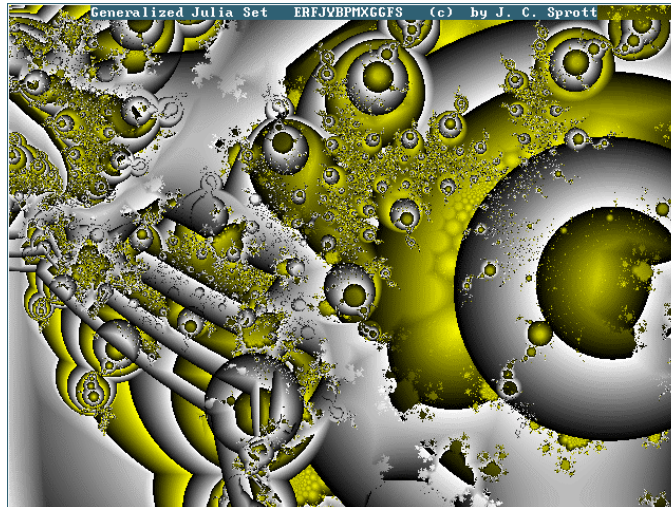


TEACHING ON THE EDGE OF CHAOS

COMPLEXITY THEORY, LEARNING SYSTEMS AND ENHANCEMENT

Dr Paul Tosey, Educational Studies, University of Surrey, May 2002

http://www.heacademy.ac.uk/resources/detail/resource_database/id111_Teaching_at_the_Edge_of_Chaos.



Acknowledgements

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Various Peanuts cartoons illustrate themes of Complexity Theory well. Unfortunately the cost of copyright permission prevents me including any here. There is a selection on the Official Peanuts Website: <http://www.unitedmedia.com/comics/peanuts/archive/index.html>

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1 INTRODUCTION



'Well, in our country,' said Alice, still panting a little, 'you'd generally get to somewhere else - if you ran very fast for a long time,, as we've been doing'.

'A slow sort of country!' said the Queen. 'Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!'

(from 'Alice Through the Looking Glass' by Lewis Carroll)

These notes, and the seminar for which they were first prepared, were intended as an introductory guide to principles, concepts and implications of Complexity Theory for those who, like me, work as lecturers in Higher Education. I wrote them to help develop and test my understanding of Complexity Theory (I have a long-standing interest in related systemic theories, and in Neuro-Linguistic Programming), and to exemplify Complexity Theory as a perspective for reflective practice by identifying challenges to my own practice.

This version for the LTSN website, in addition, highlights possible implications for the contemporary theme of enhancement.

The world of higher education increasingly resembles the Red Queen's country. If we ever really inhabited a 'slow world', it is surely long gone. But do we have to run faster and faster? Or might we, through understanding better the nature of that 'looking glass world', become smarter, so be able to act more intelligently within it? I say this because the apparent irrationality of this world interests me more than its pace. Teaching on the edge of chaos is not the same as teetering on the brink of collapse.

As educators, I believe we encounter this apparent irrationality any time we have done something for the best of the programme or for the benefit of the students, but are misunderstood; or we are attacked and accused of having bad intentions; or things simply don't work as we intended – especially if the effect is the opposite of whatever we planned. Some explain this as the vagaries of life, or as 'sod's law'. Complexity Theory can help us to conceptualise this type of experience, to see it differently, and to understand it as normal not irrational.

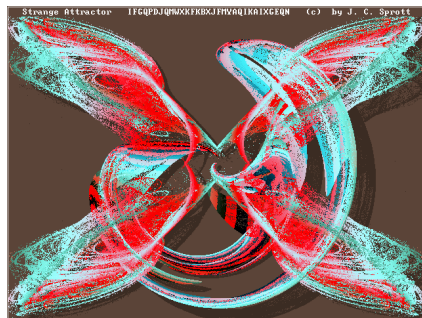
Complexity Theory suggests that the 'edge of chaos' (the dynamic between stability and instability – see section 6 below) can be the most effective and most creative place to operate. I aim to explore what this might mean in practice, and also how we (as staff) and the wider systems we work in may militate against this.

Complexity Theory would apply to many aspects of this professional context, from the 'micro' behavioural level of teacher-learner interactions to the 'macro' level of national policy and system change. All these levels are learning systems. Here I concentrate on some aspects of the everyday work of a lecturer – teaching, learning and programme management - with reflections on particular aspects of my experience on our MSc in Change Agent Skills and Strategies (CASS)¹. Of course this practice does not happen in isolation, and the final section indicates some connections with the wider Higher Education system.

2 DEFINITION & BACKGROUND

2.1 What is Complexity Theory?

'Complexity refers to the condition of the universe which is integrated and yet too rich and varied for us to understand in simple common mechanistic or linear ways. We can understand many parts of the universe in these ways but the larger and more intricately related phenomena can only be understood by principles and patterns - not in detail. Complexity deals with the nature of emergence, innovation, learning and adaptation'. (Santa Fé Group 1996, cited in Battram 1998 p.v).



2.2 Origins of Complexity Theory

Complexity theory is a cluster of ways of thinking that have developed from branches of 'new science' concerned with the behaviour of natural systems², such as:

- Chaos theory
- Dissipative structure theory
- Quantum physics
- Complex adaptive system theory (ie systems that are complex and also adapt)

Complexity theory also has much in common with 'ancient wisdoms' – for example, Lao Tzu's 'Tao Te Ching'.

¹ an advanced, experiential course enabling participants to inquire about, and to develop their skills as facilitators of, human processes of change, learning and development in organisational and community contexts. Participants are experienced in their field, which may be training, management development, organisational consultancy or a similar area. The course makes significant use of experiential learning and principles of action learning, for example through module by module tasks that involve drawing up learning contracts. There is also extensive, formalised usage of self and peer assessment. <http://www.surrey.ac.uk/Education/cass/index.htm>

² See Waldrop, M. (1994)

2.3 Contemporary usage of Complexity Theory

In contemporary literature there is much application to management, organisations and leadership. Stacey (200) contrasts Complexity Theory contrasts with 'strategic choice', which assumes that managers can control the destiny of an organisation through planning and decision-making³.

