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Linking the global and the local in educational research: some insights from dynamic systems theory

Tamsin Haggis, University of Stirling

Furlong's (2004) recent discussion of 'the re-emergence of the paradigm wars' draws attention to the remarkable resilience of what Martin Hammersley (2002) has called 'two worlds theories' in educational research (e.g. theory/practice; quantitative/ qualitative; global/local). Although the last thirty years or so have witnessed a range of analyses and deconstructions of binary thinking from a variety of critical and postmodern perspectives (see, for example, Derrida, 1976; Kaufman, 2001; Parker, 1997, Stronach & McLure, 1997), such thinking appears to be particularly recalcitrant within educational discourses.

One reaction to this critique appears to be a tendency for contemporary discourses, for example, in relation to quantitative and qualitative approaches, to attempt various types of theoretical compromise. An example of this is the promotion of mixed methods (e.g. Gorrard *et al,* 2001), which appears to suggest that the different approaches are *complementary* perspectives, which together provide a fuller, more rounded, picture. In this view, a case study often appears to be seen as providing the detail that fills in a larger scale, more quantitatively-derived pattern. Such moves, however, side-step some fairly fundamental questions; for example, if a case study is simply the detail of a larger-scale pattern, why does a large scale generalisation tend to have little or 'no applicability in the individual case' (Guba & Lincoln, 1998:198)? In reverse, why is there such trouble in using the insights derived from local, context-specific investigations in situations which lie beyond the original context of investigation? Whilst researchers working with postmodern perspectives may feel confident about their analysis and interpretations only being able to engage with 'local narratives' and 'situated truths' (Sumara *et al,* 2001), the perceived pressure to re late the results of small-scale, local types of study to other, different, situations within a wider context still creates theoretical tensions for many researchers.

This paper will examine these tensions by attempting to create a 'departure' from the usual 'discipinary orbits' associated with educational research (Derrida, 1976, in Stronach & McLure, 1997:3). Whilst postmodern and feminist perspectives attempt to challenge the assumptions of traditional sociology and psychology by using literary theory, or the visual and performing arts, the discussion here will use complexity theory, a perspective from the theoretical sciences, as its interpretative frame. Postmodernist and feminist approaches focus on discourse, text and power, and embody an intention to destabilize and complicate. Complexity and dynamic systems theories, on the other hand, have nothing particularly to say about text, language, or power, and might be seen by postmodernists as an attempt at a new kind of metanarrative. It will be argued here, however, that this perspective offers a new way of examining educational research slightly differently from within, rather than from without, some of its traditional assumptions. Rather than trying to ignore, resolve or transcend the binary of qualitative and quantitative, this analysis will deliberately use a binary summary of these different positions in order to complicate and draw attention to the relationships which such polarities involve.

A binary to explore binaries
The suspicion with which many researchers now treat any kind of binary conceptualisation is arguably in danger of reducing the possibilities for thought, rather than, as originally intended, expanding such possibilities. Moran (2000) suggests that the current tendency to reject all oppositions is a misunderstanding of Derrida's intention, which was to force a questioning of the way that oppositions are valorised, rather than an attempt to overturn them. It could be argued that, at least in Anglophone cultures, binary concepts perform a crucial function in defining and delimiting an area to be discussed, with the extremes of opposed polar positions provide a starting point for dialogue. It is on this basis that the analysis here will begin by creating a working, binary definition of tendencies within different types of educational research.

For the purposes of this discussion, ('grand') theory and quantitative research will be taken to be connected in the sense that both try to produce general principles that will apply beyond specific contexts. Similarly, practice and qualitative research will be taken as connected in the sense that both attempt to deal with the complexities which arise in more localised, specific contexts. These general distinctions will be referred to as large and small scale approaches to research. It must be stressed that this is a temporary conceptual creation, which collapses a great of subtlety and potential argument. Furthermore, even within these parameters, it has to be recognised that researchers concerned with more localised, small (or medium) scale types of research are often also interested in creating theory, and, of course, that 'research is itself also a form of practice' (Hammersley, 2002:65). These are some of the problematic issues that the paper sets out to explore.

