7

COMPLEXITY, CURRICULUM, AND THE DESIGN OF LEARNING SYSTEMS

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Over the past two decades there has been a rapid growth of interest in complexity and its value to curriculum and the design of learning systems in physical education (PE). We suggest that understanding this ‘turn’ to complexity is linked to three intertwined ideas. The first is ontological and involves viewing the world as organized through highly connected and interdependent elements so that the focus becomes not about understanding what something is (a focus on being), but how it comes into being (a focus on becoming or emergence). The second is conceptual and involves the value to researchers and practitioners of drawing on a renewed vocabulary that enables generative ways of questioning the assumptions, normalizing logics, and methodologies of educational practice. The third is reflexive and involves researchers and practitioners being aware of the dynamic, partial, layered, and contingent nature of educational practice.

We draw on these ideas to help structure the discussion in this chapter. In the first section we begin with an introduction to complexity and outline some of the concepts that can be applied from complexity to PE settings. In the second, we discuss the implications that complexity has for curriculum design and consider the ways in which prescribed learning systems can evolve into emergent learning networks. Finally, in the last section we present three case studies that help ground and illustrate these ideas as instances of concrete and current practices of physical educators designing and implementing curriculum with a focus on complexity thinking.

An introduction to complexity

There is no easy consensus around what complexity is, what principles it embodies, or quick definitions of its meaning (Davis, Phelps, & Wells, 2004; Ovens, Hopper & Butler, 2013a). Despite the common usage of terms like ‘complexity theory’ or ‘complexity science,’ it is neither a unified field nor purely a science. Rather, complexity refers to evolving systems of thought that emerge as disciplinary fields, such as economics, physics, health, and biology, grapple with objects of study that scholars find increasingly difficult to understand through conventional ways of knowing (Byrne, 2005; Cilliers, 1998). Certainly, in PE it is possible to map the interest in complexity back through several genealogical lines (Alhadeff-Jones, 2008; Davis, Sumara, & Luce-Kapler, 2014). For example, in motor learning there has been a strong trajectory through dynamical systems and ecological psychology (Davids et al., 2013; Kelso, 1995,
in pedagogy the trajectory is through complexity thinking and the work of Davis et al. and others (Ovens et al., 2013a; Storey & Butler, 2012), in sport sociology it has been through figurational sociology (Green, 2006), while others draw their lineage through contemporary social theories (Smith & Ovens, 2015; Tinning, 2010).

Viewed in this manner, complexity can be described as a collection of theories, dispositions, and conceptual tools that have evolved in different disciplinary fields to better accommodate the complex issues and realities being studied (Mason, 2008; Morrison, 2008; Walby, 2007). Some researchers have attempted to map this collection into different themes or communities to better represent the divergent positions, purposes, and histories involved (e.g. Alhadeff-Jones, 2008; Byrne, 2005; Morin, 2007; Richardson & Cilliers, 2001). While such descriptions provide a sense of the richness, disorder, and heterogeneity that can be observed in research related to complexity, we will focus this brief introduction on some of the philosophical implications of engaging with complexity.

One of the most fundamental notions in complexity is the way the object of study is modelled as a self-organizing system of interacting entities (Davis & Sumara, 2006; Ovens et al., 2013a). This simple assumption leads to some important ontological implications. First, the focus of attention is shifted to the relationality of all the elements in a particular setting and how they are affected by and affect others with which they are in contact. Theoretically, there is a broad range of metaphors used to describe this patterning of relations, including system, network, entanglement, web, mangle, and assemblage. While not all the same, these different labels allude to the importance of understanding what the elements in a system can do rather than describing what they are (Davis et al., 2004; Richardson & Cilliers, 2001). In complexity, the most common term in usage is ‘system’.

Second, when the patterning of interactions in a system leads to uncertain and unpredictable behaviours, the system is said to be complex (as opposed to simple or complicated) (Byrne, 2005; Cilliers, 1998). For example, a computer is complicated, while the internet it connects to is complex. If the system has the added ability to change its structure in response to experience it is said to be a complex adaptive system. A PE lesson is considered to be a complex adaptive system because the lesson as a whole cannot be understood by simply analysing the individual parts, and it has the ability to adapt and change over time in response to the ecosystem in which it is a part (Wallian & Chang, 2012).

