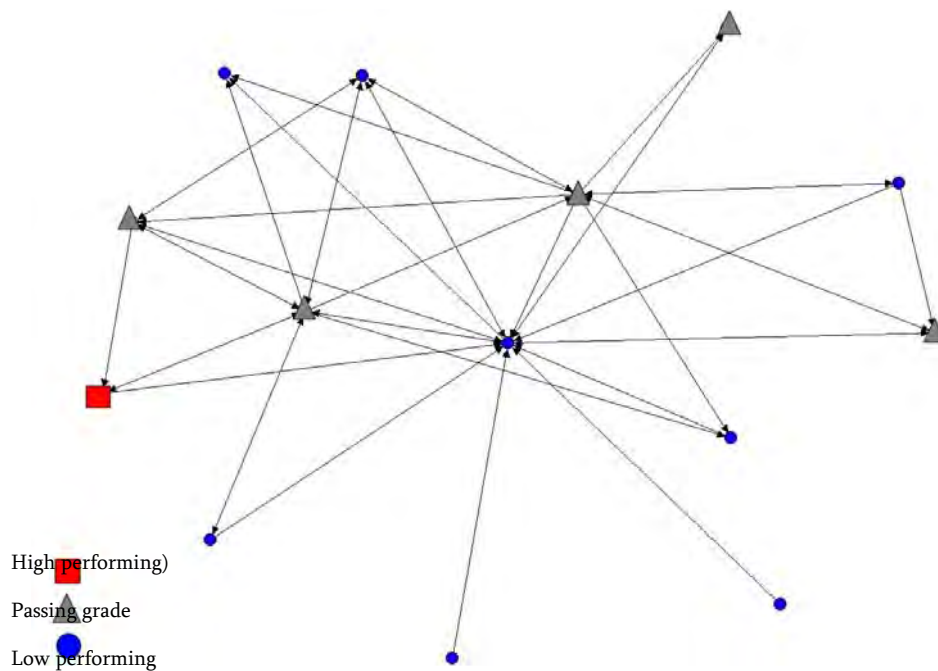


Figure 6: An example of an ego-network of an identified 'low performing' student (5 percentile group).

LEARNING AND CREATIVE CAPACITY

Evidence of students' capacity as agile networkers is, of course, only one way that we can make our pedagogical processes of creative capacity building visible. Another that is equally important is the capacity, as John Howkins (2001) puts it, to 'learning endlessly' (p.156), rather than relying on networks alone to deliver all the ideas that might be useful. Thus the disposition to learn endlessly – to borrow, to innovate, to take risks, to discover – is of great significance. Yet despite all the rhetoric to the contrary, it is a disposition that is often a casualty of formal education, rather than its product.

Before seeking evidence of the presence or absence of a learning disposition of the sort that Howkins advocates, we need to know more about how to characterise it. It is understandable that many of us may well see a learning disposition as evidenced by high academic achievement. However, social psychological researcher and educator, Carol Dweck, cautions us not to think of a learning disposition in this way. She makes a clear distinction between learning goals and performance goals as mobilisers of student action. As she puts it, an individual's performance goals are focused on 'winning positive judgment of your competence and avoiding negative ones', while an individual's learning goals are characterised by a desire to 'develop new skills, master new tasks or understand new things' (Dweck, 1999, p.15).

In Dweck's research on the performance and learning activities of young people, *performance goals* and *learning goals* were found to be present in most of these individuals in about a 50/50 ratio. They can, however, be manipulated by external social conditions or an influential significant other (e.g., a parent, trainer or teacher). When an intervention occurs, the students for whom learning goals are paramount continue to seek new strategies and to tolerate error without self-blame, while those who are performance-driven are more likely to give up on the task set, berating themselves for their inability to complete it. In other words, although both types of goals can lead to high achievement, generally, learning goals-oriented individuals tend to exhibit more adaptive responses to complexities and challenges, (a highly desirable attribute in the postmillennial creative economy), while performance goals-oriented individuals have a higher tendency to feel overwhelmed by their inability to 'get the right answer' and experience intellectual paralysis in the face of challenging problems that encompass multiplicity and ambiguity.

