A methodology for exploring emergence in complex learning communities

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1. Complex Learning Communities

Complex Learning Communities (CLCs) where diverse groups or individuals come together to gain new knowledge, understanding or skills through social interaction are increasingly being developed to address complex social or economical problems (McDonald 2005a). These learning communities attempt to capitalise on the potential synergy between diverse groups of people to address multiple, diverse aims. A good example of this phenomenon is the learning cities initiative (Yarnit 2000) which seeks to build city wide learning communities which both improve citizen learning and economic regeneration. Like learning communities in general, the educational underpinning of this movement derives from approaches such as Vygotsky's (1978) social constructivism and Bandura's (1977) Social Learning Theory. While heavily influenced by Wenger's (1998) concept of Communities of Practice, CLCs are however significantly different in the heterogeneity of their composition and the multiple drivers for participation – there is no common core aim amongst the many participants.

Learning Communities can be considered complex adaptive social systems in which the community dynamics are driven by non-linear interaction both internally between participants and externally with its environment. Like all complex adaptive systems, this means that prediction and control is difficult - design and management of learning communities to ensure successful vibrant communities which achieve their multiple aims is not a simple task. Within more traditional learning communities such as formal education learning communities or Communities of Practice, the considerable body of extant research shows that success has in large measure been achieved by narrowly restricting the community to organization, interest domain or task (Brown and Salafsky

2004). The diversity - heterogeneity and multiplicity of drivers - within CLCs means that the intrinsic complexity cannot be constrained in a similar manner. It was to address this issue and generate insight into how to improve understanding, design and management of CLCs that the methodology at the core of this paper was developed.

The intrinsic complexity of CLCs suggests that a complexity based approach might prove insightful. In complex systems, the non-linearity of the interactions means that the resultant system cannot be fully understood in terms of the sum of its component parts. This complex nature means new properties may *emerge* from the internal interactions. These properties, be it behaviour or characteristics, may be at the individual level or collective properties of the whole system. For example within a CLC, development of eLiteracy skills, innovation, professionalism or social capital may be viewed as emergence. It is precisely this generation of emergence that CLCs are relying on to satisfy the multiple aims and objectives of its participants. Understanding the role of emergence within these CLCs is viewed as critical to improving understanding and management - emergence after all may be viewed as the 'product' of complex systems. It is how to facilitate and manage the emergence of key products and identify unanticipated benefits or problems that is central to the success of CLCs. One fundamental vision of Complexity Science is that of seeking out generalisations based on the well-researched instances of emergence and using these understandings to make sense of less researched complex phenomena. This suggests that there may be underlying principles of emergence which can be used as a conceptual framework for investigation of the role of emergence in understanding, design and management of CLCs.

A key driver to the approach adopted was a wish not only to investigate CLCs but also to develop a generalisable methodology and to add to the body of understanding of complex systems. This led to the following requirements: (i) improve understanding of the intrinsic characteristics of CLCs and gaps in knowledge, (ii) focus on how or to what extent generalisations or rules regarding emergence could be extracted that would help inform a future framework for designing and managing CLCs; (iii) use complexity science as an investigatory tool rather than just an explanatory metaphor; and (iv) develop a generalisable method which could be applied in other social contexts.

This paper reports on the methodology developed which consists of a mixed method approach combining case study exploration with focussed theory-driven investigation of emergence and its structure. This enables a holistic picture of CLCs to be developed while extracting underlying generalisations in emergence that may be used to inform future development and management of CLCs. The paper proceeds as follows: section 2 begins by first identifying the methodological issues and then presenting a summary of the methodology developed to address these issues. In section 3, the methodology is analysed using specific case examples, highlighting the benefits and potential issues associated with this methodological approach. The paper concludes (section 4) with a summary of findings, identifying the novelty of the work and future steps.

2. The Methodology

2.1 Methodological Issues

Having adopted complex systems theory as a conceptual framework, an appropriate investigation strategy was sought. A review of research method literature suggested that complexity science principles were used to inform three types of investigation. The first case uses Complex Science as an explanatory tool which according to Patton (2002, p123) offers "a new set of metaphors for thinking about what we observe, how we observe and what we know as a result of our observations."

