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Author	Erica McWilliam, Shane Dawson and Jennifer Pei-Ling Tan
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Researching Creative Learning: Methods and Issues

Less elusive, more explicit:
The challenge of `seeing' creativity in action

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Introduction

Creativity has always had an association with the social sciences *in spirit*; however, we are now well into a decade in which creativity is being understood as a powerful *body* of ideas for driving economic and social change. Recent research (see Kaufman & Sternberg, 2007; McWilliam, 2008) has unhooked creativity from artistry, revealing it as economically valuable team based, observable and *learnable*. As the ability to 'move an idea from one state to another' (Jackson, 2006a: 8), creativity is argued by David Perkins (1981) and others to be evident in skills such as pattern recognition, creation of analogies and mental models, the ability to cross domains, exploration of alternatives, and problem solving. It has displaced routine 'industrial' thinking and doing as the most relevant workplace capacity in an increasingly complex, challenge-ridden and rapidly changing economic and social order. In Mihaly Csikszentmihalyi's (2006) terms, creativity is 'no longer a luxury for the few, but a necessity for all' (p. xviii).

For the widespread dissemination of this 'second generation' thinking about creativity we can thank post-millennial economic and social analysts such as John Howkins, Charles Leadbeater, Stuart Cunningham, Mihaly Csikszentmihalyi, Teresa Amabile, John Hartley and Richard Florida. They have built in double-quick time a set of understandings of creativity that have moved it on from the romantic province of arts-based idiosyncratic genius into the cut and thrust of innovative entrepreneurship. Most prominent among them has been Richard Florida, whose *Rise of the creative class* (2002) generated much intellectual ferment around the nexus between creativity and productivity at the turn of this century. While debates continue, as they should, around the extent to which Florida's claims are overblown in relation to the factors influencing the rise of a 'creative class', nevertheless his insistence on creativity's centrality to productivity – '[p]laces that succeed in attracting and retaining creative class people prosper; those that fail don't'[1] – is a message that has resonated worldwide. It has seen policy makers at all levels rushing to discover what new combinations of skills count as 'creative' and how more precisely they can turn into real economic advantage in the form of new business opportunities and regional growth.

The growing trend to value creative and relational capacities over narrow instrumental skills is reflected globally, with employers seeking 'multi-competent graduates' (Yorke, 2006, p. 2) who have 'high-level expertise … emphasizing discovery and … exploiting the discoveries of others through market-related intelligence and the application of personal skills' (p. 5). Underneath these trends is a more fundamental recognition that productivity in the twenty-first century requires 'a deep vein of creativity that is constantly renewing itself' (NCEE, 2007, p. 10). This sort of creativity is not limited to the creative industries but includes all those employed in a wide variety of professional work, including computing, engineering, architecture, science, education, arts and multimedia.

The burgeoning interest in creative capacity building in and through formal education is an outcome of this new 'creative' imperative in professional work, but it is also a response to evidence about the new ways that young people learn (Hartman, Moskal, & Dzuiban, 2005; Seely Brown, 2006). A report issued by the European University Association (2007) directs the sector to consider 'creativity' as central to their research and their teaching:

> The complex questions of the future will not be solved 'by the book', but by creative, forward-looking individuals and groups who are not afraid to question established ideas and are able to cope with the insecurity and uncertainty that this entails.
>
> (p. 6)

The problem that now bedevils educators is not that creativity needs to be 'sold' as an educational outcome. Indeed, as Norman Jackson (2006a) sees it, creativity in education is omnipresent but is not taken seriously in designing systematic approaches to teaching and learning. In other words, while glossy brochures for attracting enrolments from the brightest and best trumpet creativity as a valued graduate attribute, teaching-for-creativity is 'rarely an explicit objective of the learning and assessment process' (p. 4). This is a problem that is born, in part, out of the lack of imagination that underpins what it is that we see as worthy of assessment, and, thus, the means by which we go about the business of designing instruments for assessment and evaluation of educational outcomes. Put bluntly, creativity is, in educational terms, the emperor's new clothes: admired but never actually seen.

Creativity research as 'unscientific'

While we do not intend to expand here on the historical development of theories about what makes for 'effective' educational assessment, it is important to acknowledge the power of the scientific tradition of validation through measuring test results. This tradition ties any and every evidentiary claim to laws that allow generalizable explanation or prediction. The core business of this tradition has been to offer principles, practices and types of evidence through which credibility is established using numbers ad their interpretation. As a method for validating evidentiary claims, quantitative inquiry questions all approaches that researchers might adopt that fall outside this logic. Numerical scores allow quantitative researchers to make comparisons between like others, and this makes them valuable to educational leaders and policy makers who want to know how individuals and groups compare when ranked in terms of a particular skill – for example, literacy or numeracy. The rankings that can be produced provide a rationale for funding certain projects and refusing or cutting funding to others. In other words, a high ranking on desirable skills is *the* 'valid' measure of quality educational outcomes.

