

Prediction, Control and the Challenge to Complexity Science

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Abstract

The improvement discourse, currently in vogue, is based in a 'big science' perspective. The call is for an 'evidence base' that shows which policies and strategies 'work'. The methodology is of reduction, factor analysis, and prediction with an aspiration to control. The gold standard is the random control trial.

Complexity science challenges and undermines this kind of discourse, but what does it put in its place? Complexity theory offers reactive strategies to chaotic situations but how effective is it in proactively guiding action in relation to the improvement agenda? Can complexity help us to predict and manage the outcomes of developments in schools?

Two options are open to us. One is to simply challenge and seek to undermine the improvement discourse as simplistic and destined to fail. The best that complexity theory can offer is a view of the practitioner functioning for example, in terms of artistry or as a political operator, both of whom deal with complexity in their respective domains. The second option is to try to replace the simplistic reductionism of traditional science with complex modelling systems, to identify attractor states within organisations and recursive symmetries that may restore the element of prediction and control.

Introduction

In presenting this paper to this conference I fear that I may fall into two errors, the one is teaching my grandmother to suck eggs and the other, preaching to the converted. For this I apologise in advance. If there is an importance to my paper it lies in proposing an intellectual and ideological challenge. We are in danger of starting a new 'paradigm war'. There was little patience among policy makers and practitioners for previous ones and it is unlikely that they will be any better disposed

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towards a new one. As a new paradigm in the context of social and educational theory and research, complexity radically challenges the existing orthodoxy and, as intellectually exciting as this is, unless we can find some way of showing how complexity is a 'better' way of understanding educational systems, we may find the theory as sidelined as a kind of intellectual indulgence.

What makes it better? There are two possibilities. The first is that it is better at doing the kinds of thing that the orthodoxy demands, better at predicting what will happen in schools and classrooms, better at providing specific advice that will support the development of policy or practice. The second possibility is that, insofar as it represents a better picture of the reality of schools and classrooms, it so discredits the demands of the orthodoxy that they are no longer considered reasonable. It shows that the orthodox paradigm does not do what it purports to do and that the best way forward is to minimise external influence in the way of policy and allow for a much more flexible way of working among our practitioners. The first course plays the orthodoxy at its own game, the second seeks a revolution.

The two paradigms: orthodoxy *versus* complexity

Thomas Kuhn used the term 'paradigm' to identify a key theory or perspective around which a range of other theories and perspectives cluster (Kuhn 1962;10). The ancient Ptolemaic model of the universe was assumed into a whole body of enquiries which hung together by virtue of their Ptolemaic assumptions. Copernicus in replacing the Ptolemaic system undermined this assumption and thus challenged the whole framework of theories that went with it. In the case of our understanding of social realities it may be that there are two or three central theories that set the way of thinking about social reality in general and how we enquire into and engage with it.

The orthodox paradigm

The orthodox or 'prediction/control' paradigm works on the assumption that rational or scientific enquiry will yield causal regularities in the world which can then be used to manage material and social events. One might characterise this paradigm as broadly Newtonian insofar as its central theories are that to every action there is an equal and opposite reaction, that systems naturally exist or tend towards a state of equilibrium and that energy within systems is conserved. These theories have lain at the heart of successful technological development in engineering and clinical practice for the previous 350 years. Attempts to see social systems as peculiar kinds of technology that can be managed through the application of scientific principles, are by no means new, but have taken on a particular urgency in recent years. John Furlong in a keynote lecture to the British Education Research Association conference in 2004 referred to the 'big science' approach to educational research although he would have been more accurate if he has prefaced the word science with the adjective 'Newtonian'.

The orthodoxy in the context of educational research, what we have termed the 'prediction/control' paradigm, is characterised by the assumptions that;

- schools can be understood as bounded systems within their communities,

- small causes or interventions produce small effects and large causes or interventions, large effects,
- that social systems naturally tend towards a state of equilibrium,
- that success or failure can be attributed to particular factors in the performance of teachers or managers.