As McWilliam (2008, in press) has commented, it is much more useful for students to see strategising as 'serious play' rather than hard work that can be done through routine thinking and doing. This disposition to *play* with ideas – to hold large numbers of associations together in the mind, and imagine the interesting possibilities that arise from making novel associations – is argued by Kane, Pink and others to be a key creative capacity (Florida, 2002; Kane, 2005; Pink, 2005). As explained by psychologist Teresa Amabile and her colleagues (Amabile, Hadley, & Kramer, 2002):

It's as if the mind is throwing a bunch of balls into the cognitive space, juggling them around until they collide in interesting ways. The process has a certain playful quality to it... If associations are made between concepts that are rarely combined – that is, if the balls that don't normally come near each other collide – the ultimate novelty of the situation will be greater. (p.53)

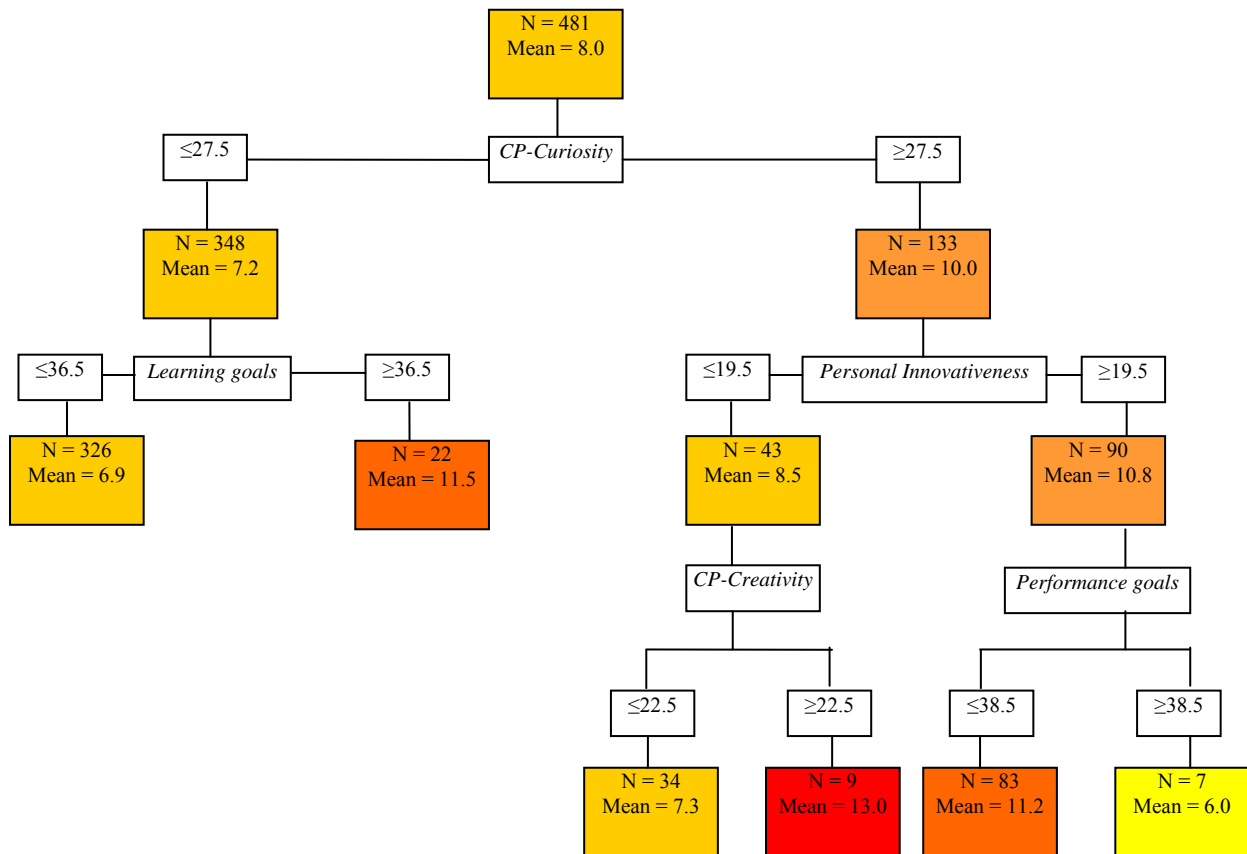
LEARNING THROUGH COGNITIVE PLAYFULNESS

'Ultimate novelty' is one way of characterising creativity, and is thus a crucial product of play. The capacity for serious intellectual play – for throwing concepts into the air – is what Jennifer Pei-Ling Tan (2008) has termed cognitive playfulness. Cognitively-playful individuals have a predisposition to curiosity, inventiveness and the desire to play with novel ideas and innovations, and this can result in increased levels of personal innovativeness and individual learning. In her study of student's learning dispositions (Tan, 2008; Tan & McWilliam, 2008), Tan construes cognitive playfulness as having two dimensions – intellectual curiosity (or level of inquisitiveness) and intellectual creativity (or level of imagination and spontaneity). Both of these dimensions emerged as highly significant in explaining the extent to which students take up new opportunities for extending their learning in school.