The second type of approach uses "the logic of complexity" as a basis for natural experiments using a collaborative, action research approach (Mitleton-Kelly 2004). This approach is based on the theory of complex evolving systems which includes co-evolution of the system with its environment. It actively 'evolves' the organisation under investigation with the help of selective employees who become researchers, actively participating in the investigation alongside academic researchers. This approach is founded upon a significant body of work which has examined the application of Complexity Theory within the Organizational Science domain. As CLCs are a relatively new phenomenon and their complexities have not yet been well studied, this field is not yet sufficiently mature to adopt such an action research approach – initial investigation is required to develop sufficient understanding before such invasive and potentially change inducing action research is undertaken.

The third application of Complexity Science is that of computer simulation. Agent Based Modelling, where multiple, possibly non-homogeneous 'agents' are represented as identifiable components which behave in an autonomous and goal-directed manner have been highly successful in replicating biological and social systems as Complex Adaptive Systems. As Axelrod (2003) suggests, "[a]s a scientific methodology, simulation's value lies principally in prediction, proof and discovery." While simulations are particularly valuable in the social sciences as they enable ethical experimentation – the exploration and prediction of system potential under differing conditions - it is first necessary to build a sufficiently realistic model of the system under investigation. Again, we are not yet at a sufficient level of understanding of CLCs to build a reasonably useful model.

Within the field of education, Davis has perhaps been the most active in using Complexity Science as a research framework. He uses complexity both as a descriptive tool and applies its principles to the teaching of mathematics (Davis and Simmt 2003). In the first case, complex systems thinking is used to describe spontaneous formation of a self-supporting learning community and in the second, five principles of complex systems are applied to the classroom teaching of mathematics. Again, the use is either of an explanatory nature or experimental, neither of which we were in a position to do.

Checkland's (1999) Soft Systems Methodology (SSM) is one of the primary methodologies used to investigate socio-technical systems, of which CLCs are a type. It draws heavily on systems thinking which he suggests is founded on two pairs of concepts – "emergence and hierarchy, communications and control". SSM is primarily a problem solving methodology which models not only organisations as open systems,

but also includes the human activity subsystems as part of the modelling process. The result is a set of recommendations that deal with specific changes necessary to solve the problems (Holwell, 1997). The problem solving focus again ruled out SSM suitability, although much of the general thinking, including the concept of rich pictures were incorporated into our methodology.

None of the above research methods fully met the requirements set out in section 1. Thus, rather than adopting a particular overall research strategy, a more pragmatic research approach was adopted, which as Cohen et al (2000, p73) suggest was "governed by the notion of 'fitness for purpose'". The novel nature of CLCs suggested that exploratory investigation was required in order to develop new fields of inquiry where little is known about the phenomenon (Patton, 2002). However, a general exploration, while gathering 'base-lining' data for CLCs, will not significantly aid in the detection of generalisable underlying patterns of emergence. This suggests a second investigatory phase which specifically explores emergence, its structure and causality within the CLCs. These two phases are described in sub-sections 2.2.1 and 2.2.2 below

2.2 The Methods Adopted

2.2.1 Phase I: Exploratory Case Studies

A case study approach, following Yin (2003), was adopted to explore the concept of CLCs, extract their intrinsic characteristics and identify gaps in knowledge pertaining to their understanding seeding and management. Four study propositions, based on the heterogeneity, multiple drivers, hybrid spaces and complexity of CLCs, derived from previous exploratory work reported in McDonald (2005a), focused the research. **Figure 1** below illustrates the conceptual framework for Phase I.

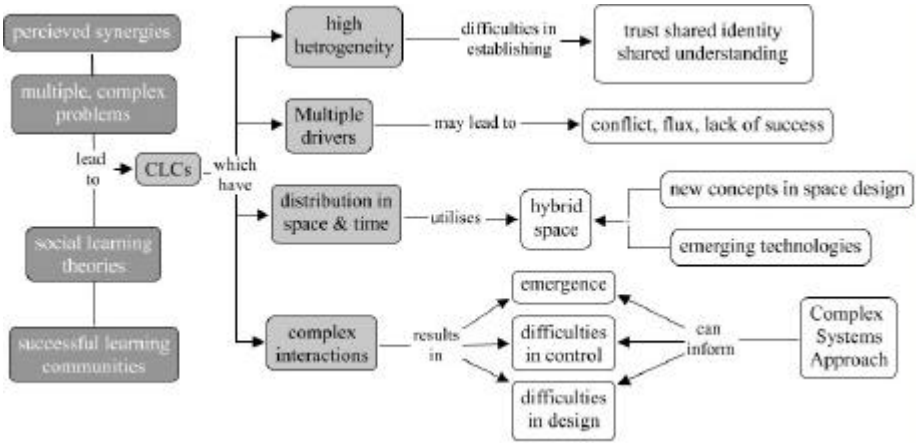

Figure 1: Conceptual framework for Phase I exploratory investigation.