Factor analysis in UK school and classroom research dominates public thinking. For the previous decade the UK Office for Standards in Education (OFSTED) has been amassing specific data about schools from inspections. There is a huge central data bank. At one point one of our more colourful Chief Inspectors of Schools, Chris Woodhead, announced that there would be no more need for research since all the data that was there to be gathered had been and that all that was needed was the classification and analysis of this data to produce a description of the optimally effective school.

A second pronged advance in orthodox paradigm has come in the form of a massive shift of research funds over to the control of the Teacher Development Agency who through a system of 'best practice scholarships' have supported teachers in researching their own practice. They feed their findings into an accumulation of research outcomes that might similarly build towards a picture of optimally effective performance. For this purpose the action research process with its linear procedures of audit of needs, plan, implement, monitor, evaluate and so back to audit, was requisitioned. I am conscious that Renata Phelps and Stewart Hase have sought to show how complexity and action research are complementary to each other (Phelps and Hase 2002) but I have to dissent from their view. Action research generally assumes that classrooms and schools are bounded systems within which specific interventions can be distinguished from all the other intervening variables, that they can be effectively delivered, monitored and evaluated, and the specific improvement outcomes identified. This has made it extremely vulnerable to the UK governments 'standards' agenda. John Elliott, (Elliott 2004) one of the UK's venerable champions of action research, has back tracked on his earlier position. He agrees that action research as traditionally formulated has been hijacked by the 'standards' driven linear model. He now calls for what he terms a 'pedagogically' driven approach that acknowledges that teaching and managing schools is not the tidy a process as his earlier characterisations tended to suggest.

The promotion of the 'big (Newtonian) science' model is not just a UK phenomenon. In the USA the Congressional 2001 Education Act (No Child Left Behind) ties government funding to the adoption of reading programmes 'scientifically proven' to improve standardized test scores, by which the act means randomized control trials. The RCT is held up as the 'gold standard' for the accumulation of evidence in relation to the effective functioning of schools.

The 'prediction control' paradigm is extremely powerful for a number of reasons. The marketisation of education leads us to talk about getting measurable value for money. It calls for competition as the best way to achieve quality and accountability to non specialists for the way in which we seek to improve schools and classrooms. We have 'high stakes' testing, and an audit and schools league table culture. Emphasis is on control and 'science' is seen as the way in which we can

enhance that control. The orthodox prediction / control paradigm purports to offer teachers and managers specific evidence based advice on how to manage schools and classrooms. The paradigm also offers the possibility of clear evidence to support the development of policy. It is relatively easy for people to understand since it is based in a model of science that accords with popular perception.

Is it delivering this promised accumulation of evidence that is gradually guiding schools toward ever improved and ultimately optimal performance? This is a difficult question. Educational practitioners are working in 'politically' sensitive environments and have a vested interest in adopting the discourse of the orthodoxy. Improvements can be accounted for in terms of particular interventions for which they take responsibility. If failures can be similarly accounted, school development plans can be produced to explain how they are being addressed. The relationship between the discourse within which practitioners are required to characterise their practice and the realities of the situation within which they work is, however, strained. Great efforts are made to shoehorn messy complex realities into the relatively tidy discourse of the orthodox, prediction/ control paradigm. Whether educational provision is actually improving is an equally difficult question to address. The issues of standards itself is one of complexity.

Thus we might suggest that;

- a) the paradigm is simplistic, based in an out of date about how science conceives the world,
- b) it generates a questionable perspective in terms of what schools are really like as social systems,
- c) it raises high expectations in terms of prediction and control,
- d) it generates a discourse that is out of alignment with the realities of schools and classrooms.

The complexity paradigm

There are a number of theories within the umbrella notion of complexity theory, thus we might be inclined to see complexity as a paradigm. The central theories are the ones with which we are all familiar, namely that;

- causal relationships between variables may be non linear and dynamic, and
- variables may interact in such a way as to generate emergent outcomes.

