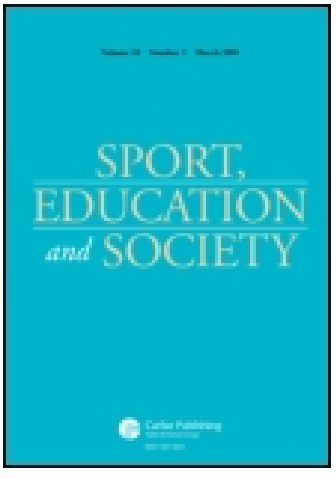

Sport, Education and Society
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/cses20

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Joy I. Butler[a], Brian Storey[b] & Claire Robson[c]
[a] University of British Columbia, Vancouver, Canada
[b] Douglas College, New Westminster, Canada
[c] University of Calgary, Calgary, Canada
Published online: 24 Apr 2012.

To cite this article: Joy I. Butler, Brian Storey & Claire Robson (2014) Emergent learning focused teachers and their ecological complexity worldview, Sport, Education and Society, 19:4, 451-471, DOI: 10.1080/13573322.2012.680435

To link to this article: http://dx.doi.org/10.1080/13573322.2012.680435

Sport, Education and Society, 2014
Vol. 19, No. 4, 451–471, http://dx.doi.org/10.1080/13573322.2012.680435

Emergent learning focused teachers and their ecological complexity worldview

Joy I. Butler[a]*, Brian Storey[b] and Claire Robson[c]
[a]*University of British Columbia, Vancouver, Canada;* [b]*Douglas College, New Westminster, Canada;* [c]*University of Calgary, Calgary, Canada*

Although Teaching Games for Understanding (TGfU) has gained ground, pedagogical models are sustainable only when situated in a comprehensive worldview and consistent epistemology. After considering the five values orientations offered by Jewett, Bain, and Ennis, the authors conclude that ecological integration offers a useful starting point in this regard, but taking this a step further, they offer a worldview that they call *ecological complexity*, woven together from social constructivism, complexity, and ecological thinking. Since the authors argue that teachers who espouse this worldview focus on emergent learning, they have coined the term *emergent learning focused* (ELF) teacher to describe the pedagogical approaches that might result. These encourage the spontaneous play seen in the schoolyard, playground, or village green as opposed to work in the factory. ELF teachers encourage learners to develop holistically as they construct meaning, positioning themselves in the ecosphere of which they form an integral part. The authors apply ecological complexity to Inventing Games, in which learners invent and refine games within the TGfU classifications. They argue that as learners work together to invent and develop ownership of their games, they engage in a cognitive apprenticeship that prepares them for life in the wider community. Specifically, learners develop core social and emotional learning skills in a process that the authors have termed *situated ethics*. As game play structures and constraints work in balance to produce disturbances, learners adapt and game play evolves. Learners learn to navigate these adaptations and evolutions by creating sustainable democratic processes. Teachers who operate from an ecological complexity worldview see all educational agents—learners, teachers, administrators, curriculum, school, community, and culture—as parts of a sustainable learning system. The authors conclude by offering the building blocks they believe might move this system closer to sustainability in games education.

Keywords: *Ecological complexity; Emergent focused learning; Complexity thinking; Physical education; Teaching Games for Understanding (TGfU); Inventing Games; World view*

Introduction

Teachers ask different kinds of questions about Teaching Games for Understanding (TGfU) these days. As recently as five years ago, when the authors presented at TGfU workshops and Professional Development days, many teachers asked why

*Corresponding author. Faculty of Education, Department of Curriculum and Pedagogy, University of British Columbia, Vancouver, BC V6T 1Z4, Canada. Email: joy.butler@ubc.ca

they should risk abandoning tried and true technique-based approaches to games education in favor of yet another educational fad. Now, it seems that the recent plethora of articles, books, and conferences on the topic have convinced even the skeptics that TGfU offers a credible alternative to drills, skills, and playing the game. Rather than questioning TGfU's validity, teachers want to know how to implement it. As TGfU advocates, the authors are encouraged. As physical educators dedicated to the construction of socially relevant curricula, we have some concerns, as we argue that broader epistemological and ontological considerations and perspectives—broad beliefs about the ways in which knowledge and meaning are constructed by teachers and learners—are vital to the projects of teacher education and curriculum innovation. When teachers fail to connect their teaching approaches with their educational values (Goodlad, 2004), they run the risk of replacing one set of problems with another. The belief that TGfU is a viable alternative to techniques-based physical education rests upon certain suppositions about the world—suppositions that make theories about knowledge and learning coherent and possible. At the heart of this discussion, therefore, lies an exploration of what this world looks like and what kinds of dispositions (Villegas, 2007) are necessary for a teacher to feel comfortable teaching TGfU, and to teach it effectively. We posit that effective TGfU teaching results from close engagement with and conscious understanding of an ecological complexity worldview.