The aim of phase I was exploration of CLCs - both the behaviour generated by their distinctive characteristics but also identification of gaps in knowledge regarding their

behaviour and management. The cases were purposefully sampled for information rich cases which would highlight key themes. In particular one learning city and one non-'learning city' CLC were chosen. Data was gathered through semi-structured interviews of participants with a management or development role and results corroborated and further investigated using documentation and pre-existing learner studies. Individual cases were first analysed and then cross-compared.

2.1.2 Phase II: Examination of the anatomy of emergence

The investigating of emergence was based on the conceptual model of emergence which is discussed in detail in McDonald & Weir (2006). This model, illustrated in Figure 2 below, was used to develop semi-structured interviews.

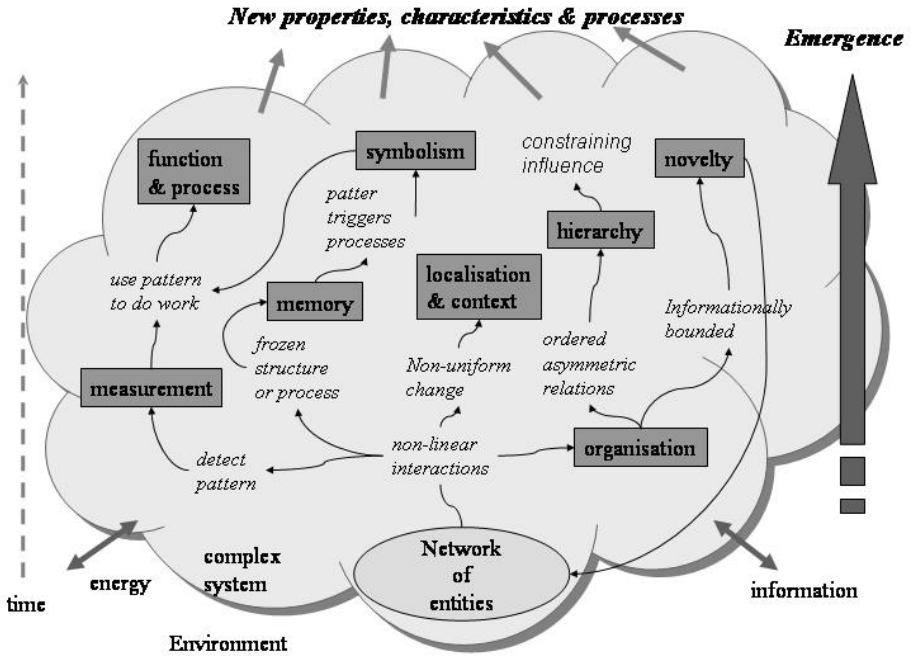

Figure 2: Conceptual framework of emergence (from McDonald & Weir (2006)).

The interviews were divided into sections. The first section dealt with emergence in general, explaining the concept and asking respondents to give examples of emergence within their CLC and how emergence in general might be detected. This was followed by a number of sections, each relating to one of the meta class of emergence. In each section, the concept of the relevant meta class was first explained. The respondent was then asked a series of questions designed to (i) identify if examples of the class of emergence existed, (ii) determine if they believed it to be emergent (iii) indicate how they knew of its existence, (iv) check that the identified property did actually arise from non-linear interactions and (v) suggest how evidence might be gathered to identify if such types of emergence had occurred. By way of illustration, Table 1 below lists the

questions used to investigate memory. Additional prompts and explanatory examples were provided as required.

(i) How are events, information or knowledge that have occurred remembered?
(ii) Would you consider the community to have a memory?
(iii) How is this 'memory' stored, adapted and utilised?
(iv) Was this designed or did it emerge?
(v) How could retention of events, information or knowledge be measured?

Table 1: Example of the memory interview questions.

The open ended nature of the questioning and the initial general section of questions allowed the possibility of identification of phenomena which did not fit the theoretical framework being used

The qualitative data collected was analysed using the conceptual model as an analytical framework. A second unstructured analysis was then carried out to see if any additional, unanticipated patterns were in evidence. Again individual cases were first analysed and then a cross-comparison undertaken. An early analysis of results was presented in McDonald (2005b).

3. Discussion

The rationale for developing the methodology reported in this paper was to improve understanding of emergence within CLCs with a view to improving their design and management. The extent to which this has been achieved is discussed below, using examples from two case studies.