Most of complexity theory consists of descriptions of the kinds of system, organisation or circumstances in which these theories may apply. When it comes to social environments such as schools and classrooms it is not difficult to persuade teachers and managers that they are working with complexity. Whenever I talk to teachers about complexity theory one sees a light of recognition coming into their eyes. But this is where the problem starts. Unlike the prediction/ control, the complexity paradigm does not offer an accumulation of data or evidence on the basis of which performance can be monitored and controlled. The complexity paradigm draws attention to the multiplicity of interaction parts in a social system and the fact that individual factors, particular teaching styles, particular organisational strategies will not necessarily produce the predicted outcomes. When the UK standards monitoring agency OFSTED comes into school and asks teachers why the reading

standards as measured by the SATs do not compare with the results in a similar school down the road, saying that complexity theory shows how subtle differences in circumstances mean that we cannot have the same expectations across the system is met with frowns.

So, although complexity theory might be recognised as apt in terms of social descriptions and explanations, at the same time it undermines expectations of control and accountability. Hunter and Benson argue that social and scientific theories are adopted on the basis of their usefulness (Hunter and Benson 1997). The prediction / control paradigm purports to offer us solutions whereas complexity offers problems. It tells us that we are limited in terms of how far we can control events and that forward planning and systematic practice are insufficient to effective teaching, whatever that is. Education is not a linear route march towards specified learning outcomes but more like a foraging party which may or may not hit particular outcomes but certainly may pick up any number of useful and unpredictable outcomes on the way. To my mind this sounds a more attractive picture of education but it is not the one that managers, quality monitoring officers like. So why should we adopt complexity as our paradigm?

Two possibilities for ways forward

The first is to seek to undermine the prediction and control paradigm. We have to persuade policy makers and practitioners that it is not working and offer alternative analogies in relation to way teachers or educational managers work than those of the clinical practitioner or engineer. This is not easy. The 'prediction / control' paradigm is easier to understand. It accords with popular perceptions and it promises specific remedies for the various problems that we face in education. Also improvements in engineering and clinical practice are much more obvious to see than in education so on the face of it, these areas seem to offer a good model of practice with which educators can work.

To strengthen our position we have to try to understand how people function effectively in complex contexts. Examples of such functioning may be observed in a number of circumstances. John Elliott called on the analogy of teaching to artistry. The artist may well draw up general plans for her work but it is unlikely that she will feel obliged to keep to them. In the context of the complex aesthetic and other purposes, meanings, intentions embedded in the artistic process, inspiration comes unbidden and the work takes on a life of its own. Political operators, football players and generals similarly function in complex situations. There are no formulae for effective political management, no rules for winning a football match or fighting battles. There are too many nonlinear, dynamic and unpredictable developments.

Describing teaching as a process of artistry, involves reference to intuitive and inspirational turns of mind, dealing with unpredictable events and involving much knowledge that is implicit to the task and therefore difficult for which to account. The function of research in this context may be similar to that of the arts critic, that is to enrich the intellectual and reflective environment within which policy makers and practitioners think about education. Research, rather than prescriptive, is primarily descriptive and explanatory and its data are the stories of schools and

teachers lives. I think that this view of research is attractive but I appreciate that it is rather 'soft centred' and further work is necessary to give it the kind of intellectual bite that is needed in such a crucial arena of public activity. Artists, politicians, footballers and generals still take responsibility for the outcomes in their respective areas but expectations are more open ended, we allow and value the unexpected, and in the meantime they are left to get on with the job. The message to the quality accountants is to lay off, to allow for more flexibility and to value the unexpected as much as the expected.

It may be that this approach is simply insufficient to satisfy policy makers and practitioners in education. The stakes are too high to leave matters to the professionals and although they may be fooling themselves governments are still happier with a system that pretends to offer a degree of clarity and specificity, that purports to deliver prediction and control than one that reduces this hope. Complexity theory, however, in the material technologies, in systems of eco management, fluid dynamics, and in the social ones, urban planning, traffic management, etc. employs forms of quantitative analysis that re-introduces the possibility of planning for unpredictability. Systems can be modelled and recursive symmetries and attractor states identified though the emphasis is on containment, coping with complexity rather than driving efficiency forward. Will the science of complexity be able to play the prediction/ control paradigm at its own game?

