COMPLEXITY THEORY AND THE PHILOSOPHY OF EDUCATION

EDITED BY MARK MASON

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Complexity Theory and the Philosophy of Education

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Paul Cilliers is Professor of Philosophy at the University of Stellenbosch in South Africa. He teaches Cultural Philosophy, Deconstruction and Philosophy of Science. He also has a degree in Electronic Engineering and worked professionally as an engineer for many years. His research is focused on the philosophical and ethical implications of complexity theory and he has published widely in the field. He is the author of *Complexity and Postmodernism* (Routledge, 1998). He also has a lively interest in literature and music.

Brent Davis is Professor and David Robitaille Chair in Mathematics, Science, and Technology Education in the Faculty of Education at the University of British Columbia. His research is developed around the educational relevance of recent developments in the cognitive and complexity sciences. He is a founding co-editor of *Complicity: An International Journal of Complexity and Education* and current editor of *For the Learning of Mathematics*. He has published books and articles in the areas of mathematics learning and teaching, curriculum theory, teacher education, epistemology, and action research.

William Doll is the V. F. and J. R. Eagles Emeritus Professor of Curriculum at Louisiana State University. In his 53 years of teaching he has taught all grades and most subjects. He has done administration at the school, college, and university level. He has also served on the Fulton, NY Board of Education. Professor Doll holds degrees from Cornell University, Boston University, and The Johns Hopkins University. He has taught at SUNY-Oswego, the University of Redlands, and now LSU, where he formerly directed the Holmes Elementary Education program and co-directed the Curriculum Theory Project. His books are *A Post-Modern Perspective on Curriculum, Curriculum Visions* (co-edited), and *Chaos, Complexity, Curriculum and Culture* (co-edited). He also contributed to *The Internationalization of Curriculum Studies* (edited by his wife, Donna Trueit). William Doll is a Fulbright Senior Scholar, and in 2005 was awarded the American Educational Research Association's Division B Lifetime Achievement Award. Interests in international education take Professor Doll regularly to Finland and China. His website is at www.lsu.edu/faculty/wdoll.

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Mark Mason is Associate Professor in Philosophy and Educational Studies in the Faculty of Education at the University of Hong Kong, where he is also Director of the Comparative Education Research Centre (CERC). With research interests in philosophy, educational studies, comparative education and educational development, he is Regional Editor (Asia & The Pacific) of the *International Journal of Educational Development*, Editor of the *CERC Studies in Comparative Education Series* (co-published by Springer), and President of the Comparative Education Society of Hong Kong. He has published some fifty articles, chapters and books in these research areas. His philosophical research interest in complexity theory and education led to the invitation from the Editor of *Educational Philosophy and Theory* to edit this book.

Keith Morrison taught in schools in the UK for many years before moving into higher education. He has worked in higher education for over twenty-five years, in the UK and Macau, formerly at the University of Durham, UK, and currently as Professor, Vice-Rector and Dean at the Macau Inter-University Institute. He is the author of twelve books, including *Research Methods in Education (6th edition)*, *School Leadership and Complexity Theory*, and *A Guide to Teaching Practice (5th edition)*, and around one hundred articles in his areas of interest. He is the editor of the journal *Evaluation and Research in Education*. His current fields of research include research methodology and evaluation, critical theory and policy scholarship, complexity theory and management, curriculum and assessment development, management and leadership, and the sociology of the curriculum.

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edited volume, *Culture and Learning: Access and opportunity in the classroom* (IAP Press); with Michael Peters and Colin Lankshear, *Critical Theory and the Human Condition: Founders and praxis*; and *Futures of Critical Theory: Dreams of difference*, also with Peters and Lankshear (Rowman & Littlefield). He has published extensively in leading academic journals in Britain, North America and Australasia.

Deborah Osberg is a lecturer in Education in the School of Education and Lifelong Learning at the University of Exeter in England. Her work is inspired by Prigoginean complexity and Derridean deconstruction, and she uses the closely associated notions of 'dynamic relationality' and 'emergence' to rethink aspects of educational theory and practice. She is Editor-in-Chief of *Complicity: An International Journal of Complexity and Education.*

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Nora H. Sabelli is Senior Science Advisor at the Center for Technology in Learning, at SRI International. She earned her PhD in theoretical chemistry at the University of Buenos Aires, Argentina, for research undertaken at the University of Chicago. Her research interests are in the use of new scientific metrologies in science education, including complexity, visualization, and other applications of modern technologies.