2.4 How can Complexity Theory help?

In summary, Complexity Theory:

- Seems to be useful for explaining the 'looking glass world' and apparent illogicality of human systems. It 'problematizes' things we may take for granted.
- Offers a radical challenge to notions of prediction and control: e.g. '...no individual or group of individuals can be "in control" of the whole system. This departs from the dominant discourse in which the only alternative to an individual being "in control" is thought to be anarchy' (Stacey et al 2000 p.124)
- Can, if taken 'as if true', offer illuminating challenges to educational practice

2.5 Critique of Complexity Theory

Complexity theory has strengths and weaknesses, and is open to critique like any other theory. Some issues and challenges are:

- Stacey emphasises that complexity needs to be used authentically, not as a loose metaphor, as appears to be the case in some management literature (even so, I believe the concepts are useful for helping people to perceive and imagine situations differently).
- Many practitioners remark that Complexity Theory is conceptually interesting, but seems difficult to apply in practice.
- To what extent is it a theory appropriate to human systems; to what extent is it a way of perceiving human systems through (for example) a biological metaphor?
- Enthusiasm for complexity concepts can lead to a polarising, 'two valued logic', glorifying this 'new paradigm' thinking and dismissing everything connected with the 'old paradigm' (often characterised as Newtonian): see for example Darwin et al 2002 pp. 180 – 181.
- Does applying Complexity Theory to the world of human experience maintain a kind of physical science 'imperialism' in relation to knowledge?
- Is Complexity Theory just a newer, if slightly fuzzier, type of positivism?

2.6 What is a 'Complex Adaptive System'?

'Complex' indicates a system in which interaction is detailed, and in which 'agents' (e.g. human actors) make choices about their individual actions, The system's behaviour is both patterned and unpredictable. Complex in this sense is contrasted with 'simple' and 'chaotic' (see figure 1).

'Adaptive' indicates that the system both influences and is influenced by its environment (but accepting that no complex system exists in isolation from other systems).

³ See Stacey et al 2000 pp.123 – 125 (eight challenges to dominant management discourse)

'A complex adaptive system consists of a large number of agents, each of which behaves according to its own principles of local interaction. No individual agent, or group of agents, determines the patterns of behaviour that the system as a whole displays, or how these patterns evolve, and neither does anything outside the system.' (Stacey et al 2000 p.106)

In this sense educational programmes are complex adaptive systems because, for example:

- They consist of human agents who make choices about their actions
- They have hierarchical structures *and* networks (see Battram 1998 p. 48)
- System behaviour is patterned *and* also unpredictable
- Programmes exist within wider systems (e.g. higher education institutions; the Higher Education system), which they both influence and are influenced by
- No individual or group determines the system's pattern of behaviour.

	Simple systems	Chaos: systems which are crudely complex	Complex adaptive systems
Number of states	Few possible states	More possible states	A huge number of possible states
Connectivity	Connections between components are fixed	Components are dispersed and completely free to interact locally	Components ('agents') are dispersed and free to interact locally within an hierarchical structure
Behaviour	Simple behaviour – predictable	Disorganised (chaotic) behaviour – largely unpredictable	Emergent behaviour with pockets of unpredictability
Examples	A central heating system or a television set	The weather or a dripping tap; a sand pile that suddenly collapses as more sand is added [like the sand pile in an egg-timer]	All living things, large organisations, ecologies, cultures, politics

Figure 1: Simple and Complex Systems (Battram, A. 1998 p.29)

2.7 Key Concepts

There is no unified view of the nature of Complexity Theory. Presenting Complexity Theory also entails the difficulty that its principles and concepts are connected. To break it down into parts is necessarily artificial.

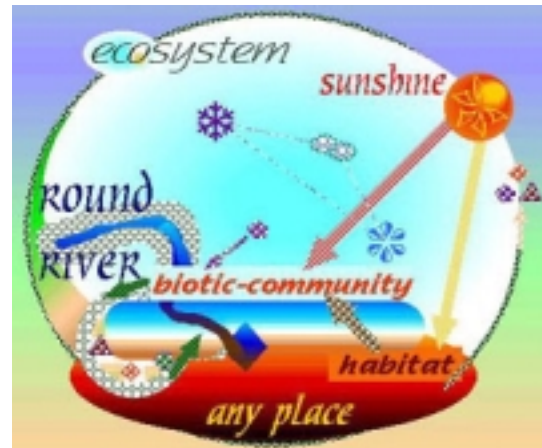
I have chosen four main concepts as an organising device in the following sections:

- **Self-organisation**
- **Paradox**
- **Emergence**
- **The edge of chaos**

3 SELF-ORGANISATION: WHO CONTROLS THE ECO-SYSTEM?

Entities have self-organising capability and can change spontaneously into other forms. Stuart Kauffman, of the Santa Fe Institute, referred to this as 'order for free' (Battram 1998 p.44).

Self-organisation refers to patterned behaviour arising from 'agents interacting locally according to their own principles, or "intentions", in the absence of an overall blueprint for the system.' (Stacey et al 2000 p.106).



This means that complex adaptive systems are like eco-systems; they change and evolve, but are too complex for human agents to control. Human intervention can be precarious, and runs the risk of doing more harm than good. This does not, of course, stop us trying to intervene in order to improve systems. With educational programmes, we believe we have the right and the obligation to intervene, because among other things we are accountable for their success. Rarely, perhaps, do we question the theory we use when intervening – and of course programmes, as systems, do not always respond in the way we intend or would like. What if, therefore, we considered educational programmes as self-organising?

An illustration:

'In order to protect their huge space rockets from weather conditions - mostly rain and lightning - the U.S. Space Agency decided to build an equally huge space-vehicle preparation hangar. Hangars have been built for the last eighty years or more, and all that needed to be done - so it seemed - was to multiply the dimensions of the largest existing hangars by a factor of maybe ten or more... it was found, probably again to the surprise of the experts, that an enclosed space of that size (after all, it is the largest construction on earth) has its own inner climate, namely clouds, rain, and discharges of static electricity - and thus produces from within itself the very phenomena it was supposed to protect against.' (Watzlawick, P. 1988 *Ultra-Solutions* New York: W.W. Norton & Co. p.29)

3.1 Example from practice: managing deadlines for students' work

A perennial concern on our MSc CASS is how to handle extensions, both within modules and for dissertations (affecting overall completion rates). Our original intention, or hope, was that individual students, as mature adults, would be self-regulating and 'take responsibility for

themselves'; and that there would also be some level of monitoring by the group, because it is meant to be a 'peer learning community'⁴.