Third, the patterning of relations leads to the important insight that the properties that become our objects of study are generated by component interactions that occur at a lower level (Anderson, 1972; Goldstein, 2013; Ovens, Hopper, & Butler, 2013b). Put another way, the ‘things’ that we see and work with are the results of processes, have uncertain life, and exist only as the emergent product of interactions occurring within the system. This means that teachers and researchers need to shift their focus from trying to understand things as stable, substantive ‘beings’ to fluid, always contingent ‘becomings’ that are always in the process of being created and open to change (Davis & Sumara, 2006; Deleuze, 1994). This is not a foreign concept in PE, since the body is readily identified as constantly changing and adapting to its daily environment (think in terms of jogging and getting fit).

Fourth, the belief that entities like curriculum, learning, students, and schools are always the outcome of component interactions opens the possibility to new understandings and descriptions of system behaviour (Doll, 2012; Ricca, 2012). For example, the concept of nestedness draws attention to the way each system is itself composed of smaller subsystems while also contributing to other, larger systems (Davis & Sumara, 2006). Nestedness draws attention to our tendency to only conceptualize phenomena at one scale rather than see them as layered and interconnected.
Complexity and curriculum

Related to this, our fifth concept of transphenomenality draws attention to the way the phenomena emerge from the organization occurring at each level (Davis, 2008). For example, it is possible to see learning as occurring at the cellular level in patterns of neuron activity, at the personal level as coordinated patterns of motor behaviour, and at the social collective level as skilful action in game play. In order to better understand learning, one needs to appreciate it as a phenomenon occurring simultaneously and interdependently at each different level of system organization.

Finally, thinking of things as composed through patterns of relations brings attention to the nature of information flow through such patterning. Complex systems are described as open systems because they can exchange information with others in the ecosystem. In terms of education, this implies the component subsystems (students, teachers, schools) are not closed and isolated, but constantly exchanging information and resources and with other systems. There are two points to be made here where education is concerned. First, the concept of perturbance refers to the reaction of a system when it encounters a disturbance in the broader system (or ecosystem). Deleuze (1994) suggests that such encounters force the system to ‘think’ and invite further inquiry. In this way, perturbance can motivate learning by provoking attention, experimentation, adaption, and structural change (Smith & Ovens, 2015). In a similar manner, the concept of recursivity refers to the way flows of information help the system to interact and develop. Recursivity is an interactive process in that information about the system feeds back into the system to shape and inform future system behaviour (Morin, 2008). It takes place in the tension between system structure and action, moving beyond the notion of feedback and system governance to include the production of knowledge when the system’s current knowledge is challenged by the knowledge required to act (Koskinen, 2013).

Complexity thinking

Before moving on, it is important to add that complexity is not just about ontological issues. One of the complexity communities identified by Richardson and Cilliers (2001) was that of complexity thinking. Hardman (2010) suggests complexity thinking has grown to be the dominant form of complexity theorizing in education today. Complexity thinking is, “an attitude which is potentially generative of, and pays attention to, diverse sensibilities without making claims to, or being trapped by, universals or absolutes” (Ovens et al., 2013b, p. 3). Complexity thinkers are concerned with the philosophical implications of assuming that reality is complex rather than predictable. They take a broad, interdisciplinary approach to understanding and researching education (Davis & Sumara, 2008). Thinking in this way encourages us to set aside our desire for certainty and facts in favour of a more open and reflexive stance that acknowledges the multiple, partial, and fluid elements that are complicit in shaping and being shaped by one’s focus of interest (Davis & Sumara, 2012).

In relation to this, one of the concepts that we believe is useful is the idea of currere (Pinar & Grumet, 1976). The word currere derives from the same root as curriculum, ‘to run, or to course’. For Pinar (2012), the concept of currere enables a way to reconceptualize the curriculum away from the impersonal goals of mandated curriculum documents and onto the emergent and collective processes of moving through the melee of present events. In this sense, the curriculum offers a space in which learning emerges, rather than a set of exercises that lead to predetermined outcomes. Rather than being simply described as the course itself (content and predetermined processes), currere is an open field of deterritorialized potential on which a pedagogical life may be run (Deleuze, 1994). In this way, currere takes into account the
multiplicity of contexts that support learning, and the way these exist in relationship to each other (see also Cothran, Chapter 3).