The hegemony of measurement in and for scientific validation has weakened any credibility that 'alternative' approaches might have by marginalizing them as 'cases where the common interpretation and validity inquiry do not hold' (Moss, Girard, & Haniford, 2006, p. 112). Indeed, as Rob Cowdroy and Erik de Graff (2005) understand it, the dominance of measurement as the means of validation has obliterated any chance of 'seeing' creativity altogether:

> 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)

It has only been in relatively recent times that some wiggle room has been opening up in relation to 'seeing' creativity in action. There has been a breakthrough of sorts from the widely held view that creativity is too vaporous and multidimensional to be amenable to empirical scrutiny. This came with the insistence of both Teresa Amabile (1996) and Mihaly Czikszentmihalyi (1999) that creativity is better understood as a process that occurs *outside* an individual rather than being the mysterious product of an unknowable inner world. With creativity exteriorized theoretically, it has become possible for independent observers to agree that what they are observing either is or is not creative. This has paved the way for developing criteria through which we can formalize systematic observations into an evidence base through which the processes of building creative capacity can be 'seen' to be operating. This means that, while simplistic quantification measures will continue to be unhelpful in any systematic inquiry into creativity in action in education, we can and should be taking cautious 'scientific' steps towards 'seeing' creative capacity building in action.

'Creatives', according to Richard Florida (2002), spend little time on routine problem solving using conventional knowledge. Instead, they focus on interactivity, navigation capacity, forging relationships, tackling novel challenges and synthesizing 'big picture' scenarios for the purposes of adding a competitive commercial edge to an organization or business. Moreover, they are more likely than other workers to be located in digitally enhanced environments (including 'home' or 'garage' environments). With few transportable templates for project design, they *unlearn* 'solutions' to higher-order problems as quickly as they learn them (see McWilliam, 2005), so they can quickly jettison ideas and formulae that do not 'add value'.

All this demands mental agility but it also demands a capacity to move, either literally or virtually, to where the action is, and away from where the action was. In what follows, we report on two studies that address each of these capacities – an agile learning disposition and an advanced capacity for social networking – in turn, showing how such capacities may become more visible without doing violence to the complex social processes through which creativity may be fostered.

'Seeing' creative learning dispositions

The capacity for engaging in creative thinking and doing – serious intellectual play that throws concepts into the air – is what Jennifer Pei-Ling Tan (2008) has termed cognitive playfulness. Her study of cognitively playful individuals shows them to have a predisposition to curiosity, inventiveness and the desire to play with novel ideas and innovations, all of which can result in increased levels of personal innovativeness and individual learning. In her inquiry into students' learning dispositions (Tan, 2008; Tan & McWilliam, 2008, 2009), she posits cognitive playfulness as having two dimensions: intellectual curiosity (or level of inquisitiveness) and intellectual creativity (or level of imagination and spontaneity). Both dimensions emerged in her study as highly significant in explaining the extent to which students are predisposed to take up 'creative' learning opportunities in their formal schooling.

Tan's mixed-methods study design incorporated a quantitative self-report student questionnaire administered to a senior school student population of approximately 600 students. The questionnaire was implemented in mid-2007, by which time a new student-led digital learning innovation, known as the Student Media Centre (SMC), had been in operation for approximately one year. The SMC was endorsed by school leadership and designed and implemented by a group of student leaders to provide their fellow students with opportunities to create and to learn, in ways that go beyond what was afforded by the dominant model of transmission-based, exam-oriented classroom learning and teaching activities at the school.[2] The numeric data from the questionnaire pertinent to this chapter included socio-psychological scales that measured students' learning dispositions and their usage behaviours related to the new SMC. Simply put, Tan wanted to know what learning dispositions underlay students' varying levels of engagement with the SMC learning innovation as part of their schooling practice.

A classification and regression tree (CART) technique of analysis[3] (Briemann, Friedman, Olshen, & Stone, 1984) was used to inquire into the statistical relationships between students' learning dispositions (predictor variables) and their levels of usage of the SMC (target variable). The learning dispositions measured include *cognitive playfulness* and two other dispositional constructs: *personal innovativeness* and *achievement goal orientations. Personal innovativeness* is 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' (Leavitt & Walton, 1975; Rogers, 1995). *Achievement goal orientations* is defined in terms of two sub-dimensions, *learning goals* and *performance goals*, following social psychologist Carol Dweck's (2000) work on self-theories. Dweck's inquiry into the paradoxical nature of educational outcomes gave rise to her distinction between an individual's *performance goals* (focused on 'winning positive judgments of your competence and avoiding negative ones') and *learning goals* (characterized by a desire to develop 'new skills, master new tasks or understand new things'; pp. 16-19). Dweck expressed concern that when young people prioritize their performance goals in ways that negatively impact on their learning goals, it can lead to the sort of fixed mindset that seeks to avoid the challenge of learning through experimentation and play.