This developed into a very permissive culture, such that students came to realise they would effectively be granted whatever extension they requested. Instead of reviewing extension requests in the peer group, we allowed it to become a staff role, ie decided by a module co-ordinator. We realised that once one student had been granted an extension, there were effectively no clear grounds for refusing an extension to anyone else. Often, more than half the student group has requested extensions for a modular assignment, which means that marking is prolonged, and tracking of extension requests and due dates is tedious and complicated for both academics and support staff.

The lesson here seems to be that instead of acting according to our designs (wishes, ideals?), each course group has self-organised around the permissions offered by the system. Each group has learnt what the 'rules' are in practice, and behaves accordingly. We have at times challenged individuals about their propensity to need extensions – other students routinely hand work in on time – but since we have created a very loose boundary, this relies effectively on students volunteering to change.

In summary, we have, very effectively, made it the teaching staff's responsibility to see that students' work is handed in on time! The effect, so far as overall completion rates is concerned, was seen by the 2000 Subject Review (in the context of a high overall score).

First, I note how this created in me a temptation to blame the students – to criticise them for not taking responsibility, or being undisciplined, perhaps to infantilise them, and perhaps to punish them for shattering my humanistic ideals about self-directed learning and therefore to justify a more autocratic approach. In other words, even though it is my theory that is inadequate, it is the students who suffer the consequences. This, as I understand it, would begin to create a 'blame culture' – even so, this intellectual awareness sat in tension with a considerable emotional pull to make life easier for myself, and to shed what felt like a load of demands and anxieties that were not really mine to carry.

Second, it caused me to question the concepts of, and boundaries between permissiveness and softness; being supportive (to some) in a way that ends up being unfair to others (e.g. those who hand work in on time); and being understanding in such a way that it creates ambiguity (e.g. unclear boundaries). I recalled the strategy of a professorial colleague at Edinburgh. Undergraduate essays for this course had to be posted into a box. At precisely 5 o'clock on the due date the box was closed and removed. There was simply no gap or space for this boundary to be fudged. It felt a very appealing solution.

Third, I am also aware that what I have done over the years is tend to treat this, and issues like it as my (or as staff's) problem', rather than raise it within the 'peer learning community', hence clearly signalling to students that in these respects we are not peers.

In all these respects, it seems to me, I have space for learning about how I have helped to create the very effects I dislike, and about which I complain. Otherwise it would then be a very slippery slope to start blaming others for my misfortune.

Assuming we want to shift this responsibility back to students, what could we do? My assumption, by the way (I state it in case you wish to take issue), is that it is our responsibility as educators to design the programme's systems for managing extensions, but that it must remain the individual learner's responsibility to manage the actual production of their assessed work.

⁴ TOSEY, P. (2002) 'The Learning Community: a Design for Teaching and Learning', in JARVIS, P. and Associates Theory and Practice of Teaching London: Kogan Page pp. 143 - 158

Our latest strategy to resolve this is to allow an automatic extension of two weeks for any modular assignment⁵, and to make any further extension dependent on written evidence of exceptional circumstances. This has operated for three modules to date, so we have yet to see a fully established pattern of how students are responding (ie how the system is self-organising around this difference) and what 'unintended consequences' it might have. However, early signs are encouraging. For the most recent module, only four student made use of the automatic extension.

From a Complexity Theory perspective there are some interesting features to this:

- We have chosen to act hierarchically, ie to create a clearer boundary and to require action from the students. As Battram (1998 p.42) acknowledges, hierarchy is still needed in complex adaptive systems as well as 'networks' (of which the 'peer learning community' would be an example).
- We have chosen to relinquish the need to make any decision on extensions of up to two weeks. This reduces the need for interaction on these decisions, and thus reduces the complexity of the system. (Systems that are over-complicated tend to freeze or become rigid – see Battram 1998 p. 47)
- We have not (we believe) abandoned our values about the self-directed nature of adult learners. If we did, we would be introducing a very significant difference into the system – and if students perceive we have done so, no doubt we will find out!

Possible learning from this example, about related principles from Complexity Theory:

3.2 Influence without control

'No individual agent, or group of agents, determines the patterns of behaviour that the system as a whole displays' (Stacey et al 2000 p.106).

Complexity 'challenges managers to act in the knowledge that they have no control, only influence. They can advocate and aspire, but they cannot predict. There are no absolute truths, only ethical decisions to be made in the here and now' (Critchley, B., cited in Hayes, C. 2002, MSc dissertation, School of Educational Studies, University of Surrey)

Humans do not control the ecology of the planet. Lions do not control the eco-system of the African savannah. Managers do not control organisations. Lecturers do not control programmes.

3.3 Systems self-organise around changes (difference)

Every change we introduce is a difference around which the system self-organises (one possibility is that the system effectively 'absorbs' the difference', ie it has no effect in practice).

3.4 Small changes can have large impacts.

Because systems self-organise around difference, a small change can have more than local effects. NB the stereotypical 'butterfly' example (e.g. a butterfly flaps its wings over Peking, initiating turbulence in weather systems that eventually cause a storm over New York) refers to chaotic systems (see Battram 1998 p.30).

⁵ on submission of an extension form, in common with the rest of SES

*For want of a nail the shoe was lost.
For want of a shoe the horse was lost.
For want of a horse the rider was lost.
For want of a rider the battle was lost.
For want of a battle the kingdom was lost.
And all for the want of a horseshoe nail.*