The relationship between large and small scale types of research is rarely examined in detail. Hammersley's discussion of macro and micro-level theories (1984; Hammersley and Atkinson, 1995), for example, refers to 'a dimension along which the scale of the phenomena under study varies'. This suggests a continuum but does not say anything about the nature of each, in relation to the other. Hammersley and Atkinson's discussion of attempts to integrate these two levels 'to show that there is only one level, not two' (*ibid.*) suggests that they are seen as separate; a position which Hammersley states more clearly in his more recent discussion of these issues(2002 [1]). In the earlier paper (1984), however, the suggestion that micro level investigations can test macro level theory implies that both are, in the end, operating within the same ontological and epistemological world. From this perspective, whatever it is that is being researched, identified and tested, at the two different levels, appears to be seen as ontologically consistent.

This assumption of ontological consistency also underpins the way that data are most commonly analysed, despite the sometimes very different philosophical positions which large and small scale approaches may be aligned to. Unless the study is longitudinal, or biographical (and often even then), both quantitative and qualitative data tends to be analysed cross-sectionally. This way of creating categories of 'things held in common' (eg. correlations, concepts, typologies, hierarchies) is so fundamental to research in the social sciences (Llewlyn, 2003) that it is rarely commented upon in conventional educational research discourses (despite the fact that postmodern and feminist analyses continue to question this approach from a variety of perspectives). The conventional approach could be seen as a *distancing* form of abstraction, in the sense that it assumes that the pattern that can be seen as the researcher becomes 'disentangled' from examples of the particular will be more useful for creating knowledge that any patterns that may exist at the level of the individual.

The assumptions which underpin much cross-sectional analysis could be summarised as follows:

- Firstly, research can only be done by *abstracting* from specific examples
- Secondly, processes of abstraction self-evidently require the creation of *distance* from the particular
- Thirdly, distancing is required because this is the only way to perceive *meaningful connections*. Meaningful connections here are patterns of *similarity*
- Finally, connections, when assumed to exist, are seen to be *consistent* across all levels, from macro to micro (ie. a case study will provide detail within a larger study)

Feminist and postmodern researchers have attempted to confound these assumptions by coming at them from unexpected angles, attempting to disturb and topple them through the use of perspectives from radically different disciplines. The analysis I am offering here, however, is far less ambitious, asking questions, at least initially, from within the same frame of reference. Even from within, however, potential inconsistencies and confusions soon appear. Though highly productive, this approach does not, for example, provide any account of what happens to the information which such commonality-seeking approaches have to discard; nor does it allow for the idea that what is discarded by the research may nonetheless be exerting an effect on whatever it is that is being investigated (Fogel *et al,* 1997:19). In addition, there are questions about issues such as the nature of the 'structural pattern' which a large-scale research study might be seen to articulate. A social science researcher might see such patterns as being representative of a dynamic aspect of social structure, such as gender relations, for example. The 'findings' of some large-scale educational research projects, however, can appear to suggest that a large-scale pattern which has been identified by the research refers not to dynamic social patterns, but to more fundamental, 'deep' structural mechanisms which are understood to underlie the apparent variety of different cases.

Such problems are arguably connected to a lack of clarity about how the patterns created at different levels of scale (small and large) relate to each other. Both 'dynamic social' and 'generative deep' structure understandings of the meaning of an aggregate pattern can appear to suggest that smaller-scale, individual or local patterns are able to provide more in-depth or detailed information about the pattern created at a larger scale, implying, as has been discussed above, an ontological coherence and consistency which transcends matters of scale. It could be argued, however, that the kinds of patterns which are visible from a distance are in fact quite *distinct* from the kinds of patterns that exist at the local level (Guba & Lincoln, 1998), in a way that is not simply the difference between what can be measured empirically, and what such a measurement may mean to an individual actor (Smeyers, 2001). This appears to be what underlies the commonly expressed idea that generalisations 'have no applicability in the individual case' (Guba & Lincoln, 1998:198). What exactly is a global pattern, if it fragments when it comes into contact with specific situations?