Inna Semetsky joined the Research Institute of Advanced Study for Humanity at the University of Newcastle in Australia after a two-year (2005–2007) Postdoctoral Research Fellowship in the Faculty of Education at Monash University. Her book, *Deleuze, Education and Becoming*, was published by Sense Publishers in 2006 in their series, 'Educational Futures: Rethinking Theory and Practice'. In 2004 and 2005 she guest-edited two special issues of *Educational Philosophy and Theory*, 'Peirce and Education', and 'Deleuze and Education'. In 2007 she was guest editor of a special issue, 'Semiotics and Education', of *Studies in Philosophy and Education*, published by Springer.

Dennis Sumara is Professor of Curriculum Studies and Department Head in the Faculty of Education at the University of British Columbia, Vancouver, Canada. His research focuses on phenomenological studies of imaginative engagement, with an emphasis on how these create opportunities for tactical interventions into normalizing discourses of identity and identification. His most recent book, *Why Reading Literature in School Still Matters: Imagination, interpretation, insight*, was awarded the National Reading Association Ed Fry Book Award.

Foreword: Complexity and knowledge systems

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Mark Mason has done us great service in assembling these chapters from a distinguished group of international scholars who are well known or who have devoted space in their thinking and writing to complexity theory and its relation to education. This collection brings together a total of fifteen chapters: an introductory set of five chapters; two chapters that address the issue of complexity theory and philosophy of education; five chapters that pick up on the theme of complexity theory and educational research; and, finally, three chapters that address complexity theory and the curriculum. The final effect is a comprehensive and significant introduction to complexity theory in educational theory and philosophy.

Given that Mark Mason, the editor of this book, has already addressed the contents of the book and that there are no less than five introductory chapters, I will not repeat the points raised or confine myself to issues that have been raised or attempt to summarize arguments or interpretations. This also obviates the need for much of a Foreword on my part. John Urry (2005) introducing a special issue of *Theory Culture and Society* commented that the social and cultural sciences over the last few decades have experienced a number of incursions including Marxism of the 1970s, the linguistic and postmodern turns of the 1980s, and the body, performative and global culture turns of the 1990s. Without commenting on the simple metaknowledge schema he introduces he then goes on to introduce the latest turn—'complexity'—which he describes as follows:

> This turn derives from developments over the past two decades or so within physics, biology, mathematics, ecology, chemistry and economics, from the revival of neo-vitalism in social thought (Fraser *et al.*, 2005), and from the emergence of a more general 'complex structure of feeling' that challenges some everyday notions of social order (Maasen and Weingart, 2000; Thrift, 1999).
>
> Within these scientific disciplines, an array of transformations took place, loosely known as chaos, complexity, non-linearity and dynamical systems analysis. There is a shift from reductionist analyses to those that involve the study of complex adaptive ('vital') matter that shows ordering but which remains on 'the edge of chaos'. Self-assembly at the nanoscale is a current example of new kinds of matter seen as involving emergent

> complex adaptive systems. At the nanoscale the laws of physics operate in different ways, especially in the way that molecules stick together and through self-assembly can form complex nanoscale structures that could be the basis of whole new products, industries and forms of 'life' (Jones, 2004) (Urry, 2005: 1).

It is, he says, in the 1990s that the social sciences 'go complex' which he dates from the 1996 Gulbenkian Commission on the Restructuring of the Social Sciences, chaired by Wallerstein and including non-linear scientist Prigogine, who together wanted to break down some of the divisions between the social and natural sciences. Complexity thought he dates from the 1990s and also the global spread of 'complexity practices' and its popularizations, including applications to the social and cultural sciences.