Butler's doctoral work (1993) was driven in part by her curiosity about the extreme reactions she observed in the 1980s-1990s, when she began to introduce teachers to TGfU. They either loved it or were totally opposed to it; there was little middle ground. As a former teacher of working class students in social priority areas, Butler had become convinced that TGfU afforded greater access to Physical Education (PE) (in terms of gender, class, and ability) and that it provided intrinsic motivation for her students, whose class backgrounds rendered them reluctant learners. These arguments seemed so persuasive that she became interested in the strong negative reactions in some teachers that TGfU seemed to arouse. Speculating that these were fuelled by more than just pedagogical reflections, she conducted hours of interviews with 10 teachers as she supported them in exploring TGfU in their Massachusetts classrooms. While many of these teachers used current educational buzz words (such as 'child-centered,' 'empowerment,' 'individualism,' 'self-discovery,' 'independent problem solving,' and 'cooperative learning'), their theoretical statements were not always congruent with their actual teaching behaviors. In a number of cases, progressive rhetoric obscured the continuation of traditional practices, and the teachers involved seemed unaware or unconcerned that this was the case (Butler *et al.*, 2000).

The reasons for such clear gaps between teachers' epistemological and ontological positions and their actual teaching practices are complex. For instance, it can sometimes be strategic for teachers to use educational buzzwords in order to further their careers, impress administrators, or fit into the broad school ethos. Reid (2006) suggests that though teachers do pay attention to curriculum theorizing, they may sometimes subvert it for practical and ideological reasons. That said, there was a marked disconnect between even more traditional and behaviorist assumptions

about how children learn and what might be called their 'educational philosophies.' Teachers offered behaviorist axioms about learning (for examples, 'they need to be spoon-fed,' or 'they need to know the basics before they can play the game' [Butler, 1993, p. 164]), but were unlikely to position these within the broad context of school, culture, and society, or to understand how their worldviews affected their choices of methodology, or indeed, their epistemological positions (Ashton & Gregoire-Gill, 2003). This interpretation of Butler's interview data is also supported by other researchers (Raths, 2001; Ha *et al.*, 2004; Thompson, 2007) and most recently by Zhu *et al.* (2011).

In the late 1980s, Butler began to see TGfU as a catalyst for ontological engagement as she encouraged teachers to work through productive aporia and cognitive dissonance in order to address pedagogical questions that had lain hidden. Although some teachers clung doggedly to the status quo ('If it ain't broke, don't fix it' said one teacher at a one of Butler's TGfU workshops in the 1980s), there was growing disenchantment with the PE curriculum as learners bailed out of after-school PE programs (Ifidi, 2005) and obesity and inactivity reached epidemic proportions (1986). A growing cohort of commentators suggested that rather than tinkering with the PE curriculum, or 'bolting on' new initiatives (Butler, 1993, p. 60) to the perennial round of seasonal games, it was time to go back to the drawing board, by taking a step back to consider the discipline's aims and purposes. Rather than instrumentalizing the curriculum, they believed it was time to take a look at the broader philosophical implications of engaging learners in games education (Sparkes, 1992; Rovegno & Kirk, 1995; Devis-Devis, 2006), or to question its ontological and epistemological perspectives. 'Why do children need to learn techniques before playing the game?' 'What should be learned in games education?' 'How do children learn more effectively?' This conversation has continued (Kirk & McPhail, 2002; Rovegno & Dolly, 2006; Solmon, 2006), and this article attempts to draw together some of the main threads, as it suggests a location for games education within a comprehensive worldview.

Jewett *et al.* (1995) developed five curriculum value orientations: disciplinary mastery, self-actualization, social reconstruction, learning process, and ecological integration. We believe the 'Ecological Integration Perspective' (Jewett *et al.*, 1995) provides the best starting point for an ontological framing of TGfU, though many practitioners draw broadly across the five orientations. As we have expanded and adapted the work of these authors by including the insights and understandings of contemporary complexity thinkers working in the field of curriculum and education (Davis *et al.*, 2008), we have constructed a worldview that we believe offers a suitable home for the approach, and we are naming this *Ecological Complexity.* We believe that in contemporary best practice, effective physical educators focus on learners and their learning process as it emerges. Teachers involved in this perspective can be referred to as an *Emergent Learning Focused* (ELF-T) and learners as Emergent Learning Focused Learners (ELF-L).