Measurement scales for the variables of interest described above, which consisted of both self-developed items and items adapted from previously validated studies, reported strong reliability and validity for test results.[4] Figure 1 provides a visual representation of the statistical results that demonstrate the extent to which learning dispositions influenced the students' usage of the media centre to further their learning opportunities and extend their learning experiences in school into more 'creative' learning options.

The results reported in Figure 1 can be interpreted as follows. First, all the individual-level variables (i.e. *learning goals, performance goals, cognitive playfulness* and *personal innovativeness*) emerged as significant predictors that together explained 44 per cent of the variance in the target variable SMC usage. Second, the predictor variable that emerged as the first child node, positioned at the top of the tree (Cognitive Playful: Curiosity), is referred to as the primary or best splitter variable for this optimal solution, and is, therefore,

the strongest predictor of SMC usage. The CP: Curiosity cut-off score of 27.5 partitioned

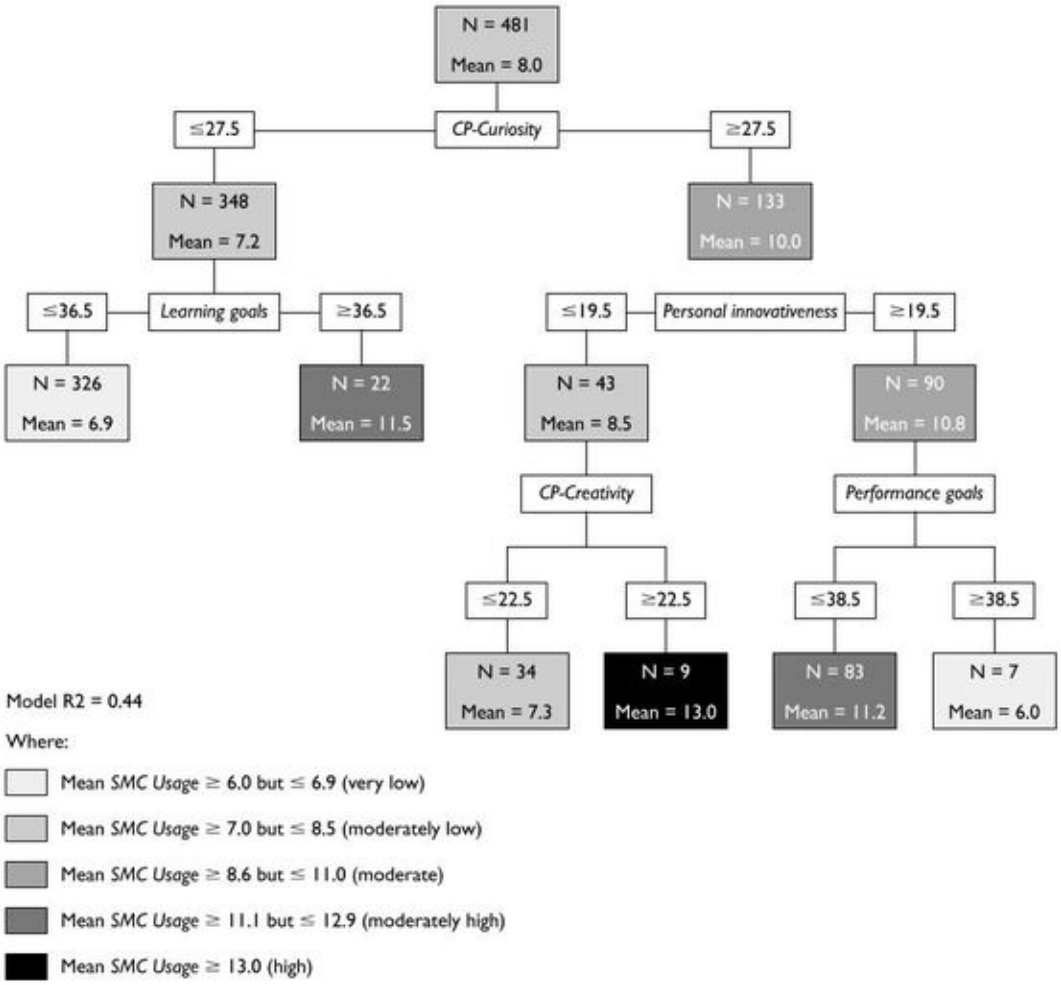

Figure 1: Optimal decision tree: learning dispositions and Student Media Centre usage.

the student respondents into two groups: 'low cognitive curiosity' ("27.5) and 'high cognitive curiosity' (≥27.5). The 'low cognitive curiosity' group consisted of 348 students and yielded a predicted mean SMC usage value of 7.2 (moderately low; SD = 5.1). The 'high cognitive curiosity' group consisted of 133 students and yielded a predicted mean SMC usage value of 10.0 (moderate; SD = 6.5).