Even when attempts are made to address the relationship between the large and the small, analysis as distancing often appears to be seen as the only option. Hammersley & Atkinson (1995), for example, discuss 'four types of theory' in relation to both macro and micro levels. The most specific of the four types, referred to as 'micro-substantive research on particular types of organisation or situation' (238) gives 'doctor patient interaction' and 'police

encounters with juveniles' as examples. Even in this most local level of theory, it is still a general principle that is sought. It appears to be simply taken for granted that all theory must, by definition, involve distancing from the particular (Flyvberg, 2001).

This situation seems somewhat incongruous when it is considered in relation to many current ideas in educational theorising. Though generalisable, statistically-based models of individual behaviour and cognitive traits remain popular in psychology, for example, these have been joined by newer perspectives which stress the importance of interaction, context, and the need to understand issues of particularity and difference in local situations. Generalised categories such as self, style, type and stage are increasingly being challenged by new interactional and social perspectives such as those of dynamic systems theory (Bosma & Kunnen, 2001), or critical and community psychology (e.g. Burman, 1994). Discussions of learning in areas such as adult education, often reflecting the influence of feminist and postmodern critiques, have also broadened to out from a reliance on atomistic, bounded categories such as 'adult learner', 'developmental stage', 'learning style' or 'special need', towards a recognition of the complexities of difference, and the context-specific nature of such difference (Edwards, et. al., 1996).

These moves could be seen as implying the need for an 'epistemology of the close-up'; a way of accounting for, and of speaking about, the difference and specificity which become apparent at a smaller scale. In terms of the gathering of research data, however, the dominant epistemology is still largely based upon a deliberate *retreat* from particularity, and upon the production of categories based on similarities; both processes which are likely to obscure and silence the ways in which things might be different. Current habits of categorising at both levels also have a tendency to produce static types of concept, rather than concepts which represent the fluidity and change involved in process and interaction (Stehr & Grundmann, 2001)

An epistemology of the close-up?

Johnson (2001) suggests, following Weaver (1948, in Johnson, 2001) that there are three types of scientific enquiry. The first deals with problems involving very limited numbers of variables, and concerns issues such as the movement of the planets around the sun (the approach underpinning Newtonian mechanics). The second approach deals with problems with are characterised by 'millions or billions of variables that can only be approached by the use of statistical mechanics and probability theory' (2001:46), which he calls 'disorganised complexity'. This perhaps could be seen as a fair description of the approach taken in much Social Science research. He suggests, however, that there is a field between these two approaches which deals with a still substantial number of variables, but with one crucial difference:

> much more important than the mere number of variables is the fact that these variables are all interrelated… these problems, as contrasted with the disorganised situations with which statisticians can cope, *show the essential feature of organisation*. We will therefore refer to this group of problems as those of *organised complexity*.
>
> Weaver, 1948, in Johnson, 2001: 47 (italics in original)

Much large-scale educational research can perhaps be conceptualised as attempting to deal with 'disorganised complexity'. The standing back involved in attempts to uncover general principles entails deliberately discounting relationships *within* individual systems (people,

cultures, classes, schools), as the interconnectedness of the elements within these types of units are seen to be too specific to be useful for the purpose of extracting a general principle. By contrast, dynamic systems theories (Fogel. *et. al*, 1997; Richardson, 2000; Valsiner, 1998) whether conceived of as versions of complexity theory (Cilliers, 1998; Byrne, 1998), or as theories of emergence (Johnson, 2001), concern themselves precisely with the interactions and relationships that occur within specific (open) systems.

A dynamic system is seen to consist of a large number of components which are interacting dynamically, with the interactions being confined to the local level (Cilliers, 1998). These multiple interactions are non-linear, and involve complex feedback loops which continually adjust and modify the both the 'parts' of the system, and the system itself. As the system is an open one, the interactions can also affect the boundaries of the system itself, and indeed have effects beyond the system.