3.5 Unpredictability

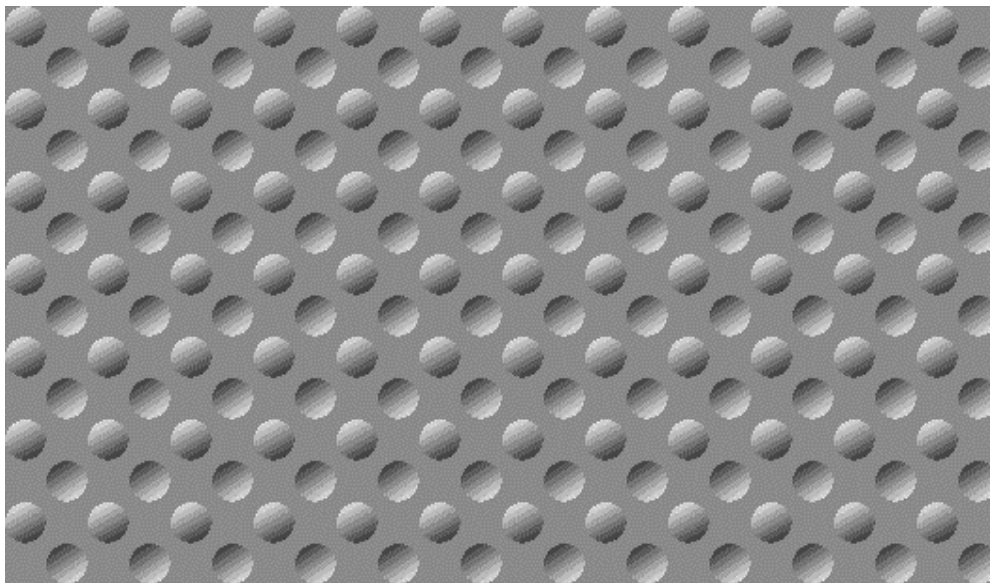
We cannot determine how the system self-organises to these differences, we can only anticipate what might happen and attend to what happens in practice. Predictions of the effects of changes (e.g. to the `rules' for extensions) are, if based on `linear' thinking, likely to be disappointed. Changes that we make will have unintended consequences, as well (hopefully) as some intended consequences. But `solutions' create new `problems'.

3.6 Participatory universe; no-one stands outside the system

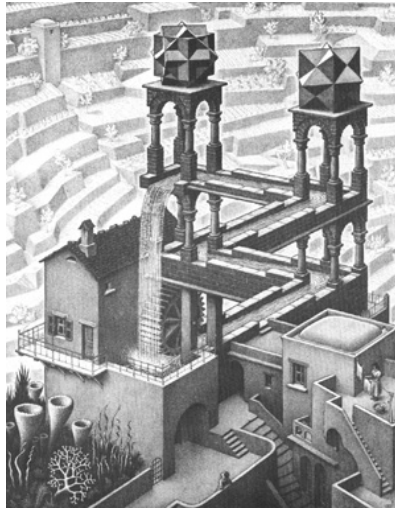
A system is a web of relationships. As staff we cannot stand outside the system; there are no privileged observers. Stacey (e.g. 2000 p.407) – no manager can stand outside the system and choose how it is to operate.

`When one moves away from thinking that one has to manage the whole system, one pays attention to one's own participation in one's own local situation in the living present. Perhaps this humbler kind of "management" is what the "knowledge society" requires'. (Stacey 2001 p.235).

Nor are systems fixed entities – what we perceive depends upon our point of view. Find a particular perspective and the picture below becomes three-dimensional.



4 PARADOX: TEACHING STUDENTS NOT TO LEARN



M.C. Escher's "Waterfall" © 2002 Cordon Art - Baarn - Holland. All rights reserved

As in Escher's drawings, complex adaptive systems operate in ways that appear paradoxical or irrational. However, there is a logic, of a different kind. Unless we appreciate or tune into this 'alternative' logic we may be left bemoaning the apparently fickle and unpredictable nature of human systems.

‘Mullah Nasrudin used to stand in the street on market-days to be pointed out as an idiot. No matter how often people offered him a large and a small coin, he always chose the smaller piece. One day a kindly man said to him:

“Mullah, you should take the bigger coin. Then you will have more money and people will no longer be able to make a laughing stock of you.”

“That might be true,” said Nasrudin, “but if I always take the larger, people will stop offering me money to prove that I am more idiotic than they are. Then I would have no money at all.” ‘

(from Idries Shah's ‘Mullah Nasrudin’ stories)

4.1 Example from practice: teaching students not to learn

As educators, naturally we encourage students to learn. We want them to learn – that is our job, and for many of us it is our vocation. It is self-evident, is it not, that we would never intentionally prevent or obstruct students' learning?

I am not so sure. In fact I suggest that as educators we perpetually regulate how, where and when students should learn; and that we are as active in discouraging learning in some respects as we are in promoting it in others.

In the MSc Change Agent Skills and Strategies we promote the idea of a programme based on inquiry. We teach skills and processes of inquiry in the first module, and students use these in all modules. In addition, the concept of the 'peer learning community' means that each group inquires into its own process and behaviour as an integral part of the programme⁶.

I am aware, however, that some aspects of the programme are more open to inquiry than others. For example, as staff we take numerous decisions about issues such as staffing; a recent group discovered that they would be having new (associate) facilitators for three second-year modules. This created much consternation. While we (staff) discussed this with the students, from their perspective the decision had been taken hierarchically and imposed upon them. They were not consulted along the way, and so had no opportunity to inquire into the situation before a decision emerged. So, are they peers or not? Do we want them to inquire, or not?

As staff, we are very capable of rationalising this. Staffing decisions are inextricably linked to managerial and resourcing issues within our department; and both practically and politically it would have been extremely difficult to open all the issues to a more public debate before they had been resolved. But, notwithstanding that our rationalisations might well be justifiable in these circumstances, they are still rationalisations. We have a programme that promotes inquiry, and yet in this area we prevented inquiry. Once again, we helped to create the response of the 'learning system'.

I think this applies more widely in the programme. We do not promote inquiry everywhere and always. We encourage inquiry and learning of particular kinds, at particular times and places. In effect, like the philosopher's trade union in Douglas Adams' 'Hitchhiker's Guide to the Galaxy', we are seeking 'rigidly defined areas of doubt and uncertainty'.

Students are aware of this, and simultaneous with their inquiring for formal purposes, they are inquiring into the 'rules' of how to behave in the peer learning community⁷. I am not suggesting that we are hypocrites. I believe that it is impossible to promote learning without constraint; and that regulation or, as I call it, 'governance' of learning is both necessary and essential for the healthy functioning of the system.

What would be unrealistic, and perhaps hypocritical, would be to deny that such regulation takes place. What is difficult is to make governance open to inquiry, because often it means drawing lecturers' attention to things of which they are unaware. However, I think the first step is for us as staff to be aware of when we are closing down inquiry simply because it makes us uncomfortable, or threatens our authority, or looks like being inconvenient⁸.