**Complexity applied to physical education settings**

Many of the concepts relating to complexity have a clear application to PE. A comprehensive list of these is presented in the glossary of Ovens et al. (2013a) and we encourage readers new to complexity to investigate additional texts such as Davis and Sumara (2008), Morin (2007), and Davids et al. (2013). For the purposes of this chapter, we have listed those concepts (see Table 7.1) that we feel to be particularly generative in PE.

**Introduction to curriculum development and implementation**

The turn to exploring curriculum development from a complexity perspective corresponds not only with the development of new language and theoretical frameworks, but also with long-time concerns that the dominant discourse framing curriculum is one oriented around prediction and control (Radford, 2008). Inherent in such a discourse is the belief that learning is an ‘input–output’ linear process in which teaching methods and learning outcomes can be predefined and managed with confidence and certainty. By the mid twentieth century, this belief was exemplified in what came to be known as the Tyler Rationale, in which the processes of curriculum design became simplified to identifying objectives, selecting appropriate learning activities, organizing student activity to maximize effect, and evaluating to see if students

<table>
<thead>
<tr>
<th>Concept</th>
<th>Description</th>
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<tbody>
<tr>
<td>Relationality</td>
<td>A sensitivity to the connecting, connectable, connected nature of systems and the webbed patterns such interconnections display that give a sense of ‘aliveness’ to the system (Doll, 2012).</td>
</tr>
<tr>
<td>Emergence</td>
<td>A process that occurs when a network of relations begin to exhibit properties that arise from the interactions of agents and elements that make up the system and cannot be explained from understanding the elements individually.</td>
</tr>
<tr>
<td>Nestedness</td>
<td>A belief that complex systems are themselves made up of many subsystems as well as being nested within other systems. Each system can be “simultaneously seen as a whole, a part of a whole, or a network of wholes” (Davis et al., 2014, p. 178).</td>
</tr>
<tr>
<td>Transphenomenality</td>
<td>An awareness that educational phenomena emerge across a wide range of phenomena and thus need to be studied at the different nested levels and scales of organization.</td>
</tr>
<tr>
<td>Perturbance or disturbance</td>
<td>The act of disturbing or challenging the current state of a system in order to evoke moments in which system change may occur.</td>
</tr>
<tr>
<td>Recursivity</td>
<td>A process in which the information produced by the system is used to inform the system and enable it to adjust accordingly.</td>
</tr>
<tr>
<td>Currere</td>
<td>A focus on the emergent and collective processes of moving through the melee of present events in order to expand the space of the possible and the as-yet-to-be-imagined (Pinar, 2012).</td>
</tr>
</tbody>
</table>
Complexity and curriculum

attained the predefined objective (Tyler, 1949; see Cothran, Chapter 3). The discourse was also evident in the school effectiveness movement that emerged in the 1980s, which developed sophisticated modelling approaches involving a wider range of variables, consideration of contextual factors, and multilevel statistical analyses. Despite this, the underlying assumption remained— that schools were a relatively stable, homogenous, and closed field of operations (Teddlie & Reynolds, 2000).

It is still possible to detect modernist ideas of prediction and control as they continue to frame the wave of curriculum reform discussions at the start of the new millennium (see also Penney, Chapter 9 & Ennis, Chapter 8). While many of these appear grounded in good intentions, such as ideas and plans for ‘improving the quality of learning’ and ‘raising levels of achievement’ or ‘better preparing students for the 21st century,’ it is rare that these discussions move beyond attempts to simply revise the outcomes and standards expected, to introduce greater accountability for teachers, to increase evaluation and assessment of students, and to introduce rewards for those who can achieve the outcomes in the most efficient and effective ways (McCullick, Gaudreault, & Ramos, Chapter 25). Each solution for reform appears hopelessly constrained within an instrumental rationality where curriculum is a design specification for society, teachers are educational technicians enacting the design, and students are commodities whose subjectivity and individuality are mercilessly overlooked and deprived. The turn to complexity provides a means to challenge such notions and instead open a space to rethink curriculum and pedagogy as an organic and living process that is connected to place, community, and local knowledge.