Ecological complexity worldview

According to Apostel (Aerts *et al.*, 1994), a worldview is an ontology that serves as a descriptive model or schema of the known world, which consists of everything around us—the physical universe as well as mind, life, culture, and society. Our worldview is by nature interpretative, in that it is made up of a framework of ideas and beliefs (including beliefs about the nature of knowledge) that allow us to structure and make sense of how the world operates. It is also dynamic. Although it provides a map that we can use to *orient* and *explain*, we also use this map to *evaluate, act,* and put forward *prognoses* and *visions* of the *future*. Apostel believed that a well-formulated worldview consisted of seven basic components:

(1) Explanation
(2) Etiology
(3) Futurology
(4) Values
(5) A praxeology (theory of human action)
(6) Epistemology (theory of knowledge)
(7) Building blocks

We have used six of these seven components to organize this article. The third item, futurology, lies beyond the scope of this article and has thus been omitted.

Explanation of ecological complexity in TGfU

While some areas of the PE curriculum have been informed and shaped by a range of worldviews (health and wellness come to mind, as do outdoor experiential activities), the prevailing value orientation in games education in North America, Asia, and Europe is what Jewett *et al*. have named the 'disciplinary mastery perspective' and what Metzler has called the 'direct instruction model' (2000). Since games education still dominates the overall PE curriculum (typically taking up 33% to over 80%), the general perception of PE is that it is wedded to this perspective (OFSTED (UK) 1995, cited in Lockwood, 2000, p. 133). In this Explanation of Ecological complexity section, we begin by identifying that from which we are moving away (Aerts *et al*., 1994)—the disciplinary mastery perspective, then explain how TGfU can be located in disciplinary mastery and what differences in worldview need to occur to locate TGfU in a Ecological complexity worldview.

Disciplinary mastery perspective

The disciplinary mastery perspective comes from a worldview that considers that truth can be separated from falsehood and that knowledge is a corpus that can be measured, quantified, and transmitted. Because mastery is valued, teachers deliver knowledge, the curriculum emphasizes correct and efficient ways to carry out skills, and ideal learners are compliant, responsive, and able to memorize information. As Bourdieu

(1984) has pointed out, sport is a class specific practice through which dominant social structures are constituted through everyday actions and practices. It is, therefore, necessary to locate PE within its larger cultural context (Light, 2001). Typically, schools transmitted cultural heritage (or class habitus) through the generations and evaluation has been based upon narrow definitions of effective performance, as in the nineteenth-century factory. In PE, an emphasis on efficiency can be traced back to the connections between sport and the military (Singleton, 2010), and to the impact on education of the movement towards industrial efficiency (Bobbitt, 2004).

As this worldview translates into classroom practice, we will note that teachers transmit techniques, (hoping that these will somehow transfer into game play) as well as the knowledge and beliefs that lie unquestioned in their cultural heritage and in their own previous learning experiences, where success was conflated with successful adoption of their PE teacher's values and beliefs about learning (Hopper & Sanford 2006). Teaching and learning strategies are generated by behaviorist theory and the five main concepts of behavior training: shaping, modeling, practice, feedback, and reinforcement.

However, effective game performance does not necessarily need to be attached to a culture of compliance and order. With Davis *et al.*, the authors believe that all actions are 'rooted in a coherent interpretative system' (Davis *et al.*, 2008, p. 101) and that education can unsettle the status quo as it opens up critical practices to wider sections of the populace (Bourdieu, 1984). Rather than fixing errors, teachers who believe that knowledge is complex and emergent might work to make sense of the web of associations that make up their learners' interpretations and perceptions. This will be discussed further.

Locating TGfU: the disciplinary mastery perspective. It is completely possible to teach TGfU from a disciplinary mastery perspective; indeed many, if not most, PE teachers do.

When working within a disciplinary mastery worldview, TGfU teachers focus on connection and transfer and thus take several steps away from the more traditional focus of physical educators on proficiency in techniques and skills in isolation. Such teachers emphasize content and knowledge (such as the TGfU games classifications, the four categories and their main intentions) and ensure that learners experience a balanced range of games from each. Attention is paid to progressions, as teachers develop a scope and sequence of concepts, strategies and skills for each year level. Games chosen within each category reflect and thus reaffirm the school's history and cultural heritage, though the classification structure might allow some departure from traditional sports into some lesser known games activities. Ability is still largely defined in terms of successful performance of skills and high-quality game play, though learners do develop a network of skills, concepts, and strategies that permit and promote inter-transfer and intra-transfer between and amongst the categories in the TGfU games classifications (Ellis, 1983, 1986; Almond, 1986). Here, we argue that games education can rightly lay claim to a larger educational purpose—to help learners develop in ethical, cognitive, and social dimensions and to practice the

critical analyses, interpretations, dispositions, and attributes that they will find useful as engaged global citizens. This is where the disciplinary mastery and ecological complexity perspectives part company.