What is the paradoxical aspect of this? It is, I suggest, that as lecturers we are simultaneously educators of individual students and 'governors' of educational programmes. Whatever we say or do in relation to a programme is both an act of education and an act of governance – and, in effect, governance is an exercise of power.

Paradoxes arise because, for example:

1. These 'dimensions' of action can be in conflict. When I suggest that a student read a particular book for an assignment, for example, the student as individual learner might well choose not to act upon my suggestion. But as member of the system in which I hold an hierarchical position, the student might well consider that I might look unfavourably on his/her

⁶ The MSc emphasises personal development, self-awareness and interpersonal skills, as core competences in change agent work.

⁷ See Snyder, Benson R. (1971) The Hidden Curriculum Knopf: New York

⁸ Argyris describes such practices as 'defensive routines'. See for example ARGYRIS, C. (1999) (2nd edn) On Organizational Learning Oxford: Blackwell (651.4 ARF)

essay if the book is not in the references (this is regardless of any intent, or lack of, on my part to coerce the student into reading the book).

2. As staff we seem to behave as if we can change context at will, and that this is both transparent to and accepted by students. I suggest this is not the case. We are necessarily in these relationships with the student, and we cannot escape them or stand outside them.

Possible learning from this example, about related principles from Complexity Theory:

4.2 *Our world is paradoxical, 'arational' and messy (inevitably and necessarily)*

Complex adaptive systems are like the Looking Glass World. They are not, and never will be, 'rational' places⁹.

4.3 *Power and regulation: every educational action is also an act of 'governance'*



Whenever we communicate (and, as Bateson points out, saying nothing is still a communication) we inevitably and necessarily communicate 'meta-messages' about relationship and context. In this sense, power is inherent in every interaction with students.

4.4 *Paradoxical action*

In the Looking Glass World, we need the capacity of paradoxical action – action that takes account of, and is suited to, the paradoxical nature of human systems..

If you would have a thing shrink
You must first stretch it;
If you would have a thing weakened
You must first strengthen it;
If you would have a thing laid aside
You must first set it up;
If you would take from a thing
You must first give to it.¹⁰

⁹ See Russell and Whitehead's theory of logical types, from which Bateson's theory of levels of learning is developed (1973 pp 250 - 279).

¹⁰ LAO TZU (1963) Tao Te Ching (transl. D.C.Lau) Harmondsworth, Middlesex: Penguin Books p.95

`When in 1334 the Duchess of Tyrol, Margareta Maultasch, encircled the castle of Hochosterwitz in the province of Carinthia, she knew only too well that the fortress, situated on an incredibly steep rock rising high above the valley floor, was impregnable to direct attack and would yield only to a long siege. In due course, the situation of the defenders became critical; they were down to their last ox and had only two bags of barley corn left. Margareta's situation was becoming equally pressing, albeit for different reasons: her troops were beginning to be unruly, there seemed to be no end to the siege in sight, and she had similarly urgent military business elsewhere. At this point the commandant of the castle decided on a desperate course of action which to his men must have seemed sheer folly: he had the last ox slaughtered, had its abdominal cavity filled with the remaining barley, and ordered the carcass thrown down the steep cliff onto a meadow in front of the enemy camp. Upon receiving this scornful message from above, the discouraged duchess abandoned the siege and moved on.¹¹

5 EMERGENCE: MAKING IT UP AS WE GO ALONG?

Emergence refers to the way that the behaviour and qualities of systems emerge from local, unco-ordinated interactions.



`In systems such as the economy, the actions of individual players in the market are not co-ordinated in any way, yet the overall behaviour of the market emerges from the combined impact of their actions'. (Battram 1998 p.33)

`Casti (1997) defines "emergence" as an overall system behavior that comes out of the interaction of many participants – behaviour cannot be predicted or "even envisioned" from a knowledge of what each component of a system does in isolation.¹²

5.1 Example from practice: assessment as emergent

¹¹ Watzlawick, P., Weakland, J. And Fisch, R. (1974) Change - Principles of Problem Formation and Problem Resolution New York: W.W. Norton p. xi) (157.946 WAT)

¹² Lissack, M. (1999) `Complexity: the science, its vocabulary, and its relation to organizations', Emergence; a journal of complexity issues in organizations and management Vol 1 No. 1 pp. 110 - 126

Assessment criteria are 'givens', are they not? Don't we put lots of time into defining them, and linking them logically to learning outcomes, level descriptors and the like (see our curriculum mapping for the 2000 Subject Review)?

I wonder, though, how much this downplays the extent to which assessment criteria are in effect emergent, negotiated and re-negotiated each time they are used. We all know that criteria are imprecise, impossible to specify definitively, and open to interpretation.

Assessment on our MSc CASS intentionally involves students in self and peer assessment¹³. This probably highlights the extent to which assessment criteria are uncertain, and acquire meaning through usage, because students have to learn to use them. I am aware that assessment on this programme becomes an interesting, sometimes challenging, and complex dialogue that opens up questions of meaning, and thus of purposes and values that lie behind the criteria.

This is both an intrapersonal and an interpersonal dialogue. I debate assessments internally, for example between my intuitive apprehension of a student's work; my insights into what they are saying 'between the lines'; and my literal sensing of what they have written. Interpersonally, I may be in dialogue both with academic colleagues and, at times, with students. These dialogues give me feedback too about the types of outcome I have specified, and thus about the educational intentions and values underlying a module.

I can recall such dialogues where I have upheld, fiercely, a criterion I believed to be important, only later to question whether I had got the criterion itself out of perspective with the intentions and values. Most often, I am aware that in 'second-marking' I create a basis for debate and (at best) inquiry between myself and a 'first marker'; and that, while often our independent assessments will be in agreement, discovering how another person has set intentions and interpreted criteria will give me a different perception of an essay.

From a Complexity perspective, I perceive the stating of criteria as putting down markers around which such dialogues form and (self-) organise; and the dialogues can in turn influence and re-shape the criteria. This does not happen so radically as to tear up the whole assessment process; it is more subtle. But this is quite different, I suggest, from seeing criteria as a pre-defined, pre-empted reality.

At heart it is as simple as acknowledging that speaking something out loud changes its meaning. We hear it for ourselves, and voice it in relationship to another person; it is the difference between musical notation and performance. All performance creates the possibility for improvisation, even if only through the expressiveness with which some stipulated notes are played¹⁴.