The 'low cognitive curiosity' group was split further into two groups according to their learning goals orientation: 'low learning goals' ("36.5) and 'high learning goals' (≥36.5). The 'low learning goals' group consisted of 326 students and yielded a predicted mean SMC usage value of 6.9 (very low; SD = 4.8). The 'high learning goals' group consisted of 22 students and yielded a predicted mean SMC usage value of 11.5 (moderately high; SD = 6.6). *Learning goals* therefore emerged as a variable that had mediating effects on the relationship between cognitive curiosity and SMC usage. If a student was low in *cognitive curiosity* but high in *learning goals*, then they would still engage with the SMC to a comparatively high degree. On the other hand, students who reported very low levels of SMC usage ranked low on both *cognitive curiosity* and *learning goals.*

In sum, these results suggest that, first and most importantly, *cognitive playfulness* in terms of intellectual curiosity is the best predictor of SMC usage. In other words, students who exhibited higher levels of intellectual inquisitiveness – a learning disposition that mobilizes 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 creative affordances of the digital learning innovation to a larger extent when compared with the general student population. Second, students who exhibited higher levels of cognitive playfulness relative to their peers, in terms of both intellectual curiosity and intellectual creativity, emerged as the learner category that reported the highest usage of the SMC (mean = 13.0, SD = 5.8). On the other hand, students who reported low levels of engagement with the SMC (mean = 6.0, 6.9, 7.3; SD = 6.1, 4.8, 5.1) 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 disposition that is a vital component of creative capacity.

Two other interesting trends emerged from the results shown in Figure 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, SD = 6.1) suggests 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, SD = 6.6), individuals who may not be particularly dexterous or agile in the cognitive domain but exhibit robust levels of learning goals 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 twenty-first-century digital-age life-worlds characterized by forces of rapid change, shifting and multiple identities, and exponential technological advancements and growth.

‘Seeing’ agile networking

As much as Tan’s study begins to put meat on the bones of empirically assessing creativity at an individual level, there still remains the problem of developing methodologies for evaluating and identifying creativity within the collective. To assist us in the task, of identifying creativity, there is an emerging consensus within the research literature that the skills and attributes associated with creativity relate to originality, imagination, communication, seeing connections, problem solving and team and individual leadership (Tierney, Farmer, & Graen, 1999; Robinson, 2000; McWilliam, 2008; Burt, 2004; Jackson, 2006b). Interestingly, most of these skills and attributes are focused on the importance of teamwork and developing opportunities for interactivity. Simply put, creativity as a process is enhanced through sustained interactions within a collective of active, agile and enterprising networkers.

Recent research in social networks has much to offer in terms of identifying the key individuals, attributes and relationships that are commonly associated with the process of creativity (Tepper, 2006). For instance, sociologist Ronald Burt (2004) has demonstrated that individuals located in key positions within an organizational network (see Figure 2) have greater and earlier access to information and resources than their less strategically connected peers. In Ronald Burt’s terms, individuals located within these key brokering positions have opportunity ‘to see early’ and ‘see more broadly’ the information and resources accessible throughout the whole network. Thus, individuals occupying these brokering positions have access to ‘a vision of options’ that are ‘otherwise unseen’ (Burt, 2004, p. 354).

individuals, attributes and relationships that are commonly associated with the process of creativity (Tepper, 2006). For instance, sociologist Ronald Burt (2004) has demonstrated that individuals located in key positions within an organizational network (see Figure 11.2) have greater and earlier access to information and resources than their less strategically connected peers. In Ronald Burt’s terms, individuals located within these key brokering positions have opportunity ‘to see early’ and ‘see more broadly’ the information and resources accessible throughout the whole network. Thus, individuals occupying these brokering positions have access to ‘a vision of options’ that are ‘otherwise unseen’ (Burt, 2004, p. 354).

Figure 2: Example social network – illustrating an individual (A) occupying a key brokering position with the network.

The actors occupying these network positions are essential for building creative capital within the organization. This manifests through their ability both to control knowledge dissemination in more value-adding ways and to form new ‘boundary spanning relationships’ (Geletkanycz & Hambrick, 1997, p. 654) within and external to the existing organization. It is for this reason that the identification and monitoring of social networks and the actors who bridge network gaps (i.e. brokering roles) are central to our understanding of creative capacity.

In empirically demonstrating the relationship between creativity and social networks, Burt's work has provided a foundation for developing the necessary tools for visualizing and evaluating creativity in process. The identification of the network at large and the individuals occupying certain roles and positions provides a valuable quantifiable set of indicators for determining creativity in action. In the education context, creativity may be evidenced in the positions students hold in their various peer networks and the artefacts that evolve from learning and teaching practices that promote student-to-student interactivity. The application of social network analysis within the field of education can start to develop more quantitative – and therefore explicit – evidence of creativity, while also providing opportunity for evaluating the learning and teaching activities that are designed to foster creative capacity more generally.