The historiography of these successive turns does not attract Urry's attention although to me it demands more of an explication and one that in a very real sense bears on the complexification of the social sciences and philosophies of practice like philosophy of education. An analogy and related phenomenon is the history of the *avant garde* in twentieth century modernism and its uneven geographical spread across cultural capitals of the world—Paris and Impressionism, Moscow and formalist linguistics and poetics, Vienna and Dadism, Paris and Cubism, New York and Abstract Expressionism etc., and the dissipation of the *avant garde* as a series of successive paradigms, each critique-ing the other, as it traveled to the west coast and finally gave up the struggle and died among the eclecticism of a postmodernism in arts and architecture that admitted strands of diverse and multicultural thought and experience, as well as a total consumerism that incorporated art.

We could also tell a similar story of disciplinary reception of new formalist techniques and developments in mathematics and physics and their penetration into the social and cultural sciences, and indeed into philosophy (although this, it might be argued, had a different trajectory especially with developments in logic and philosophy of time, from Kant onwards), especially after Minowski's elegant equations gave mathematical expression to Einstein's theories of relativity in the early twentieth century. The subsequent mathematicization of 'space-time' and its vectorization in the social and cultural sciences, as much a series of flows and influences from the arts, indicated that epistemologically speaking scientific communities exhibited an increasing complexity in their influence and formation, and in the development of formalist methodologies and techniques adopted from developments in mathematics.

What is interesting to me here and is part of the kernel of investigating knowledge systems is that complexity as non-lineal, emergent, self-organizing and dynamic systems, with the advent of computers, with Claude Shannon's 1948 'Mathematical Theory of Communication', with the development of cybernetics and the Macy group (von Neumann, Shannon, Bateson, Mead etc.) after the war, and with the development of the Internet as the preferred academic mode of scholarly communication, the epistemological complexity of knowledge systems per se and their interdisciplinization was set in motion as an irreversible development of

global systems. These developments in mathematics and in physics, evidenced in topology, in forms of spatial analysis, in cybernetics and systems theory, in relativity, thermodynamics, and chaos theory, as well as in the growth of techniques in military surveillance, coding and decoding of military intelligence, soon spread to allied disciplines and fields in the physical sciences that were open to quantification and required the processing of very large numbers, and also to emergent sciences like biology, ecology and other studies of living and social systems that seemed to accompany the first awarenesses of globalization and socio-epidemiological studies. The globalization of system analyses within and across the disciplines demands a complexity approach, but more importantly, it demonstrates that these complex systems operate at the level of infrastructure, code and content to enable certain freedoms while controlling others.

Complexity as an approach to knowledge and knowledge systems now recognizes both the growth of global systems architectures in (tele)communications and information with the development of *open knowledge production systems* that increasingly rest not only on the establishment of new and better platforms (sometimes called Web 2.0), the semantic web, new search algorithms and processes of digitization but also social processes and policies that foster *openness* as an overriding value as evidenced in the growth of open source, open access and open education and their convergences that characterize global knowledge communities that transcend borders of the nation-state. This seems to intimate new orders of global knowledge systems and cultures that portend a set of political and ethical values such as universal accessibility, rights to knowledge, and international knowledge rights to research results especially in the biosciences and other areas that have great potential to alleviate human suffering, disease and high infant mortality. Openness seems also to suggest political transparency and the norms of open inquiry, indeed, even *democracy* itself as both the basis of the logic of inquiry and the dissemination of its results.

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It's probably a good idea to begin an introduction to complexity theory and the philosophical study of education on a sceptical note, by taking note of the comments of the physicist, Philip Ball (2004, p. 5):

> We have been here before. In the 1970s, the catastrophe theory of René Thom seemed to promise an understanding of how sudden changes in society might be provoked by small effects. This initiative atrophied rather quickly, since Thom's phenomenological and qualitative theory did not really offer fundamental explanations and mechanisms for the processes it described. Chaos theory, which matured in the 1980s, has so far proved rather more robust, supplying insights into how complicated and ever-changing ('dynamical') systems rapidly cease to be precisely predictable even if their initial states are known in great detail. Chaos theory has been advocated as a model for market economics, ... [b]ut this theory has not delivered anything remotely resembling a science of society.
>
> The current vogue is for the third of the three C's: complexity. The buzzwords here are *emergence* and *self-organization*, as complexity theory seeks to understand how order and stability arise from the interactions of many components according to a few simple rules ... . But very often what passes today for 'complexity science' is really something much older, dressed in fashionable apparel. The main themes in complexity theory have been studied for more than a hundred years by physicists who evolved a tool kit of concepts and techniques to which complexity studies have added barely a handful of new items.