Locating TGfU: the ecological complexity perspective

> The school is responsible for the development of individuals who function effectively as citizens of a single world and whose commitment to human futures goes beyond personal competence, local achievement, and national pride. The curriculum is directed toward a sociological ecosystem as a biological ecosphere. (Jewett *et al.*, 1995)

Most, if not all, teachers would agree that their actions and decisions can never be entirely separated from those of their learners or from the context within which they occur. Emergent learning focused (ELF) teachers take a small extra step from this position, as they see themselves and their students as being embedded in the learning system in a co-constructed search for the unknown. TGfU advocates (like many others) are concerned not only with the short term—the quality of teaching in PE—but with the long-term learning and lifestyles that this may inspire. Building on the ecological integrated perspective defined by *Jewett et al.* (1995), ELF teachers encourage learners to ask and consider critical questions in order to construct knowledge and meaning and develop a sense of ownership of their own learning. As Bourdieu (1984) has noted, collective forms of subjectivity are central to the negotiation of agency, and the breakdown of such social endeavors is destructive of it. As they work and think together learners come to see themselves as an integral and important component of the ecosphere. Schools are regarded as contexts within which holistic individuals might be integrated. Learning looks to the future, and evaluation techniques are selected to ensure that learners develop, think, and operate from holistic perspectives.

The ecological complexity approach borrows from democratic play in contexts such as the playground or the local park rather than the institutionalized and structured factory as its cultural model (Factory vs. Village Green, Butler, 1998). In spontaneous contexts such as these, children learn through self-discovery, exploration, observation, and interaction. When it is located in this perspective, TGfU's main purpose is for learners to construct meaning from the situation in which they are placed. Their ability to make decisions as part of a skilful performance is paramount, as are holistic learning outcomes. If understanding, synthesis, application and the ability to use information in new situations are the purposes in games education, a TGfU approach is effective.

Table 1 is presented not to encourage an either/or mindset but as a means to unpack the properties of the two worldviews. One of the obvious questions facing us subsequent to viewing a polarity table is whether this is a polarity to manage or one to solve.

Table 1. Comparing disciplinary mastery and emergent learning focused teachers worldviews

Properties	Disciplinary mastery	Ecological complexity
Stage 1: explanation of the world view		
Ontology: why it is taught (philosophical and historical perspectives)		
World view	Factory/product model	Local park/play education
A framework of ideas and beliefs through which an individual interprets and interacts with the world	Compliance, efficiency, and order	spontaneity, creativity on the edge of chaos
Context	Isolation within school context, links with coaching and professional sport	Integration of school and community
Training	Efficiency/military influence	Movement education, problem solving
Experience	Specialism/sport	Integration and inclusiveness
Teaching Philosophy in games education	A teacher-directed process wherein the teacher chooses the game category, context, and form (Metzler 2005)	A democratic process wherein learners decide on the game structure constraints (Butler, 2006), Once game play begins, the teacher acts as a catalyst to learners' emergent learning through the creation and facilitation of disturbances
Stage 2: etiology		
(Where do these world view ideas come from? How were they constructed?)		
Learning theory	Behaviorism: shaping, modeling, practice, feedback, and reinforcement	Emergent learning focus: social constructivism, complexity thinking, and ecological thinking
Stage 3: values		
A direction or set of goals that helps guide tour actions—our moral compass		
Belief system	Dualism: a healthy mind in a healthy body	Integration of mind/body/spirit/ecosystem
Context	Isolation, links with coaching and professional sport	Integration of school and community
Goal	Lifelong participant in physical activities Individual improvement	Active, critical, democratic citizen of integrated school and community
Skills and attributes	Physical skills are privileged and taught in isolation. Cognitive and affective learning is hoped-for and assumed	Skills and attributes across the domains are taught for consciously in integrated unit and lesson plans
Stage 4: A praxeology (theory of human action). This answers the question 'How should we act?'		
Pedagogy: practices—how it is taught		
Learning focus	Response learning	Emergent learning
Instruction	Teacher—centered	Learner—centered
Strategy	Part—whole	Whole—part—whole

Table 1 (*Continued*)