Harvesting student interactions

Although social network analysis provides a sound methodology for evaluating creativity, the identification and subsequent capturing of the network relationships are complex and time-consuming. This is further complicated as the network size grows and when relationships are established beyond the organizational environment (Brooks, Hansen, McCalla, & Greer, 2007). Thus, it represents a complex challenge for educators attempting to evaluate the impact of any learning and teaching activity designed to promote creativity through the development of student networking agility. However, a solution to this impasse may be found in the increasing adoption of information and communication technologies (ICT) across the education sector.

At a global level, universities have been increasingly adopting various ICTs to supplement or entirely replace prior traditional models of teaching delivery. For example, learning management systems (LMS) such as BlackBoard, Moodle and Sakai are increasingly a core component of the student learning experience. These systems have been largely adopted for the provision of more flexible opportunities to access content delivery and engage and interact with peers regardless of time or place. While there are a high number and diversity of tools available within any given LMS, Macfadyen and Dawson (2010) demonstrate that the discussion forum is the primary resource by which educators aim to develop more online socially engaging learning activities. Consequently, any study relating to student social networks, or online learning communities, will commonly include discussion forum archives as an essential data source.

The common reliance on discussion forum data is in part due to the readily attainable archived discussion via the recorded LMS logo. A key feature of all LMS is their capacity to track and record student interactions. Thus, the captured logs associated with a specific teaching unit can be harvested in order to provide a representation of the student social network that has developed through the peer-peer discussion forum interactions. Dawson (2006a, 2006b, 2007) has previously discussed the pedagogical benefits that can be leveraged from the analysis of student LMS activity logs. For example, he demonstrates how student discussion forum activity can be used to reconstruct visualizations of the social network. His study identified a relationship between student sense of community and an

individual's learning network position. The constant interrogation of the evolving LMS data can be readily used to inform educators of the levels of student interaction and engagement, and provide proactive and timely lead indicators of individual student skills and attributes in action.

In building on this prior research, Dawson has been involved in further developmental work[5] to design the necessary tools and resources for teachers to reconstruct the extracted LMS log data into more readily interpretable formats for reflection and action (see Figure 3). The visual generation of the student social networks, or sociograms, provides for rapid identification of students who are central to the network, peripheral and disengaged, or linking previously disparate clusters into a networked community (See Figure 3). These linking students are critical for uniting these prior fragmented clusters of small-world networks into a broader, more substantial community. This provides greater opportunity to draw upon the resources, information and strengths of the entire collective. In elaborating upon the types of pedagogical models that enhance creativity, McWilliam and Dawson (2008) have described these pivotal individuals as 'border-crossers'. They note that border-crossers commonly display the enterprise and agility skills necessary for bridging network gaps (or, as Ronald Burt has termed them, structural holes) in order to fertilize the broader network with new ideas, knowledge and processes. Through these visualizations, educators can start to identify the key networked individuals and the changing dynamics of the network in order to distinguish indicators of creative capacity that are developing within the student cohort. Importantly, this process of extraction and visualization of student behaviour provides an instrument for evaluating the impact of implemented learning and teaching activities. Educators can observe network behaviour and then design future learning interventions informed by the actual student behaviour and the developing network properties.

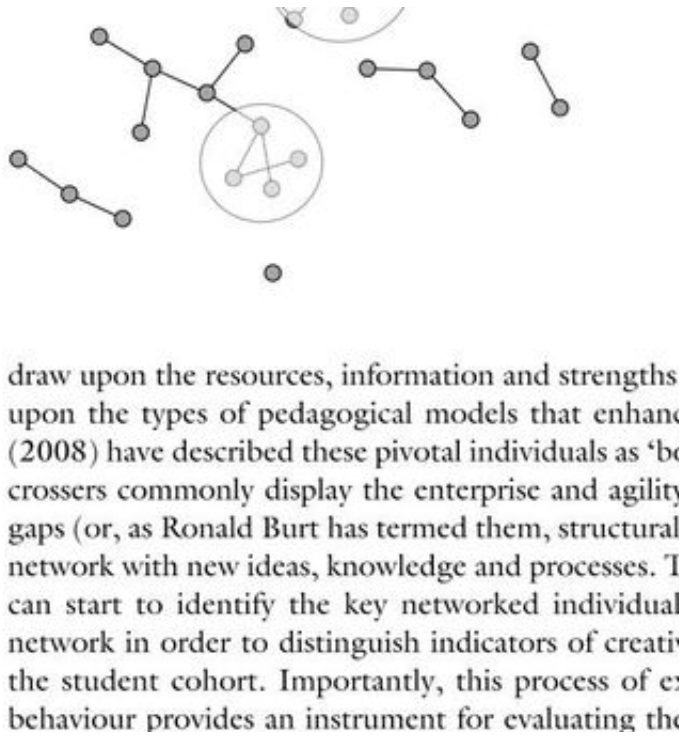

Figure 3: An example student social network constructed from student discussion forum interactions. Clusters of small-team student networks and a student (A) occupying a linking position are illustrated.