It is worth pausing at this point to reflect on the distinction between a prescribed curriculum and one that is more organic and complex. Table 7.2 lists some of the defining characteristics of these two curriculum systems. Contrasting the systemic nature of curriculum in this way has become a mechanism used by a variety of people to highlight some of the broader shifts occurring in contemporary education (for example, Jess, Attencio, & Thorburn, 2011; Macdonald, 2003; Morrison, 2008; Radford, 2008; Williams, Karousou, & Mackness, 2011). Schools and teachers are constantly evolving and such a comparison highlights the key aspects inherent in these changes. However, there is a risk to thinking of curriculum practice and change in a binary manner (as existing as either one position or the other). Not only does this tend to oversimplify the way curriculum practice is linked to broader social, political, economic, and technological factors and present each pole of the binary as homogenous positions, but also, such binaries are typically organized to favour one side over the other. For many, the list of characteristics under the emergent learning networks would represent favoured positions on key educational and pedagogical issues, leading to the rejection of those characteristics under the prescriptive learning systems column. It should be stressed that not all top-down, prescriptive systems are bad or unworkable (and conversely, not all bottom-up development is good). Rather, the focus should be more on how the learning system engages different stakeholders in webs of relations that co-create value and form value networks (Desai, 2010). There is also a risk that such binaries reify the modernist notion that change represents progress towards better and improved education. In a complex sense, all we can say is that education is in a constant state of emergence and becoming different. The question of whether this is better depends on who is doing the asking.

One way of acknowledging that curriculum is multifaceted and viewer dependent is to view it as a series of simultaneities—phenomena that exist together and are coupled in such a way that they mutually influence each other (Davis & Sumara, 2008). Hussain, Connor, and Mayo (2014) envision curriculum as six partial and incomplete views of curriculum that exist simultaneously (see Table 7.3). By moving between these views and seeing each as a space for
problematizing practice, it is possible to position curriculum in an ever-evolving reality that is brought forth in the process of enacting educational practice. It is also possible to acknowledge within this process the deliberate intention to strategically foster learning without knowing or prescribing exactly what will emerge.

**Table 7.2 Characteristics of prescriptive and emergent curriculum frameworks**

<table>
<thead>
<tr>
<th>Nature of system</th>
<th>Prescriptive learning systems</th>
<th>Emergent learning networks</th>
</tr>
</thead>
<tbody>
<tr>
<td>System organization</td>
<td>Top down, hierarchical, external and institutional control</td>
<td>Developmental, holonic, collaborative, self-organization</td>
</tr>
<tr>
<td>System behaviour</td>
<td>Predictable, complicated, mechanistic</td>
<td>Complex, adaptive, organic</td>
</tr>
<tr>
<td>Link to environment</td>
<td>Closed, internally interactive, learning community</td>
<td>Open, highly connected, learning network</td>
</tr>
<tr>
<td>Conception of learning</td>
<td>Prescribed, predictable, product driven</td>
<td>Emergent, uncertain, process driven</td>
</tr>
<tr>
<td>Learning activity</td>
<td>Passive participation, directed activity, individualized experiences</td>
<td>Active participation, self-organized action, collaborative experiences</td>
</tr>
<tr>
<td>Pedagogy</td>
<td>Transmission, de-contextualized experience, summative feedback</td>
<td>Emergent, situated and authentic experiences, formative feedback</td>
</tr>
<tr>
<td>Validation and revision</td>
<td>Absolutist, best practice, bureaucratic, informed by large-scale quantitative research. Externally benchmarked</td>
<td>Shared, dynamic practice, networked, informed by transdisciplinary and multi-method forms of research. Reflectively evaluated</td>
</tr>
</tbody>
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**Table 7.3 The six simultaneities of curriculum (adapted from Hussain et al., 2014)**

<table>
<thead>
<tr>
<th>Simultaneity</th>
<th>Its focus is on …</th>
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<tbody>
<tr>
<td>Curriculum as structure</td>
<td>Conceptualizing and understanding the systems that exist in the setting, i.e. nested systems of knowers, knowledge, and curriculum/activity.</td>
</tr>
<tr>
<td>Curriculum as process</td>
<td>Understanding emergence and the processes of drifts and self-organization that give rise to it.</td>
</tr>
<tr>
<td>Curriculum as content</td>
<td>Creating an enabling constraint to enable teachers and children to make decisions about curriculum content.</td>
</tr>
<tr>
<td>Curriculum as teaching</td>
<td>Foregrounding the teacher-as-knower and how his/her thinking and actions contribute to curriculum and are influenced by other aspects of curriculum.</td>
</tr>
<tr>
<td>Curriculum as learning</td>
<td>Foregrounding the child(ren)-as-knower and how his/her/their interactions with others and participation in activities trigger changes in knowledge and activities.</td>
</tr>
<tr>
<td>Curriculum as activity</td>
<td>Generating and enacting the activities at the centre and explaining how these influence and are influenced by teaching and learning.</td>
</tr>
</tbody>
</table>
Complexity and curriculum design