Below we present the research design and mode of data collection in the Tan study that fleshes out cognitive playfulness as a key knowledge object for developing creative human capital. The study included an extensive quantitative self-reported student questionnaire administered to a senior school student population of approximately 600 students. This student questionnaire was implemented in mid-2007, by which time a student-led online media centre had been in operation for approximately one year. The numeric data from the questionnaire pertinent to this paper include socio-psychological scales that measure students' learning dispositions (including their achievement goal orientations, levels of cognitive playfulness and personal innovativeness) and their usage behaviours related to the Student Media Centre (SMC), in terms of volume and frequency of use. In simple terms, Tan wanted to know what was or was not mobilising these students to take up the new opportunities for learning endlessly afforded by the Centre.

A Classification and Regression Tree (CART) technique of analysis¹ was used, as developed by Briemann and colleagues ((Briemann, Friedman, Olshen, & Stone, 1984) more than two decades ago for predictive modelling of non-parametric datasets that is widely used in fields as diverse as econometrics, finance and banking, international relations and social welfare policy (Bridgstock, 2007; Furnkrantz, Petrak, & Trappl, 1997; Gibb, Auslander, & Griffin, 1993; Yohannes & Webb, 1999). This statistical technique allowed analysis of the relationships between students' *learning dispositions* (predictor variables) and their levels of *usage* of the SMC (target variable). The learning dispositions measured include *learning and performance goals* and *cognitive playfulness*, as well as *personal innovativeness*, which is in turn closely related to the concept of *cognitive playfulness* and commonly defined as "one's willingness to change, an openness to new experiences and the propensity to go out of one's way to experience different and novel stimuli particularly of the meaningful sort" (see, for example, (Hurt, Joseph, & Cook, 1977; Leavitt & Walton, 1975; Rogers, 1995). Measurement scales incorporated self-developed items as well as adapted items from previously validated studies in the field, and reported strong reliability and validity test resultsⁱⁱⁱ.

Figure 7 provides a visual representation of the decision tree modelling results that demonstrate the extent to which learning dispositions influence the students' usage of the media centre to further their learning opportunities and extend their learning experiences in school.



Model $R^2 = 25.0\%$

Where:

- Mean SMC Usage ≤ 6.0 (very low)
- Mean SMC Usage ≥ 6.1 but ≤ 8.5 (moderately low)
- Mean SMC Usage ≥ 8.6 but ≤ 11.0 (moderate)
- Mean SMC Usage ≥ 11.1 but ≤ 12.9 (moderately high)
- Mean SMC Usage ≥ 13.0 (high)

Figure 7: Optimal Decision Tree 1: Individual Learning Dispositions (predictors) and SMC Usage (target)

This optimal decision tree predicting SMC usage demonstrates a reasonable level of explanatory power, where the predictor variables explain 25% of the variance in the target variable.^{iv} Results of the decision tree model show that, first and most importantly, cognitive playfulness (in terms of intellectual curiosity) was the primary splitter variable and strongest predictor of SMC usage. In other words, students who exhibited higher levels of intellectual inquisitiveness, which is a learning disposition that causes them to ‘explore and *play* with a problem until it is solved’ (see (Dunn, 2004; Glynn & Webster, 1993) were most likely to engage with the SMC learning innovation to a large extent, when compared with the general student population. Second, students who exhibited higher levels of cognitive playfulness in terms of both intellectual curiosity and intellectual creativity, relative to

their peers, emerge as the learner category that reports the highest usage of the SMC (mean=13.0). On the other hand, students who reported low levels of engagement with the SMC (mean=6.0; 7.2; 7.3) exhibited relatively low levels of cognitive playfulness (both intellectual curiosity and creativity) and learning goals-orientation. This finding underscores the importance of cognitive playfulness as a learning disposition that motivates individuals to engage with and embrace novel situations and inventions, a propensity that is a vital component of creative capacity.