Evaluating creative practice

Above, we have argued that the process of creativity is enhanced through sustained and diverse interactions. Given this, the visualization of the student social network, derived from online activities, not only provides an insight into the skills and attributes of the individuals situated within the network, but also acts as an evaluative tool that can assess the impact of any implemented learning activity congruent with creativity-enabling practice. The contrast between Figures 4 and 5 well illustrates this premise. Figure 4 highlights the lack of student engagement and diversity established through the social discussion forum activities. In this instance, the instructor (A) has largely established a one-way communication flow: instructor to student. Thus, the implemented learning activities have contributed little in developing the sorts of engaged interactions that lead to the development of creative capacity. By contrast, Figure 5 represents the sorts of diverse engaged interactions that we would argue are lead indicators of well-designed creativity-enabling practice.

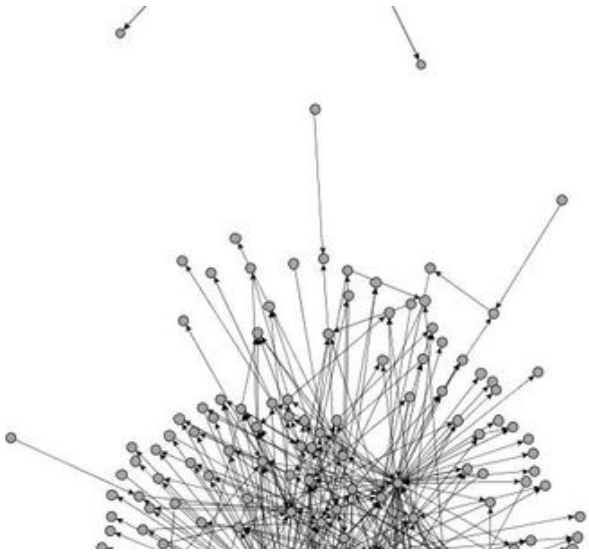

Figure 4: Sociogram of student discussion forum interactions, highlighting the minimal level of student interaction and the dominant role of the instructor (A). Thicker lines represent a greater number of communication exchanges.

Through this process, educators have an early and timely opportunity to implement learning interventions to promote diversity of student interactions and thereby reduce possible incidences of homophily. As noted above, while diverse and engaged networks are critical for developing creative capacity, there is a propensity for individuals within an organizational network to form connections based on similar attributes or characteristics (McPherson, Smith-Lovin, & Cook, 2001). The promotion of similarities such as occupations, demographics, etc. within an established group does provide for rapid relationship development and initial early growth of the network. However, if left unchecked, these ongoing interactions with similar individuals can also lead to what the business community has frequently described as *group-think*. In these instances of strong homophily, creativity is essentially strangled out of the network. By monitoring the evolution of the student online networks, educators can initiate the necessary learning interventions in order to combat group-think – promote diversity and cultivate a community that comprises agile and enterprising networkers. It is through these sorts of proactive practices that education can begin to meet the challenges associated with developing

graduates imbued with the sorts of skills and capacities necessary for the conceptual age.