There is an awkward paradox that exists in relation to designing for complex educational systems. The concept of design, like the related notion of planning, implies an intention to achieve a particular outcome by manipulating form to fit function (Blecic & Cecchini, 2008). However, if the inherent characteristic of a complex system is that they display non-linearity, uncertainty, and unpredictability, then acts of design and planning become somewhat problematic. The complex nature of teaching means that what works in one situation may not work in other situations with other students and may not even work again for the same situation at a later date. In short, teachers (and curriculum planners) should not envisage some generic future state toward which the learners can be moved, since the possible futures open to the learning system are too many and the causes leading to it are too obscure.

One way of resolving this paradox is to begin with the assumption that learning will be emergent whether it is designed for or not (Wenger, 1998). In this way, the design process becomes an intention to foster emergent learning without predetermining or knowing what the specific outcomes will be (Blecic & Cecchini, 2008). Framed in this way, curriculum becomes an ever-evolving reality invented by the ongoing interactions of knowers, knowledge, and activities situated in the different nested layers (or simultaneities) of the education system (Hussain et al., 2014). This process is recursive in the sense that information produced by the system is continually informing the system and enabling it to adjust accordingly. This situation demands that the planning and design should be as emergent as the learning.

This brings us to the concept of currere, which frames curriculum and pedagogy as processes that emerge through a learning system that is flexibly organized in ways that allow students to explore what is socially relevant, intellectually engaging, and personally meaningful. Currere requires curriculum planners and teachers to give up the role of ‘grand curriculum designers’ and instead take on the roles of eco-system architects or engineers who use lesson plans that are open-ended and responsive to student input. It places students in a rich and complexity dynamic environment in which they can be engaged in meaningful learning and able to participate in curriculum conversations that are driven by interaction, relations, and recursions. As the complex web of interactions, relationships, and understanding is woven and develops in the classroom, the curriculum emerges as a conversation.

In Table 7.4, we return to the list of complexity concepts identified in Table 7.1 and consider how these may be applied to the design and implementation of an emergent learning system PE.

Case studies highlighting complexity theory and curriculum implementation in health and physical education

This chapter will highlight three case studies that demonstrate the use of complexity theory as it is applied to the various social, political, and structural complexities affiliated with constructing and implementing health and PE curriculum.

Case study 1: reconfiguring support networks in a secondary school physical education department in order to refocus curriculum planning around emergent student learning