Nevertheless, having pointed out that '[a]t the root of this sort of physics is a phenomenon that immediately explains why the discipline may have something to say about society: it is a science of *collective behaviour*' (ibid., p. 5), Ball goes on to suggest (ibid., p. 6) that

> ... even with our woeful ignorance of why humans behave the way they do, it is possible to make some predictions about how they behave collectively. That is to say, we can make predictions about society even in the face of individual free will.

The physics might then not be new, but the substantial development of and rapidly increasing interest in complexity theory in the social sciences certainly is. As Mason indicates in the third chapter in this collection, complexity theory offers some useful insights into the nature of continuity and change, and is thus of considerable interest in both the philosophical and practical understanding of educational and institutional change. Complexity theory's notion of *emergence* implies that, given a significant degree of complexity in a particular environment, or *critical mass*, new properties and behaviours emerge that are not contained in the essence of the constituent elements, or able to be predicted from a knowledge of initial conditions. These concepts of *emergent phenomena* from a critical mass, associated with notions of *lock-in*, *path dependence*, and *inertial momentum*, contribute to an understanding of continuity and change that has not hitherto been readily available in other theories of or perspectives on change.

Developed principally in the fields of physics, biology, chemistry and economics, complexity theory arises in some senses out of chaos theory, and before that, catastrophe theory, in that it shares chaos theory's focus on the sensitivity of phenomena to initial conditions that may result in unexpected and apparently random subsequent properties and behaviours. Chaos theory suggests that even a very slight degree of uncertainty about initial conditions can grow inexorably and cause substantial fluctuations in the behaviour of a particular phenomenon. Perhaps more importantly, complexity theory shares chaos theory's concern with wholes, with larger systems or environments and the relationships among their constituent elements or agents, as opposed to the often reductionist concerns of mainstream science with the essence of the 'ultimate particle'. While it was pioneered in economics (Holland, 1987; Arthur, 1989, 1990), complexity theory is otherwise a relative stranger to the social sciences. It is, as Morrison (2002, p. 6) puts it, 'a theory of survival, evolution, development and adaptation'. It concerns itself with environments, organisations, or systems that are complex in the sense that very large numbers of constituent elements or agents are connected to and interacting with each other in many different ways.

Many authors in this collection offer an introduction to complexity theory in their particular chapters—this on top of the fact that some of the earlier chapters (see especially Morrison, Mason, Davis and Alhadeff-Jones) are dedicated substantially to introducing the field. Individual authors have not been asked to remove these introductions in their chapters for two main reasons: first, leaving them in the chapters enables readers who are not familiar with the field to read just one or a small selection of chapters, because they will find in that or those chapters a brief introduction to complexity theory; and second, the introductions offered by this volume's various authors offer different entries to and perspectives on the field—together they thus enhance the experience of the reader who studies the whole volume. In particular, the first two chapters that follow this introduction to the collection are best read in conjunction with each other, in that each is concerned with providing an accessible introduction to complexity theory, with Morrison raising ten challenges to complexity theory for the philosophy of education, and Mason considering some of the implications of complexity theory for educational change.

In his chapter, 'Educational Philosophy and the Challenge of Complexity Theory', Keith Morrison introduces some core tenets and features of complexity theory in a manner helpful to readers entirely new to the field. While Morrison does indicate some of the insights offered by complexity theory for educational philosophy, and its attractiveness, not least because of its critique of positivism, its affinity to Dewey and Habermas, and its arguments for openness, diversity, and the importance of relationships, agency and creativity, he is rather less sanguine about its use in and for education. There are many questions still to be answered. While complexity theory challenges educational philosophy to reconsider accepted paradigms of teaching, learning and educational research, the theory is not without its difficulties. These, as Morrison elucidates in the chapter, lie in complexity theory's nature, status, methodology, utility and contribution to the philosophy of education, in that it is a descriptive theory that is easily misunderstood as a prescriptive theory, that it is silent on key issues of values and ethics that educational philosophy should embrace, that it is of questionable internal consistency, and that it currently adds limited further value to educational philosophy. Morrison nevertheless raises some interesting and difficult questions for education—principally with regard to schools, the curriculum, learning and teaching—and educational research in the light of the insights of complexity theory. With respect to educational research, he concludes that complexity theory suggests the need for case study methodology, qualitative research and participatory, multi-perspectival and collaborative (self-organised), partnership-based forms of research, premised on interactionist, qualitative and interpretive accounts. In this, complexity theory points to methodological, paradigmatic and theoretical pluralism.