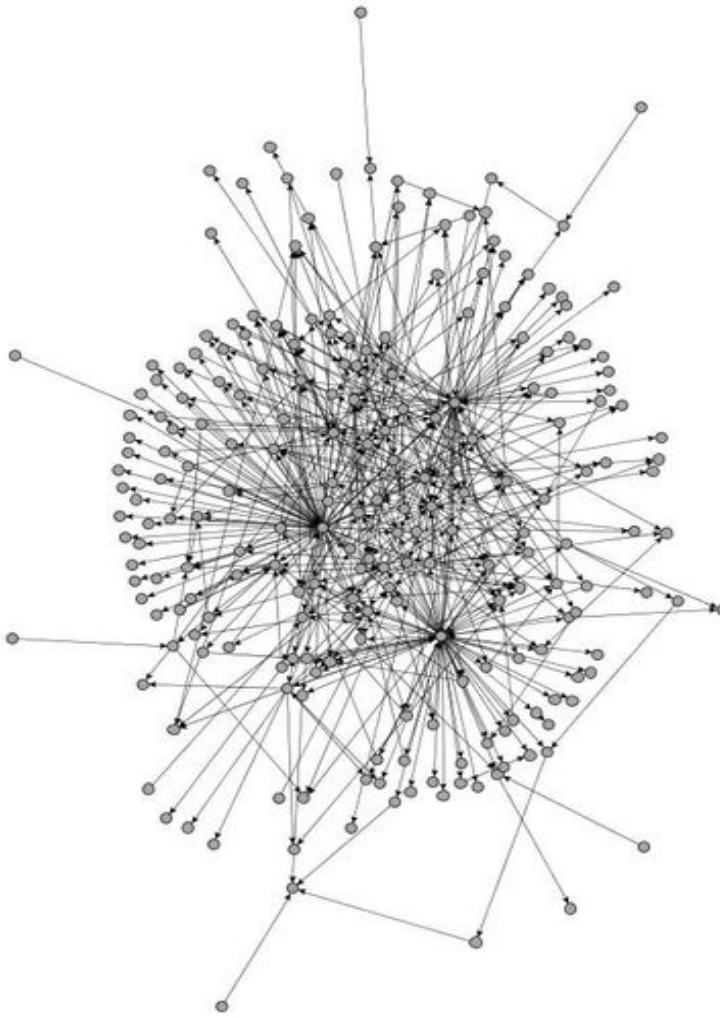

Figure 5: Sociogram of student discussion forum interactions. The diagram highlights the diverse and engaged interactions among the student cohort.

Conclusion

The two studies summarized above are illustrative of a second generation of inquiry into creativity as a set of dispositions and processes that are learnable and possibly even teachable. They demonstrate how we can begin to 'see' with more confidence the capacity young people have to engage in value adding through creative co-production. This capacity is likely to be optimally displayed in groups and cohorts of students co-creating, co-editing and co-evaluating in conjunction with each other and with their teachers and mentors, rather than in giving the correct answers to one-shot examination questions. It can also be seen through the application of tools that can distinguish a learning disposition from one focused more squarely on performance.

When taken together, studies such as those documented above can allow better judgements to be made about whether a prospective employee will measure up in terms of all the desirable skills and attributes of a 'creative' worker. Creativity for employability is not simply a matter of accumulating undergraduate degrees in business and information

technology and/or a degree in the creative industries or the creative arts. With all that we now know about creative capacity as a complex set of dispositions, high-level aptitudes and unique lifestyle preferences, we can and should be looking to a second generation of tools for making creative worker potential visible and calculable. This chapter opens up just two of many ways for doing so.

References

Amabile, T. (1996). *Creativity in context.* Boulder, CO: Westview Press.

Briemann, L., Friedman, J., Olshen, R., & Stone, C. (1984). *Classification and regression trees.* Belmont, CA: Wadsworth.

Brooks, C., Liu, W., Hansen, C., McCalla, G., & Greer, J. (2007). Making sense of complex learner data. In Workshop of Assessment of Group and Individual Learning through Intelligent Visualization (AGILEeViz). Thirteenth International Conference on Artificial Intelligence in Education (AIED 2007). Marina del Rey, Los Angeles.

Burt, R. (2004). Structural holes and good ideas. *American Journal of Sociology, 110,* 349-399.

Cowdroy, R., & de Graff, E. (2005). Assessing highly-creative ability. *Assessment and Evaluation in Higher Education, 30,* 507-518.

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

Csikszentimihalyi, M. (2006). Foreword: Developing creativity. In N. Jackson, M. Oliver, M. Shaw, & J. Wisdom (Eds.). *Developing creativity in higher education: An imaginative curriculum* (pp. xviii-xx). London: Routledge.

Dawson, S. (2006a). Online forum discussion interactions as an indicator of student community. *Australasian Journal of Educational Technology, 22,* 495-510.

Dawson, S. (2006b). Relationship between student communication interaction and sense of community in higher education. *The Internet and Higher Education, 9,* 153-162.

Dawson, S. (2007). Juxtaposing community with learning: The relationship between learner contributions and sense of community in online environments. Thesis, Queensland University of Technology, Brisbane.

Dunn, L. L. S. (2004). Cognitive playfulness, innovativeness, and belief of essentialness: Characteristics of educators who have the ability to make enduring changes in the integration of technology into the classroom environment. PhD dissertation, University of North Texas, Denton.

Dweck, C. (2000). *Self-theories: Their role in motivation, personality and development.* Ann Arbor, MI: Psychology Press.

European University Association (2007). *Creativity in higher education: Report on the EUA Creativity project 2006-2007,* Brussels: European University Association.

Florida, R. (2002). *The rise of the creative class.* New York: Basic Books.

Geletkanyez, M. A., & Hambrick, D. C. (1997). The external ties of top executives: Implications for strategic choice and performance. *Administrative Science Quarterly, 42,* 654-681.

Glynn, M. A., & Webster, J. (1993). Refining the nomological net of the Adult Playfulness Scale: Personality, motivational and attitudinal correlates for highly intelligent adults. *Psychological Reports, 72,* 1023-1026.