Two other interesting trends emerge from the results of Decision Tree 1, which call attention to the value of being healthily learning-oriented rather than merely performance-focused. Specifically, the profile of the lowest SMC user-group (mean=6.0) suggest that despite possessing an above-average level of cognitive playfulness and personal innovativeness, an individual who tends towards being highly performance-driven, may value performing in ways that overwhelm the former learning dispositions, and this in turn may well be a barrier to the individual's capacity to experiment with new ideas, innovations and learning opportunities. On the contrary, as indicated by the profile results of the second-highest SMC user-group (mean=11.5), individuals who may not be particularly dexterous or agile in the cognitive domain but exhibit robust levels of learning-orientation, may nonetheless be open to experiencing new ways of living and learning by engaging with innovative technologies available to them. Once again, they may be able to self-fashion in ways that incorporate both academic achievement and new strategies for learning.

Overall, Tan's results show that individuals who are intrinsically motivated to learn new things and acquire new skills are likely to appreciate the opportunities presented by innovations such as online and/or digital tools to extend their range of abilities and competencies. By contrast, individuals who are primarily focused on 'getting the right answer' and winning positive judgments of their competence while avoiding 'looking dumb', are likely to resist experimenting with new learning technologies that challenge the comfort zones of traditional pedagogical practices. This resistance or unwillingness to take on new ways of learning and engaging may militate against the sort of robust learning disposition needed for 21st century digital-age lifeworlds characterised by forces of rapid change, shifting and multiple identities, and exponential technological advancements and growth.

CONCLUSION

The research examples detailed above constitute an embryonic investigative foray into the interface of pedagogy, creativity, and empiricism. In doing so, they move us on from endless rehearsals of the creativity-versus-objectivity binary that have proven to be such a cul-de-sac on our thinking about how to make teaching-for-creativity claims that really stick.

Creative capacities, as indicated earlier, are characterised by a wide and diverse range of *thinking* and *doing* skills. They include both individual cognitive capacities and the agility needed to move quickly across and within numerous social networks to re-purpose information for new audiences. We have shown that it is possible to investigate a highly relevant learning disposition in the thinking of individual students – i.e., cognitive playfulness - and also to identify and monitor the creative doing of students through tracking small team networks and the social movement individuals who bridge network gaps.

But the above research does more than this. It provides us with a new generation of vocabularies for *speaking* creative capacity building. In doing so it is responsive to John Seely Brown's (2006) more general call for a shared language through which it is possible to speak meaningfully about processes of creative cultural production. We cannot bring the next era of capacity building into being without a new language to name it. Brown advocates a different vernacular for speaking the student's ability to be creative – to cut and paste words, images, sounds, artefacts and ideas in new and meaningful ways – to store, apply and then discard them when no longer useful. Along with Brown, we would highlight the need to probe the ways that teachers think about the pedagogical processes they use to address complex learning problems, including their ability to evaluate critically the efficacy of their strategies, and to engage meaningfully with their students and their colleagues in that process of critical evaluation.

In assisting teachers to 'see' their students actively networking, building and re-building their neighbourhoods of flockmates, in helping them to understand what cognitive playfulness is and how it is often stifled by narrow notions of academic performance, in encouraging them to use digital tools, not just as a means for disseminating information or storing it, but for designing smarter pedagogical processes, the paper seeks to make a contribution toward warranting claims that we are building creative capacity in our schools and universities, and providing a more robust language for doing so.

END NOTES

- i. Project is funded by the Australian Learning and Teaching Council.
- ii. The social network script for extracting LMS discussion data was developed by Aneesha Bakharia and Shane Dawson.
- iii. A detailed discussion of the CART statistical technique, as well as scale validation procedures and results are beyond the scope of this paper but can be made available to interested readers on request.
- iv. In the field of innovation adoption and diffusion studies where the target variable measures *actual usage* rather than the *usage intentions*, this R^2 value of 25% represents a reasonably significant percentage of variance explained in the target variable, particularly when only individual-level factors have been taken into consideration for the purpose of this paper. In comparison, a landmark innovation adoption predictive model proposed by (Chwelos & Benbasat, 2001) which considered a range of individual, technological and institutional factors reported an R^2 value of 32%, which is marginally higher than that reported in the decision tree model discussed in this paper. The full predictive model of innovation usage developed and tested in Tan's study incorporating systemic factors reported an R^2 value of 54%.

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