The structural framework provided by the meta model enabled the texture of emergence found in the case CLCs to be systematically explored. For example, in one case study, a significant focus on 'e'-Literacy emerged, which had not been one of the original drivers of the CLC. A number of factors contributed to this. Poor uptake of the group working technology and difficulties in capturing outcomes for later reuse were observed. To rectify this, one of the CLC development team who had librarian skills was introduced into the classroom to teach 'e'-Literacy skills in a contextually relevant manner. The co-incidental interest and past experience in 'e'-literacy of this development team member significantly influenced the approach adopted – synergy was capitalised on. This had several consequences. Firstly, it introduced a multi-discipline teaching team, giving non-traditional roles experience of classroom activity, significantly changing the structure of the CLC as a result. Secondly, it opened up the role of a librarian to the learners, who subsequently made use of the librarian as a resource within both ongoing CLC activity and outwith. This was illustrative of a new functionality being developed. Although there was a significant change in usage of the technological resources, localised pockets of under use were still found. Further investigation suggested that this was a *sign* of lack of uptake of the technology by some group tutors, due to insufficient 'e'-literacy skills.

The major advantage of the meta class approach was that it afforded comparison of types and causal patterns of phenomena observed across case studies. For example, while the organisation and management within two case studies both claimed to follow

an organic model, in reality each followed very different paths. Examining the texture of how the particular paths emerged enabled the significance of tightly managed boundary constraints to be identified and the effects of localisation and context to be contrasted. This in turn highlighted the significance of creativity-enabling conditions in the success of CLCs. As a result, a set of matrices, which suggest how various combinations of characteristics and environmental factors may lead to different types of emergence were developed. Such matrices may be used to design future CLCs.

While it was the theoretical exploration that in large measure afforded the development of generalisable rules, the initial investigatory exploration was also critical to the success and reliability of the methodology. The initial investigation enabled the context - the drivers, initial structures and community space - in which the various emergent phenomena developed, to be better understood. By carrying out the initial explorations outwith the emergence framework, it afforded the advantages of a dual lens investigation. For example, the development of the community space was examined from a point of view of high level drivers in phase I and lower level structural components in phase II. This enabled the effects' multiple drivers to be compared with that of *localisation* of participants at ground level and how their innovative use of technologies led to the emergence of the community space with many unplanned features. Thus, the two phase approach provided rigour by triangulation of data and helped minimise interpretation bias.

In social systems, individuals with their independent and purposeful mind add another layer of complexity. While the investigation was not grounded in theories such as critical theory, agency or power, the openness of the interview structure enabled issues such as conflict, power and agency to be explored as and when they arose. For example, within the Learning City case study, there was a tendency to promote the success of projects by the effects that it had on the lives of the participants. One particular story which was often singled out as illustrative of the success of the learning community was that of a disenfranchised learner, who had been homeless during part of his participation in the CLC. Through the skills and contacts developed during participation in a particular CLC initiative, this learner went on to build a successful career in the creative arts. However, investigating of how participants *measured* events within the CLC highlighted that while the CLC was indeed a contributing factor to his success, other respondents felt that he would have succeeded no matter what due to his intrinsic talent and personality. Indeed the participant concerned himself observed (*measured*) the publicity he was receiving as an illustrative story and turned it into a positive advantage, furthering his own career through active participation. Thus, the effect of agency was identified and explored.

4. Conclusion

In this paper we have presented a two phase, mixed methodology designed to generate insight into the developing phenomena of CLCs. Our methodology offers a practical way of furthering understanding; combining exploration of the effects of the constituent components with theory-driven investigation of emergence and its causal factors. This combination of views enables a holistic picture of CLCs to be developed from which

underlying guidelines regarding their development can be extracted. Inclusion of a theory-driven phase, as opposed to a less structured approach more akin to phenomenology, proved extremely useful and fruitful as it focused the research, encouraging respondents to drill down on the product of the interactions within CLCs. This is particularly useful as emergence can be perspective dependant and may be difficult to identify from within a system. The novelty of our methodology is the combination of a 'base-lining' exploration with meta class-driven investigation of emergence. The rich textural information gathered affords identification of generalisable patterns and associations which can in turn inform future development and management of CLCs. While our methodology was developed to address CLCs, the generic nature of the methodology means that it will be generalisable to other complex systems where emergence is a key factor and facilitator. The next steps are to apply the methodology in other social domains and to adapt the underlying methodological principles to develop an action research version which may be utilised where a more collaborative and co-evolutionary approach is desired.

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