Hartman, J., Moskal, P., & Dzuiban, C. (2005). Preparing the academy of today for the learner of tomorrow. In D. G. Oblinger & J. L. Oblinger (Eds.), *Educating the net generation: An Educause e-book* (Chapter 6). Retrieved from www.educause.edu/educatingthenetgen (accessed 8 July 2007).

Jackson, N. (2006a). Imagining a different world. In N. Jackson, M. Oliver, M. Shaw, & J. Wisdom (Eds.), *Developing creativity in higher education: An imaginative curriculum* (pp. 1-9). London: Routledge.

Jackson, N. (2006b). Creativity in higher education: Creating tipping points for cultural change. *SCEPTrE Scholarly Paper, 3,* 1-26.

Kaufman, J. C., & Sternberg. R. J. (2007). Resource review: Creativity. *Change, 39(4),* 55-58.

Leavitt, C., & Walton, J. (1975). Development of a scale for innovativeness. In M. J. Schlinger (Ed.), *Advances in consumer research* (pp. 545-554). Provo, UT: Association for Consumer Research.

MacFadyen, L., & Dawson, S. (2010). Mining LMS data to develop an 'early warning system' for educators: A proof of concept. *Computers & Education, 54(2),* 588-599.

McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology, 27,* 415-444.

McWilliam, E. (2005). Unlearning pedagogy. *International Journal of Learning Design, 1(1),* 1-11.

McWilliam, E. (2008). *The creative workforce: How to launch young people into high-flying futures.* Sydney:

UNSW Press.
McWilliam, E., & Dawson, S. (2008). Teaching for creativity: Towards sustainable and replicable pedagogical practice. *Higher Education, 56,* 633-643.
Moss, P., Girard, B., & Haniford, L. (2006). Validity in educational assessment. *Review of Research in Education, 30,* 109-162.
NCEE (2007). *Tough choices or tough times: The report of the New Commission on the Skills of the American Workforce*. Washington, DC: National Center on Education and the Economy. www.skillscommission.org
Perkins, D. (1981). *The mind's best work.* Cambridge, MA: Harvard University Press.
Robinson, K. (2000). *Out of our minds: Learning to be creative.* Oxford: Capstone.
Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.) New York: The Free Press.
Seely Brown, J. (2006). New learning environments for the 21st century: Exploring the edge. *Change, 38(5),* 18-25.
Tan, J. P.-L. (2008). *Contestations and complementarities: An investigation of the adoption and diffusion of a student-led online learning initiative within a mainstream schooling context*. Brisbane: Queensland University of Technology.
Tan, J. P.-L., & McWilliam, E. (2008). Cognitive playfulness, creative capacity and generation 'C' learners. Paper presented at the ARC Centre of Excellence for Creative Industries and Innovation: Creating Value between Commerce and Commons Conference, Brisbane, Queensland, 25-27 June.
Tan, J. P.-L., & McWilliam, E. (2009). From literacy to multiliteracies: Diverse learners and pedagogical practice. *Pedagogies: An International Journal, 4(3),* 213-215.
Tepper, S. (2006). Taking the measure of the creative campus. *Peer Review, 8,* 4-7.
Tierney, P., Farmer, S. M., & Graen, G. B. (1999). An examination of leadership and employee creativity: The relevance of traits and relationships. *Personnel Psychology, 52,* 591-620.
Yorke, M. (2006). Employability in higher education: What it is – what it is not. In M. Yorke (Ed.), *Learning and employability series one.* York: The Higher Education Academy. Retrieved from www.heacademy.ac.uk/assets/York/documents/ourwork/tla/employability/id116_employability_in_higher_education_336.pdf

Notes

[1]Retrieved on 12 February 2008 from www.washingtonmonthly.com/features/2001/ 0205.florida.html.

[2]A comprehensive description of the digital learning innovation's technological and pedagogical design is provided in Tan (2008) and Tan and McWilliam (2008, 2009), and can be made available on request.

[3]CART modelling was first developed more than twenty years ago as a statistical method of analysing relationships among variables and has since been used widely in fields that engage primarily with complex and non-linear data sets, such as finance and banking, social welfare policy and epidemiology. In brief, CART predictive modelling aims to examine each predictor variable through a process of binary recursive partitioning of data to obtain the most accurate prediction of the dependent variable that has the lowest error cost and highest explanatory power. This process is considered binary because each split of a group of participants or cases (parent node) results in two groups (child nodes). The predicted value at each node is the mean of the target variable for all cases included in that node. A comprehensive discussion of CART can be found in the definitive text on this statistical technique (Briemann, Friedman, Olshen, & Stone, 1984).

[4]Scale validation procedures and results are beyond the scope of this chapter but can be made available to interested readers on request.

[5]Bakharia, A., & Dawson, S. (2009). Social Networks Adapting Pedagogical Practice (SNAPP) (Version 1.2). Brisbane, Australia. For more information, see http://research.uow.edu.au/learningnetworks/.