The first case study examines how a PE department in a medium sized urban secondary school in Canada undertook to revise their curriculum and teaching (see McGinley & Kanavos, 2014).
<table>
<thead>
<tr>
<th>Concept</th>
<th>Possible application to HPE</th>
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</table>
| Relationality       | • Students in a class are not just a group of isolated individuals. Rather, they connect with, and relate to, the others in the class so that they also become a networked collective.  
• The social network of students is not closed or isolated, but extends beyond the boundaries of the lesson.  
• Patterns of connections within and beyond the classroom influence the depth and richness of learning that emerges within a class of students. Therefore teachers should adapt and take advantage of the relationships of students with others in and outside of the class.  
• Students need to be coached to develop their own personal learning networks because it is not how smart the individual is, but how smart the network they build that is important.  
• New technologies have the potential to connect students with other people and knowledge systems. |
| Emergence           | • What students learn from a lesson cannot be predicted or planned with certainty. The teacher can only increase the probability of an outcome through managing the constraints shaping students’ engagement with the lesson.  
• Diversity in groups is important to the creativity, intelligence, and problem solving ability of each group.  
• Knowledge and skills emerge as solutions to the problems the student encounters in a specific context. |
| Nestedness          | • Learning is always layered, occurring at the cellular, organ, person, classroom, school, school district, and society levels.  
• Students need help to make the connections between layers meaningful. |
| Transphenomenality  | • Complex events are best understood by observing at least three levels of organization.  
• Identities are framed by contexts – who one is and where one is are inextricably intertwined. |
| Perturbance or      | • Allow for and provoke ‘teachable moments.’  
• Game structure (rules and regulations) and game play constraints work in balance to create both spontaneous and planned disturbances (unexpected events). As players adapt due to the disturbances created by one set of structural constraints and integrate those adaptations into their game play, the balance is disturbed and a new game structure is needed to rebalance the system. |
| disturbances        |                                                                                                           |
| Recursivity         | • Use feedback generated from students to the teacher to inform pedagogy and curriculum, so that the learning system becomes adaptive and can evolve.  
• Game structures themselves are also open to feedback in order for the system to evolve.  
• As players gain new insights into tactical options and their abilities, teachers can use direct, Socratic, or democratic methods to adapt the game structure, thereby extending or expanding the adaptation potential of a game. |
| Currere             | • The curriculum offers a space in which learning emerges, rather than a set of exercises that lead to predetermined outcomes.  
• Keep learning objectives simple and general to minimize confusion.  
• Use problems to guide what is needed to be known, i.e. learning from mistakes. |
As was typical, the department in this study was responsible for scheduling classes and facilities and for teaching and assessing mandatory PE in grades 8–10 (approximately 360 students), and four elective classes in grades 11–12 (80 students). This task was traditionally undertaken by the Head of Department (HoD) in a hierarchical approach, anecdotally described by one of the teachers as “ticking boxes on a checklist.” This included ensuring that the programme addressed the Ministry of Education’s prescribed learning outcomes (PLO’s) and that teachers could report achievement against established assessment criteria. These criteria focused on students achieving normative standards of fitness, being competent in isolated skill progressions (games, gymnastics, and dance), and having a competent understanding of rules and activity structures. These were all taught within a teacher-centred pedagogy. This implied that learning can be identified ahead of time and assessed by checking that these prescribed outcomes are achieved. In summary, learning was framed as a linear mechanical process.

Initiating and sustaining departmental change is never easy. An important element in this case was the way the HoD could reconfigure the pattern of relations within the department that sustained current practices. He did this by enrolling in a Master’s degree (opening a channel for new ideas and information to come into the department) and by inviting a district counsellor from a nearby school to act as a ‘critical friend’ (creating a means to perturb current practice and enhance feedback). Another key element was the willingness of the HoD to develop a department culture that was more collaborative, democratic, and focused on placing student learning at the heart of all planning and departmental initiatives. Creating a culture of support and trust where each member felt their contributions mattered required a shift in the usual hierarchical traditional approaches to leadership. Enabling this meant the HoD becoming less of a director and more willing to find ways to engage greater participation and sharing of ideas amongst his colleagues and students.

Energy was then focused on developing a ‘growth plan’ for the department. Once everyone in the department felt this was not another ‘flash in the pan’ or ‘top-down initiative’ provided by either the district or school administration, a sense of trust developed. Time during department meetings and other ad hoc meetings was set aside for discussions about teaching, knowing, and learning. The development of the plan involved several phases (similar to action research), including planning, implementation, an action plan, and time to reflect and evaluate before moving onto the next phase. The HoD kept the principal and other essential stakeholders in the loop about developments and reported back to meetings. As the group began working collaboratively around scheduling, resources, teaching methods, implementation strategies, they began to develop a shared language and culture about teaching PE. These became a necessary part of bonding. “We put a great deal of energy into creating a healthy environment that encouraged dialogue, inquiry, and sharing of ideas.” The department became vibrant and energized. Its members rediscovered a spirit of idealism more typical of undergraduate students than veteran teachers – including rekindled hope, passion, and interest in their learners.

Through close collaboration, department members re-envisioned and rewrote major goals and policies for their department. By being involved, they became more willing and able to engage in the ‘School Growth Plan’ (SGP) goals being initiated by the School Administration team. Through a recursive process between school and department discussions, department documents dovetailed well into the child-centred policies of the SGP goals. These in turn fitted well into the wide interpretation of the provincial pupil learning outcomes and assessment guides. Such involvement in broader school policy making was a radical departure for several members of the department.