¹³ GREGORY, J. and TOSEY, P. (2000) 'Self and Peer Assessment of Experiential Learning in Higher Education', HPRG, University of Surrey

GREGORY, J. (2002) 'Assessment of Experiential Learning in Higher Education', in JARVIS, P. and Associates *Theory and Practice of Teaching* London: Kogan Page pp. 171 - 188

¹⁴ jazz improvisation is a practice used by American author Frank Barrett to illustrate the emergent behaviour of complex systems.

Possible learning from this example, about related principles from Complexity Theory:

5.2 Reality as emergent and co-constructed: dialogue

`Reality' (ie what people take to be reality) is emergent, in the sense that it is constructed through interaction and dialogue. By analogy, the culture of an organisation is emergent, and can evolve or change spontaneously, regardless of, and sometimes in spite of any stated `core values'.

Change happens less through planned programmes and interventions, more through free flowing conversations (Stacey 2000) and `complex responsive processes' (Stacey 2001). `Strategic direction is not set in advance but understood in hindsight as it is emerging or after it has emerged' (Stacey 2000 p.413).

5.3 Reality as recursive and transient

Such constructions of reality are recursive; in other words, dialogue about assessment criteria is not simply a process of clarification, it can change the assessment criteria because a new understanding emerges. Any construction of reality is temporal and transient --as in postmodern thinking, there are no absolutes. The future is emergent and unpredictable.

5.4 Local interaction

No two situations are the same, and what works in one situation will not necessarily work in another.

6 THE EDGE OF CHAOS¹⁵: THE PRACTICE OF PSEUDO-CHANGE¹⁶?

The term 'edge of chaos' refers to the dynamic of (between) stability and instability; turbulence and disequilibrium.

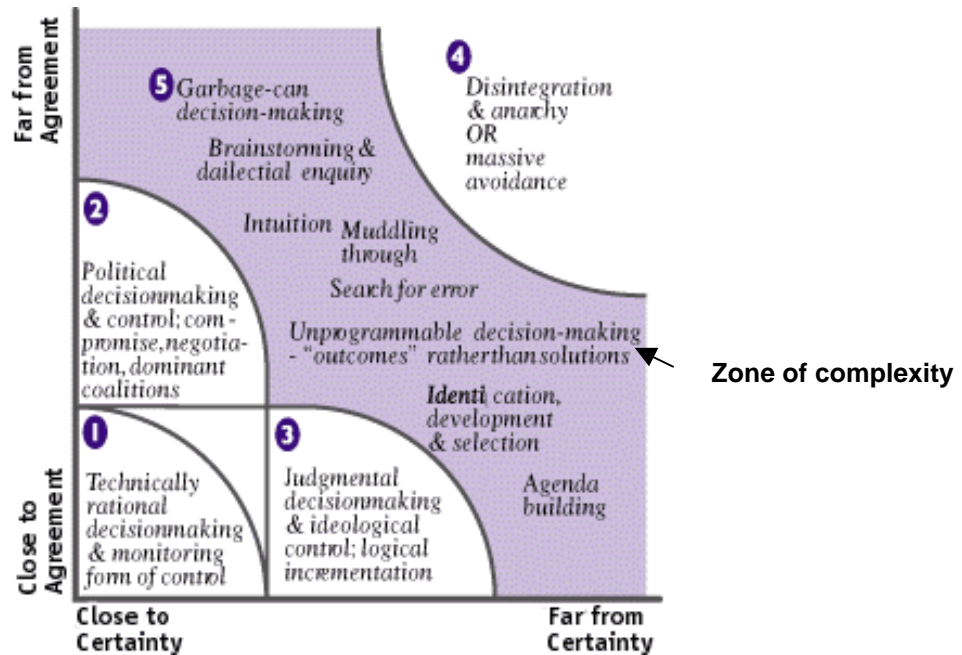


Diagram of the Edge of Chaos/Zone of Complexity (from

http://www.plexusinstitute.com/edgeware/archive/think/main_aides3.html,

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'There is a large area on this diagram which lies between the anarchy region and regions of the traditional management approaches. Stacey calls this large center region the zone of complexity - others call it the edge of chaos. In the zone of complexity the traditional management approaches are not very effective but it is the zone of high creativity, innovation, and breaking with the past to create new modes of operating.' (Zimmerman, see reference for diagram)

The implication is that systems operate best 'at the edge of chaos'. At the edge of chaos, change can occur easily and spontaneously. It is like a good party; lively, lots of flowing conversations, and fun. A party in stasis would be safe, but probably boring and stilted; one in chaos might be thrillingly anarchic, or perhaps offensive or dangerous. In chaos, a system could self-organise into a higher level of complexity, with novel forms of relationship emerging, or it could disintegrate.

¹⁵ A term coined by Chris Langton from the Santa Fe Institute

¹⁶ 'Hirschhorn (1997:123) summarises the impact of using such approaches – they produce pseudo-results "to keep underground the political conflicts, interpersonal skirmishes, and serendipitous actions" that shape actual outcomes.' (Hirschhorn L., 1998, Reworking Authority: Leading and Following in the Post-Modern Organization, Cambridge Mass: MIT - cited by Rowena Davis, unpublished notes)

‘This balance point – often called the *edge of chaos* – is where the components of a system never quite lock into place, and yet never quite dissolve into turbulence, either’. (Waldrop 1992 p.12).

6.1 Example from practice: towards or away from the edge of chaos?

The MSc CASS is quite an unusual type of programme. We use experiential learning throughout. Personal development and the emotional and spiritual dimensions of participants’ lives are part of the programme agenda. As noted, self and peer assessment is prominent and significant.

As director of this programme for its first few years, I was acutely aware of potential threats to the programme from its non-standard nature. The move towards modularisation, for example, threatened the principle of having a closed, peer learning community. The high level of face to face contact made the programme appear quite resource-heavy (although the programme has always been fully self-financing). Self and peer assessment clashed with many academics’ assumptions about who should be in charge of assessment.

I therefore used to do a lot of what I called ‘boundary management’, in the sense of protecting the programme from such perceived threats. I would find ways to adapt to, for example, University requirements and systems, so as to justify and defend the programme against the – my – perceived threats.