As the title of his chapter suggests, Mark Mason asks 'What Is Complexity Theory, and What Are Its Implications for Educational Change?' Mason considers questions of continuity and change in education from the perspective of complexity theory, introducing the field to educationists who might not be familiar with it. Given a significant degree of complexity in a particular environment (or 'dynamical system'), new properties and behaviours, which are not necessarily contained in the essence of the constituent elements or able to be predicted from a knowledge of initial conditions, will emerge. These concepts of emergent phenomena from a critical mass, associated with notions of lock-in, path dependence, and inertial momentum, suggest that it is in the dynamic interactions and adaptive orientation of a system that new phenomena, new properties and behaviours, emerge. The focus thus shifts from a concern with decontextualised and universalised essence to contextualised and contingent complex wholes. This is where complexity theory seeks the levers of history. Mason takes the notion of *inertial momentum* from physics and posits it as the conceptual link between the principle of emergent phenomena as developed principally in the natural sciences and the notion of socio-historical change in human society. He argues that educational and institutional change is less a consequence of effecting change in one particular factor or variable, and more a case of generating momentum in a new direction by attention to as many factors as possible. Complexity theory suggests, in other words, that what it might take to change a school's inertial momentum from an ethos of failure is massive and sustained intervention at every

possible level until the phenomenon of learning excellence emerges from this new set of interactions among these new factors, and sustains itself autocatalytically.

In 'Complexity and Education: Vital Simultaneities', Brent Davis considers how complexity theory might be appropriate to the concerns of educators and educational researchers. He addresses this question by exploring several 'simultaneities' offered by complexity thinking. Using the term to refer to events or phenomena that exist or operate at the same time, he sets it down as a deliberate contrast to the modern and Western tendency to think in terms of discontinuities around such matters as theory and practice, knowers and knowledge, self and other, mind and body, art and science, and child and curriculum. In the context of popular debate, he reminds us, the terms of these sorts of dyads tend to be understood as necessarily distinct, opposed, and unconnected, even though they seem always to occur at the same time. In other words, such simultaneities tend to be seen as coincidental, but not co-implicated. Thinking in the perspectives of complexity theory challenges these modes of interpretation and, in the process, offers useful insights into the projects of education and educational research. The simultaneities that Davis addresses include:

- 'knower and knowledge', where complexity theory, by considering both simultaneously, aims to move beyond the common distinction between teachers' representing the established and objective knowledge of the curriculum while pedagogically fostering subjective knowing in learners;
- 'transphenomenality', where complexity theory offers insights that can be had only by the simultaneous consideration of factors normally associated with apparently quite different phenomenal levels of explanation;
- 'transdisciplinarity', where, similarly, complexity theory offers insights that can be had only by the simultaneous consideration of factors normally associated with apparently quite different disciplinary perspectives;
- 'interdiscursivity', where, similarly, complexity theory offers insights that can be had only by the simultaneous consideration of factors normally associated with apparently quite different discursive perspectives;
- 'descriptive and pragmatic insights', where Davis asserts that the emphasis in complexity research has recently moved beyond careful descriptive accounts of complex phenomena toward deliberate attempts to prompt the emergence and affect the character of such phenomena, an emphasis well suited to the pragmatic concerns of educationists;
- 'representation and presentation', where Davis aligns himself with Derrida in pointing out how the representation (say, in an academic paper) of a phenomenon is inexorably complicit in presenting that phenomenon: our representations 'contribute to the shape of possibility', being 'partial rather than comprehensive, active rather than inert, implicated rather than benign';
- 'affect and effect', in the terms of which Davis argues that educators and educational researchers are uniquely positioned to contribute to complexity thinking, most obviously because of the transphenomenal nature of the educational project, the transdisciplinary character of educational research, and the interdiscursive nature of educational thought; and