If there is a sufficient number of these interactions, and if they take place over a sufficiently long period of time, specific forms of order, or organisation, will periodically emerge from within the system:

> (Dynamic systems) solve problems by drawing on masses of relatively stupid elements, rather than a single, intelligent' 'executive branch'…. In these systems agents residing on one scale start producing behaviour that lies one scale above them: ants create colonies; urbanites create neighbourhoods; simple pattern-recognition software learns how to recommend new books
>
> <div align="right">Johnson, 2001:18</div>

Two examples discussed by Johnson describe this in more detail. The behaviour of ants, for example, is believed to come about not as a result of the directions of a queen, but as a result of simple forms of chemical communication between individual ants, which relay information about local conditions. The sheer size of the number of interactions, and the fact that these take place over time, result in emergent behaviour at the level of the colony (moving away from danger, for example, or towards food). Similarly, neighbourhoods within cities organise themselves along lines of social class, and cities themselves continually change and adapt in ways that have not been planned.

Discussion of the unpredictability of emergence in this kind of description of dynamic processes is often misunderstood to imply randomness, chaos or indeterminism. Non-linear systems, however, are in fact seen to be operating causally, though this causality is not of the deterministic, linear kind. What distinguishes it from more linear types of deterministic process is the fact that it is impossible, due to the speed and number of interacting variables, for many of the deterministic processes which are going on to be tracked or observed (Goldstein, 2000). For this reason, the results of the interactions cannot always be predicted, because it is not possible to know in advance what will interact with what, or indeed, what has interacted with what up to that point, and what has resulted from previous unknown interactions. In this sense the history of the interactions both within and beyond the system is crucial in determining the form of future emergences. Furthermore, this is seen to be a completely decentralised process, in that the order which is produced is seen to emerge solely from the multiple interactions. There is no key variable, no centrally-guiding programme or brain, and no one principle factor which makes everything happen. This does not, however, imply that anything at all can emerge, as emergence is ultimately constrained by certain

features of the system itself, and by its interaction with factors and systems beyond its own boundaries (Fogel *et. al.* 1997).

The implications of this conceptual framework have not yet been investigated very much in relation to approaches to educational research, or to the study of learning (see, however, Fenwick, 2003; Osberg & Biesta, 2003). In terms of attempting to find alternative epistemologies of difference, specificity and context, however, these ideas are interesting in that they privilege the importance of local interactions, and the interconnectedness of multiple, different elements in a local situation. The stress on dynamic interactions, for example, provides the potential for talking about 'learners' and 'context' as different kinds of interwoven process which are continually creating, and being created, by each other, rather than as static objects, manifesting characteristics, surrounded by an environment and affected by teachers. This perspective, however, does more than simply highlight processes of change and flow; it suggests that in fact there *is* only change and flow, in the sense that *it is the interactions themselves which are the system* (a person, from this perspective, is entirely 'composed' of interactions). The fact that the interactions produce changing forms of order does not necessarily imply something static, or even bounded. A sense of 'self' may emerge from the interactions of brain and environment, and function to order consciousness, but this does not have to imply that such a sense of self is either static or essential.

Theories of emergence and educational research
A dynamic systems approach could not be used to talk about many kinds of population research, when a 'population' refers to an abstract category which has deliberately been created in order to track statistical patterns in relation to a large number of *different* systems (e.g. different schools, different students). This kind of population, does, of course, exist within a number of larger connected systems; British society, for example, 'working class culture', or 'the English university system'. This conceptualisation of the larger system, however, is not necessarily part of the framing of population-based research, which may be more likely to focus on a population as a category which contains a range of examples of the variation presented by many different, smaller units within the larger system. For example, 'Scottish dyslexic students' are likely to be investigated in relation to their individual psychologies, rather than the way that in which such psychologies might exist in relation to certain cultural/systemic interactions within a particular social group. Similarly, a dynamic systems approach could not be used to talk about themes across data from different interviews, as a theme is an abstract category which has been extracted from the different systems (and systems of meaning) which the individual interview texts represent.