In retrospect, I believe I may have done this to an exaggerated, unnecessary and unhelpful degree. The challenge I now put to myself is of the extent to which I was keeping the programme ‘close to agreement and certainty’ on Stacey’s map. The positive side of this was that the programme, I still believe, represents a considerable achievement in its integration of personal development and academic degree. But the downside is that I restricted the programme’s radical potential. Perhaps, in the guise of protecting the programme, I was actually doing more to shield the rest of the University from the challenge it might represent – and thus was protecting myself from the risk and discomfort of championing something new and different. Indeed, through my own lack of confidence and tendency to avoid conflict, I tended to see the programme’s distinctive characteristics more as abnormalities to hide than as excellence to celebrate!

What this highlights for me is the potential for ‘pseudo-change’ in my educational practice. What I mean by this is that I constantly have choices – about how to teach, how to organise programmes, how to respond to students, and so on. With each choice I can choose to move towards the ‘edge of chaos’; or back towards stasis (or into chaos, or elsewhere on the matrix).

The challenge here is that when I move towards stasis, am I doing so awarely? Am I introducing changes that effectively interfere with the system’s capacity for evolution, by keeping it away from the edge of chaos? Am I doing so, for example, to preserve stasis for myself? Even where I am psychologically robust enough not to need to avoid conflict, might I veer away from the edge of chaos simply to avoid creating work for myself?

Alternatively, do I create more work for myself by adapting to students’ (customers’) demands (another type of movement towards stasis) rather than staying with the potential risk and anxiety of inquiring into the student’s underlying need? I am often aware of this in teaching, for example, when I catch myself responding to the content of a student’s question (e.g. ‘do we have to do X in this essay?’) rather than inquiring into its underlying statement or need (‘I don’t see the point of X’).

I feel this same applies at, for example, a Board of Studies. Here is an official forum for participation and for exchanges of views. Should we not be using this type of forum to practice what we preach, especially because students are involved? Where better to model inquiring behaviour? My experience, however, is that the change of context is significant and dramatic. At

a Board of Studies one might sometimes be forgiven for believing that lecturers specialise in an ability to discount student's views and concerns (whilst appearing to take them seriously).

This example links back to the principle of paradox; 'good' boundary management in the MSc CASS also reduces risk and may obstruct the spread of new practice.

Possible learning from this example, about related principles from Complexity Theory:

6.2 Connectivity

The principle of 'connectivity' is that a system's behaviour relies less on the nature of individual agents than on the quantity and quality of connections between them. This encourages us to emphasise relationship, as when we have a 'good' group of students who support each other and develop a sense of community.

6.3 Inquiry

Stacey (2000 p.412) emphasises the need for agents to take an inquiring attitude – a movement towards self-awareness and reflection. This would include inquiry into our own 'dialogue'/rhetoric (as educational professionals) and into how we may be preserving the status quo, privilege etc, whilst advocating change.

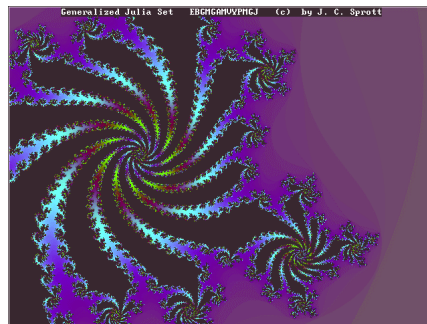
6.4 Minimal structure

Complex adaptive systems appear to operate best according to simple rules or principles. The more complicated the rules, the more the system is likely to 'freeze'.

For example: 'a Himalayan mountaineering expedition adopted three rules (principles) that guided them through the trip:

1. We all return safely
2. We return as friends
3. We climb the mountain

These rules, in order of priority, then informed all their actions and ensured that they maintained a healthy perspective on what signified success.¹⁷



¹⁷ Jones, M. (2002) MSc Dissertation, School of Educational Studies, University of Surrey, p. 27

7 Concluding Thoughts

7.1 *There is a 'saving grace'*

Complexity Theory is often heralded as something new. My own belief is that we all, already, have a tacit awareness of the paradoxical nature of systems. It is just that we do not take this as seriously as we might, and we only use it in certain contexts.

What do I mean? For example, as educators we already often recognise that we cannot control or determine (many forms of) learning; that students are essentially **self-organising**; that (much) learning is **emergent** and constructed – and often the most valuable learning is like this. Most of us recognise the **paradox** that if we focus on learning (product) that can be 'engineered' we limit the educational experience. Many of us believe that the best we can do – and that what we should do as professionals – is create conditions under which learning is likely to emerge, and that our educational relationship to students is highly influential – we do not stand outside their learning. This necessarily means working at the **edge of chaos**.

7.2 *Implications for enhancement?*

The underlying question this all raises for enhancement is, in my view; 'what is our theory of "learning systems"?' In other words, what is our theory of the behaviour and dynamics of the systems we are striving to enhance; and thus what is the theory guiding our interventions?

Complexity Theory is one possible guiding theory. It appears to have advantages in its capacity to represent some of the more apparently 'illogical' behaviour of learning systems; and it offers a robust and penetrating challenge to theories based on more linear or mechanistic assumptions about human systems.

Complexity Theory can therefore assist our reflections on practice, and may indicate creative alternatives to typical strategies for enhancement. For example, what if we applied it more explicitly to the programmes/learning systems we create and manage? If we were to take the world-view of Complexity Theory seriously – i.e. if we were to treat it 'as if it were true' – what might we do differently in our educational practice? We might:

- accept that we are not in control
- stop and inquire any time we were tempted to try to 'make' students behave a particular way
- explore how to base learning systems on 'minimal structures' of simple principles
- promote 'connectivity' among the agents in the learning system (students and staff)
- have ways of inquiring critically into our own 'theories in use' of teaching and learning, and programme management
- understand that all our behaviour is both an act of teaching and an act of 'governance'.

7.3 *The wider context; policy etc.*

As I said at the beginning, all complex adaptive systems exist within, and in relationship to, other complex adaptive systems. It is in principle impossible to isolate a system. So, our learning systems exist within the context of wider systems such as educational institutions and national policy frameworks.