While very brief, the case helps to highlight some of the elements that enabled this group of teachers to enact an effective change process around their departmental curriculum and
teaching. In summary, these were: 1) reconfiguring the professional network to enable new sources of ideas and feedback; 2) deep examination of the educational beliefs and philosophy underpinning current practice; 3) support and time for developing and implementing curricular and pedagogical innovations; 4) supportive, open-minded leadership; 5) development of shared values, beliefs, and resources through collaborative inquiry; and 6) perturbation and recursivity around perceived barriers for change, which provided a means for informing the system. For a more complete report on this case, we suggest reading McGinley and Kanavos (2014).

Case study 2: supporting regional curriculum development with a self-organized professional learning community

The second case study focuses on how a group of teachers in the São Paulo region of Brazil self-organized their own professional community to support curriculum in their region (Sanches Neto, Venâncio, Betti, & Daolio, 2014). Brazil is a huge country divided into 27 states and 5570 municipalities. While it has national curriculum guidelines (Brazil, 1996) each metropolitan region has considerable autonomy for how the school curriculum is implemented in its own area. Complicating this is the fact that a high population density and shortage of schools means education in Brazil occurs in a series of ‘shifts’. Each school can operate up to three shifts each day to meet the population demand and this means that students attend school only in the morning, afternoon, or evening. For the PE teachers working in the São Paulo region, who commonly have to work across several school districts, with different curriculum regulations and insufficient equipment and facilities, the job of creating quality PE programmes is particularly complex.

In 2005, a group of PE teachers decided to look at ways to work collaboratively to help support and enhance their teaching. They were inspired by Elliott’s (1998) notion of ‘teacher-researcher’ as a way they could create an inquiry-oriented approach to solving the unique problems they encountered in their daily work. Initially they met in person to share vignettes of their individual experiences (similar to the method proposed by Tsangaridou & O’Sullivan, 2003) and support each other. Later, a website was developed that could help link the group, provide a means to coordinate activities and share resources, and encourage additional members (Sanches Neto et al., 2014). Over time, this group has grown and there are currently more than 265 teachers registered on the group’s website.

Questioning the nature of curriculum practice in São Paulo schools and the role PE played in enhancing the lives of young people was always a central concern for the teachers in the group. What became important was acknowledging that PE was an expression of the interdependent and specific factors in play in any school setting and not the application of generic solutions. What emerged from their work was the idea that curriculum should be broadly organized around the four ‘thematic content sets’ of the dynamics of culture (cultural elements), body (personal and interpersonal aspects), movement, and environment (environmental demands) (see Table 7.5). When implementing this curriculum the aim for teachers is not only to include at least one topic from each set, concurrently, in each lesson, but also to treat them pedagogically in an integrated mode in order to enhance the efficacy of the experience for the students involved (Sanches Neto et al., 2013).

While brief, the snapshot provided in this case study reveals something of the passion and commitment of the teachers involved to participate in the complex work of bringing a meaningful curriculum to life for the students in their particular region of Brazil. In effect, the teachers began to self-organize their own professional learning community that had no institutional or governmental affiliation (Sanches Neto, 2014). By working as a collective, they were able
Complexity and curriculum

Case study 3: creating a complexity framework at the macro level (national curriculum) that enables curriculum frameworks at the micro level (individual schools)

The third case study focuses on curriculum complexity at a national level. Like many countries around the globe, Scotland has grappled with ensuring its national curriculum meets the needs of learning to live and work in the twenty-first century. This has led to an increasing level of discussion at the policy level of the education system for revising curriculum around aspirational claims for young people to become ‘successful learners,’ ‘confident individuals,’ ‘effective contributors,’ and ‘responsible citizens’ (Scottish Executive, 2004a). It was also seen that to achieve such goals there was a need for teachers to be more flexible in how they interpreted the curriculum and use more active learning approaches to enable “the creative, adaptable professional who can develop the ideas that arise when children are immersed in their learning” (Scottish Executive, 2004a, p. 19). Coupled with this was the view that PE contributed significantly to achieving national health outcomes and, consequently, was “an area of the curriculum which, exceptionally, needs greater priority to support the health and well-being of young people in Scotland” (Scottish Executive, 2004b, p. 1).