A dynamic systems perspective draws attention to the importance of the interactions *within* open systems. Research mechanisms which deliberately cut across systems cannot, by definition, track the ways in which different elements within a system react together to create certain types of outcome. Views from outside selected systems can track what can be seen to emerge from the different systems, but not the processes which led to these types of emergence. This reverses Silverman's (2001) notion that qualitative research can only describe the 'what' and 'how', with quantitative research providing the answer to 'why'; here it is the study of a particular set of systemic interactions which would provide clues as to the 'why' of specific forms of emergence.

These ideas could offer a new perspective on the problems outlined above in relation to the connection between macro and micro levels of research activity. Research results and/or theory are usually aggregated abstractions, which it is nonetheless expected will be 'applied'

to specific situations in a way that is meaningful to that specific situation. Though researchers are often blamed for the difficulties or failures involved in these attempts at connection, such failure could be because the logic/pattern which exists at the abstract level is simply not echoed further down the line. Patterns which exist at the level of the situated, particular example are arguably quite different from larger, aggregate patterns, because they are produced in a different way. From a dynamic systems perspective, patterns at the local level are the emergent properties of the multiply interacting variables which make up the open system which is the focus of attention. These emergent properties are *specific to the system being investigated* (although this does not preclude the possibility that similar properties might emerge from the interactions of a different, but similar open system). By contrast, an abstraction (e.g. a research model, or a policy innovation) is created by aggregating the similarities that can be seen when a number of unconnected open systems are viewed from a distance. What can be seen from a distance, however, is not an 'underlying' principle which unites the different cases, but simply a particular kind of shape. Selective qualitative investigations carried out within large scale studies cannot, from this perspective, 'illuminate' 'or 'flesh out' the pattern of connections that exist between different systems, because such patterns only *exist* at a distance. Individual cases, on the other hand, are operating in relation to their own sets of variable interactions, which the distance pattern, by definition, has had to filter out of view.

Interacting multiple worlds: distinct, but interwoven

For some early attempts to use this approach in the analysis of data, see Haggis, (2004a) and Haggis, (2004b). These papers report on two different analyses of the same set of interviews with a small group of mature students talking about learning in higher education. In both papers the results of a normal, distancing type of analysis are compared to a second, more 'indeterminate' type of analysis, which explores the patterns which begin to emerge when multiple factors in an individual case are considered in detail, without looking for causalities or even correlations. What emerges from this, particularly when contrasted with the dominant models of learning in higher education, is an argument that an understanding of difference could be as important in understanding learning as an understanding of commonalities. The analysis explores how patterns of meaning begin to emerge within individual accounts, when using this approach, in ways that are quite different from the type of pattern which might emerge from a cross-sectional analysis. What these papers argue for is not necessarily different from what many qualitative researchers are already doing in biographical and life history types of analysis. Dynamic systems/complexity theory, however, may be able to provide a different kind of language for talking about what it is that non-generalising studies attempt to do.

A dynamic systems perspective appears to reverse most of the assumptions outlined in the first part of this paper. Abstraction which operates by creating distance from the particular could be seen, rather than as potentially enabling the isolation of 'key principles' (in relation to different individual systems), instead as actively destroying the very interactions and connections which constitute such systems. If the aim of the research is to understand the functioning of individual systems, this perspective seems to suggest that it is necessary to study such systems 'close-up', in relation to their own interaction histories. Distancing approaches, by contrast, compare emergences *from* the interactions of a given system (often at a given moment in time) with the emergences from other, different systems. In some situations it would simply require a conceptual shift to begin to move from one type of analysis to the other, in the sense that distancing abstractions carried out in relation to

separate, unconnected systems could become 'close-up' abstractions if the different systems being investigated were instead conceptualised as being interrelated features of the larger systems that contain them.

The perspective outlined here begins to provide an articulation of why generalisations cannot be applied to particular cases, or why a case study cannot simply provide the detail of a larger scale pattern. The interactions within a system are constrained both from within the system itself (in relation to its initial conditions and circumstances), and by its interaction with other, different systems which simultaneously exist both within and beyond its own boundaries (eg. culturally enacted discourses of gender, class, etc.). The history of the interactions within any given system, however, and what this interaction history produces in terms of emergence, is always particular to the individual case. A cross-system pattern which has been created through comparing the external features of (or emergences from) a number of different systems is thus ontologically distinct from the patterns of interaction which could be described at the level of a particular system. Because some of the interactions within smaller systems are also interactions within larger systems, however, an abstraction created in relation to different systems within a population (eg. 'characteristics of dyslexic students') might also represent some of the interactions of the larger system pattern as well ('effects of British societal attitudes to expressions of dyslexia').