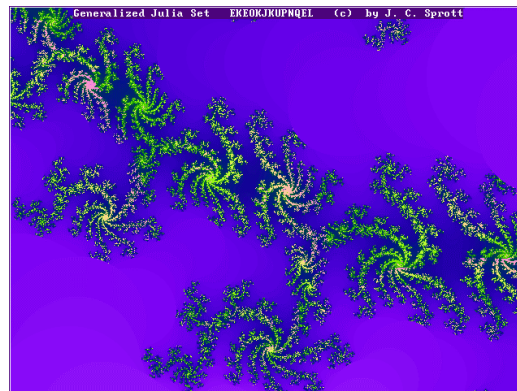
I have chosen here to focus on the local, but these wider systems are highly significant. I believe that in many ways our local actions and problems mirror the features of the macro system. Note that the micro and macro systems are mutually influencing; this is by no means to suggest that the wider system somehow causes our local problems, and that we can therefore relinquish responsibility for our choices and actions.

To consider the wider system from a Complexity Theory perspective would take another paper. You might wish to consider the implications of self-organisation, paradox, emergence, and the edge of chaos, for a policy-making framework whose raison d'être seems to be to engineer particular outputs and system behaviours.

Efforts from the wider system to create excellence at local level appear not to be predicated on this type of understanding of human systems, and their effect is often to steer us away from the edge of chaos. Very briefly, as I experience it the pressures from the wider system (for example, the QAA framework; the RAE; funding systems) are often towards creating certainty and risk reduction, but through overloading local systems with demands. This seems to drive local systems both towards stasis (e.g. we can concentrate on producing ever neater and tighter controls, quality assurance systems, etc.) and towards chaos (e.g. overload of inputs – demands for QA returns, monitoring of research projects and funding, on top of local process of restructuring – may lead the system towards breakdown).

The paradoxes are that systems cannot be creative and innovative in an orderly fashion; nor can they be excellent if their every move is monitored¹⁸. From a Complexity Theory perspective, one would expect the local system that wishes to survive to have to filter these demands, reducing, ignoring or perhaps transcending the input overload and refusing to become locked into stasis.

This is necessarily a simplification of the dynamics. Nevertheless there seems to be a need for attention to, and debate about, the unintended consequences of strategies of educational change. Otherwise, like Alice, we may be doomed to the exhaustion of running faster and faster just to stay in the same place.



¹⁸ Like the apocryphal story of the person who planted a seedling, took it out of the soil every day to see how well the roots were forming, and then wondered why it died.

8 Selected References (from University of Surrey library)

- BATESON, G. (1973) Steps to an Ecology of Mind, London: Paladin, Granada (150 BAT)
- BATTRAM, A. (1998) Navigating Complexity The Industrial Society (302.35 BAT)
- BINNEY, G. and WILLIAMS, C. (1995) Leading into the Future: Changing the way people change organizations London: Nicholas Brealey (65.014 BIN)
- BROWN, S.L. and EISENHARDT, K.M. (1998) Competing on the Edge: strategy as structured chaos Boston: Harvard Business Press (658.4012 BRO)
- CILLIERS, P. (1998) Complexity and Postmodernism: understanding complex systems London: Routledge (117 CIL)
- DARWIN, J., JOHNSON, P. and McAULEY, J. (2002) Developing Strategies for Change Harlow, England: Pearson Education Ltd. (658.406 DAR)
- KAUFFMAN, S. A. (1993) Origins of Order: self organization and self selection in evolution Oxford: Oxford University Press (575 KAU)
- PHILLIPS, K. and SHAW, P. (1998, 2nd edition) A Consultancy Approach for Trainers and Developers Aldershot: Gower (658.386 PHI)
- STACEY, R. D. (2000) (3rd edn) Strategic Management & Organisational Dynamics: the challenge of complexity London: Routledge (65.0122 STA)
- STACEY, R. D. (2001) Complex Responsive Processes in Organizations London: Routledge (658.403 STA)
- STACEY, R. D., GRIFFIN, D. and SHAW, P. (2000) Complexity and Management: fad or radical challenge to systems thinking? London: Routledge (658.4 STA)
- WALDROP, M. (1994) Complexity: the emerging science at the edge of chaos London: Penguin (501 WAL)
- WEICK, K.E. (1995) Sensemaking in Organizations London: Sage (158.7 WEI)
- WEICK, K.E. (2001) Managing the Unexpected San Francisco: Jossey Bass (658.4056 WEI)
- WEICK, K.E. (2001) Making Sense of the Organization Malden, Mass.: Blackwell (158.7 WEI)
- WHEATLEY, M.J. (1992) Leadership and the New Science: Learning about Organisation from an Orderly Universe San Francisco: Berrett-Koehler (500 WHE)

9 Websites

The Complexity & Artificial Life Research Concept for Self-Organizing Systems: 'an on-line educational activity of CALResCo (an organisation dedicated to promoting understanding of complex system sciences), for scientist, artist and humanist, young and old'
<http://www.calresco.org/index.htm>

'An Introduction to Complexity in Social Science', Bernard Pavard & Julie Dugdale, GRIC-IRIT, Toulouse, France
<http://www.irit.fr/COSI/training/complexity-tutorial/complexity-tutorial.htm>

The Santa Fe Institute
<http://www.santafe.edu/>

'Edgeware' - complexity resources for healthcare professionals. Includes the article about Stacey's 'Agreement and Certainty Matrix' (related to the 'Edge of Chaos' idea). Other useful articles and links on the same site.
http://www.plexusinstitute.com/edgeware/archive/think/main_aides3.html

'This site is the work of a University of Pittsburgh doctoral candidate. It contains a host of references, papers on business applications, and links to other web sites.' (link from 'Edgeware')
<http://www.brint.com/Systems.htm>

Systems Thinking Practice

'A joint effort to create a unique, interactive yellow pages directory to Systems Thinking and related activities on the Web.'
<http://www.sgzz.ch/home/links/stp/sysbasis.htm> (updated 21.11.01)

Whole systems

'This area is devoted to the study of whole systems.' (many links)
<http://www.worldtrans.org/whole.html>

The Tangled Web: a non-hierarchical celebration of entanglements
http://www.lawrence.edu/dept/environmental_studies/tangledweb.html

The Complexity and Management Centre, Business School, University of Hertfordshire, UK (Ralph Stacey's Unit)
<http://www.herts.ac.uk/business/centres/cmcc/>

Website of the Complexity and Organisational Learning Research Programme at the London School of Economics. Includes an extensive bibliography.
<http://is.lse.ac.uk/complexity/default.htm>

Emergence: A Journal of Complexity Issues in Organizations and Management
<http://www.emergence.org/>