One of the groups charged with working with primary schools and their teachers to help implement this vision was the Developmental PE Group (DPEG) at the University of Edinburgh. To effect curriculum change at the national level, the DPEG recognized that there was a complex mix of factors that influence how curriculum is enacted in schools. Key amongst these was the influence of primary teachers’ experiences during their own schooling and teacher education to shape their knowledge and beliefs about the purpose of PE, its content, and teaching approaches (Elliot, Atencio, Campbell, & Jess, 2013). Associated with this, the DPEG group also saw the need to challenge the fragmented and compartmentalized nature of the traditional

<table>
<thead>
<tr>
<th>Cultural elements</th>
<th>Movement</th>
<th>Transdiscipline approach</th>
<th>Environmental demands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Play and games</td>
<td>Combination and specialization</td>
<td>Anatomy and biomechanics</td>
<td>Administration and economy</td>
</tr>
<tr>
<td>Circus and gymnastics</td>
<td>Stabilization skills</td>
<td>Anthropology and psychology</td>
<td>Aesthetics and philosophy</td>
</tr>
<tr>
<td>Dance</td>
<td>Abilities and training</td>
<td>Biochemistry and nutrition</td>
<td>Physics and nature</td>
</tr>
<tr>
<td>Wrestling and capoeira</td>
<td>Manipulation skills</td>
<td>Embryology and physiology</td>
<td>History and geography</td>
</tr>
<tr>
<td>Sports</td>
<td>Rhythm</td>
<td>Motor behaviour</td>
<td>Sociology and politics</td>
</tr>
<tr>
<td>Daily life activities</td>
<td>Locomotion skills</td>
<td>Health and pathology</td>
<td>Virtual</td>
</tr>
</tbody>
</table>

Table 7.5 Content sets for physical education (adapted from Sanches Neto, 2003, 2014)
curriculum model in which student activity was often marginalized, rarely developed within a situated and authentic context, and usually failing to provide deep learning experiences.

In embarking on the ambitious project to lead a complexity-informed curriculum development programme, the DPEG encouraged teachers to tap into the potential of students to self-organize their own learning. This meant supporting teachers to use exploratory and open-ended tasks within different environmental settings. The emphasis was on working with teachers to help them create an inclusive learning culture where learning emerged through the posing of problems, the encouragement of dialogue and critique, and the scaffolded discovery of movement patterns. The DPEG emphasized the need for teachers to recognize and support young people’s ‘edge of chaos’ explorations so that students could view ‘mistakes’ as an important, necessary, and even enjoyable part of the movement learning process. Coupled with this the DPEG encouraged teachers to look beyond the idea that learning to move was about developing sport specific techniques and should rather be focused on the development of broader movement foundations, including adaptability and creativity, which enhance participation in most physical activities across the lifespan (Jess et al., 2011).

This case study not only highlights the transphenomenal nature of curriculum, by demonstrating how concerns around the nature and practice of curriculum emerge at various levels of the education system, it also acknowledges the uncertainty and non-linear nature of curriculum change. That is, it helps demonstrate how the aspirational and flexible outcomes relevant to physical activity, health, and well-being at the macro level of national curriculum policy provide the enabling framework for curriculum at the micro level of individual school practice rather than determining those practices. The results from the work of the DPEG reveal encouraging signs that schools, teachers, and young people have moved to a more complex and constructivist approach to learning movement. Importantly, by informing their work from constructivist, ecological, and dynamic systems theories, they have effectively created a complexity framework that enables them to articulate a vision of teaching PE while still acknowledging the ‘messiness’ and ‘chaos’ of doing this in practice (Jess et al., 2011).

Conclusion

The turn to working with complexity has value to those seeking to research curriculum and design of learning systems in PE. As we have outlined in this chapter, complexity can be generative in a number of ways. By viewing the world as organized through highly connected and interdependent elements, attention becomes more focused on affect and process rather than substance and being. This provides researchers and practitioners a vocabulary that enables new ways of questioning the assumptions, normalizing logics, and methodologies of educational practice. As our case studies demonstrate, it also provides researchers and practitioners a means to work with the dynamic, partial, layered, and contingent nature of educational practice in order to find the spaces in which they may make a difference.

Reflective questions for discussion

1. Describe six principles associated with contemporary approaches to complexity theory/thinking.
2. In what ways do schools reflect complex systems?
Complexity and curriculum

3. To what extent can we use complexity thinking as a conceptual framework to explain or account for (some of) the multiple processes and individuals influencing school-based curriculum development?

4. Explain how each case study reflects complexity thinking as described in this chapter.

References