The interrelatedness of distinct systems creates the paradoxical situation of an ontological distinction between the 'two worlds' which (perhaps bizarrely, for the western mind) is at the same time non-dualistic. The worlds are separate, whilst being at the same time completely enmeshed. What connects them, however, is not the common underpinning of a deep structural unity, which becomes ever more secure as the scale at which the pattern can be shown to persist becomes larger. From a dynamic systems perspective the worlds instead make up a multidimensional 'space of flows' (Castells, 1996); an interconnected system of interwoven larger and smaller systems, which are interacting dynamically in relation to boundaries and constraints which are themselves constantly undergoing modification. Although each set of systemic patterns is determined by the individual makeup and history of that particular system, systems are themselves partly constituted by 'elements' of other systems (though these consist of interactions, rather than entities), and are thus constantly interacting with aspects of themselves which are, at the same time, beyond them.

Conclusion

Dynamic systems theories appear to offer a new way of looking at things which previously could not easily be seen. The focus on phenomena as open systems composed of interactions, rather than objects; the impossibility of tracking multiple causalities which nonetheless produce patterns of order and meaning; and the importance of time, history and specificity, all appear to offer something new in relation to the ancient divisions implied by dualities such as theory and practice, large and small, and quantitative and qualitative forms of research.

Dynamic systems thinking could hold out theoretical promise for researchers who may be trying to find ways of illuminating complex, human aspects of learning which tend to be reduced or left out of many current research frameworks. It does this in a number of ways. Firstly, it provides an acknowledgement of the complexity of phenomena, rather than attempting to reduce complexity to simplified abstractions. Secondly, it provides a rationale for a focus on the ways that things are interconnected, rather than demanding various forms of separating out from context. In this sense, it offers a way of engaging with the often rather

general idea of 'context' in quite specific ways. Thirdly, it offers a way of thinking about process and change, rather than modelling state, 'type' and condition. A possible application of this in education could be to change the distancing, abstracted question of 'what works?' into a specific, process question such as 'what is happening when something is working'?

Finally, this type of thinking articulates a different vision of causality and determinism. Processes of interaction and emergence, although largely untrackable, are seen to be generated in a way that is logical and consistent with the interactions between different parts of (and beyond) the (open) system. It may be impossible to track the pathways that lead to the emergence of schizophrenia, a meaningful sense of the world, or motivation to learn, but the appearance of these conditions and orientations, from a dynamic systems perspective, is an outcome which is likely to be consistent with the interacting factors involved. This idea offers the potential of a different way of thinking about why emergences can be difficult to understand when they are viewed from a perspective beyond the system that generated them, and when they are compared with emergences from other, different systems. It is only when a system is observed from a vantage point which is *outside* of that system that things appear to be 'messy', contradictory or unexplainable; in relation to the internal dynamics of the system, what emerges is seen to be a direct result of the various interactions involved, even though these cannot be precisely measured or anticipated.

This suggests, perhaps surprisingly, a position that appears to be congruent with a more 'natural science' view of phenomena as being based on principles of ordering and consistency. Naturally occurring systems do produce changing forms of order, in the sense that, if they did not, there would be no system (selves, groups, cultures). Such order, however, may not exist in the form of 'underlying principles' which can be identified and then applied to multiple occurrences of different phenomena. Unexpected patterns of natural order may in fact exist more obviously in the very places where one might least expect to find them; in the local, the situated, rather than being visible from the perspective of a 'god's eye view'.

[1] Hammersley (2002) does also discuss problems with this idea of separated worlds, but he approaches the idea of what the worlds might have in common from a different perspective to that being discussed here.

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