Often the kinds of questions that policy makers and practitioners ask belie the complexity of the situation and the answers that can be given. How do I improve the reading standards of my 6th grade boys? or how can I work in partnership with parents to improve standards of behaviour in my school? How do we move from talk about 'attractor states', 'recursive symmetries', 'lock in', and 'bifurcation' to providing something like a response to these questions that will be considered useful? The last I heard Salome Vogel in South Africa was trying to establish virtual classrooms which would simulate the running of ordinary classrooms and could be run over and over in order to isolate attractor states. I am not really qualified to comment but at the moment I am sceptical about the possibility of a science of complexity that could be readily communicated to teachers and managers, and that would provide the sort of support and advice to which the prediction control paradigm purports. But in the meantime that is our challenge.

Discussion

A number of points were raised in discussion but three stand out in my mind and may need brief discussion. The first concerns the nature and role of action research. Action research is generally promoted as a professionally emancipating form of activity and as such might form a line of defence against, what has been presented as a potentially oppressive approach represented by the prediction / control paradigm. It is important to ask how action research is emancipatory. It certainly strengthens the practitioner in terms of her professional confidence and operational efficiency. Action research shows that she is 'objectively' evaluating her own work and providing specific evidence for particular forms of practice. Notwithstanding methodological problems of practitioners formally investigating their own work,

action research tends to focus on questions of 'how' rather than 'why' and as such discourages practitioners from engaging in broader judgements about the nature and value of school provision and the agenda under which they are required to work. Furthermore the way in which it has been traditionally formulated with its reductive, 'classroom as laboratory' methodology suggests that, if we are to understand classrooms as complex, it is not doing what it purports to do. Rather it is putting a 'big science' spin on what is a messy and potentially indeterminate reality.

The second question referred to the possibility of critical theory as offering an alternative paradigm to those presented. It is difficult on the face of it to identify the key theories (in the Kuhnian sense of a paradigm) that would centrally characterise critical theory. If Lyotard's theory of the 'death of the grand narratives' as represented in his essay, 'The Postmodern Condition: A Report on Knowledge' is taken as a key contribution to this area of theory then some interesting observations ensue. Despite the reference to the 'prediction/control' paradigm as adopting the methodology of 'big (Newtonian) science' it is not a paradigm that draws from any strong theoretical perspectives. The contributions to our educational understandings from John Dewey, Jean Piaget, Jerome Bruner, etc. are eschewed in favour of a 'grounded theory' approach which concentrates on pragmatic and local solutions. Lyotard talks about knowledge as determined with a context of 'pragmatic valencies' and the 'prediction/control' paradigm sets us amidst a sea of these. There is a sense of continuous revision and development. 'Big science' in the traditional sense, is governed by a concept of truth and a sense of finality in understanding towards which its methodology can guide us. The prediction control approach, while adopting the reductive methodology of 'big science' substitutes the notion of 'truth' with 'optimal effectiveness' as its objective within given conditions and sets us in a political and social context of continuous change.

The third point, if I understand it correctly, drew attention to the difficulties if not impossibility of challenging the 'quality control' model implicit in the 'prediction/control' paradigm. We are in a sense 'locked in', politically, socially and educationally into a way of thinking in relation to which complexity theory is alien to popular and political understandings of how education works. If this is the discouraging conclusion towards which we are driven, all that may remain for complexity is as a theory of 'poesis', a theme which was strong in this year's conference. It is difficult to compare the importance of such aesthetic and cultural discourses alongside the real and urgent needs of professional practitioners and students in our schools. In one sense these cultural discourses touch the very soul of society but they are essentially elevated, sophisticated and more at home in the academy rather than the downtown school. This is not to say that poetry has no part in schooling but rather than it must be set alongside the massive technical demands of management and pedagogy. If complexity theory is to be seen to have relevance for education outside the academy, then we must see it as an important intellectual and critical lever against the dominant practice outlined in this paper and a genuinely emancipatory model for professional practitioners.

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