Properties	Disciplinary mastery	Ecological complexity
Content	Techniques based	Concept based
Teacher role	Transmission of information	Facilitation of problem-solving
Learner role	Passive learning	Active learning
Context	Teacher—learner interaction	Multi-dimensional interaction of nested systems
Evaluation	Mastery	Demonstration of understanding and contributions to process
Stage 5: epistemology: (theory of knowledge)		
What is true and what is false?		
Purpose	Knowledge is transferred from teacher to student as inert chunks of information—fixed and absolute	Meaning is constructed by learners in social context—negotiable and emergent
Objective	To define what we know	To discover what is unknown and apply what is known
Lesson design	Lesson plans delineate clear, measurable outcomes, usually the acquisition of knowledge, skills, and techniques. Once these are identified, they are taught in sequence and largely in isolation. Game play follows drills and practices	Perturbation or disturbances force adaptations by the agents in the system (teachers and learners). Thus lessons created are not rigid scripts, but rather, visualization documents for probable, but flexible, learning outcomes. Game play is ongoing
Outcome	Performance	Thinking, decision-making, democracy, situated ethics
Game frameworks	Seasonal activities	Classifications
Tactical knowledge	Tactical knowledge becomes the focus after teaching of technique, skill, modified game, game sequence	TGfU requires that teachers provide a tactical language framework, such as the one proposed by Wilson (2002). Emergent learning in the area of tactics and strategy may be demonstrated by learners, however, if they do not place a cognitive framework on top of their embodied experience, transfer may be limited
Stage 6: building blocks (ecological complexity perspective only)		
How do we get from here to there?		
What changes in the system might result in broad systemic change?		
Teacher change	Reorientation of philosophy and self-image, as teachers change their beliefs, values, ideologies and understanding with regard to pedagogical assumptions and themes	

Table 1 (*Continued*)

Properties	Disciplinary mastery	Ecological complexity
Administrators	Provision and support of the infrastructure necessary to sustain change in curricular design or implement curricular innovation	
Research	Provision of evidence that TGfU works and theorization of how it fits into broader educational goals	

Inventing Games. The holistic learning outcomes that become possible when TGfU is located within an ecological complexity perspective are well illustrated through Inventing Games, an offshoot of TGfU (Almond, 1986). In Inventing Games units, learners invent their own games, based on one of the four categories, and then to decide how they can be refined in order to make them more fun, fair, and inclusive. When groups are situated within the structure of an Inventing Games process, they become loci of learning and the individuals in these groups become learning systems within the larger learning system. The experience of creating a game (within the parameters of teacher guidelines around safety and inclusion) enables learners to construct a shared and negotiated understanding of game structures and rules, together with a sense of ownership of the game and of the learning experience itself. In this sense, their environment is both social and physical. As Bourdieu (1984) has suggested, habitus functions in pre-reflexive and embodied ways that precede more discursive critical practices. It is our contention here that Inventing Games provides a context in which social relationships can be renegotiated. As knowledge is constructed in a social context, it becomes negotiable and emergent rather than fixed and absolute.

Situated ethics. As learners work together cooperatively and learn from watching, listening, and engaging with others, they engage in a 'cognitive apprenticeship' that prepares them for life in the larger community (Hansman, 2001, p. 45). The affective component of this learning is critical. Butler's current program of research engages researchers, students, and teachers in exploring how ethics might be taught through Inventing Games (in processes they are calling, Situated Ethics). Preliminary findings suggest that game play engages learners in core Social and Emotional Learning (SEL) skills, such as self-awareness, social awareness, self-management, relationship skills, and responsible decision-making, a conclusion also supported by the work of Ragozzino and his colleagues (2003). As part of this research, Butler (in press) is considering how such outcomes might be planned and taught for.

As teachers and learners focus more on 'the why' than 'the how,' Inventing Games encourages learners to think and feel, rather just 'do.' The classroom becomes more participatory and democratic, as learners embrace both autonomy and responsibility. It is essential to note here that 'the how' still has an important place, as learners work together, and with the help of their teachers, to become more efficient and effective

at all levels of the game, including execution of skills, developing practices that will help perfect them. But in addition, learners have opportunities to:

(1) make choices and decisions in order to solve problems and regulate their own behavior
(2) employ invention, creativity, and imagination as they create their own games
(3) make good rules to regulate behavior and make the game run smoothly
(4) appreciate fairness and equality
(5) consider others' points of view, to compromise and to negotiate conflict constructively
(6) understand why rules are meaningful
(7) make decisions including all members of small groups
(8) become willing to question and trust their creativity
(9) take a turn at all roles, to develop empathy and consideration for each position and official
(10) construct their own cognitive maps as they create relationships amongst classifications to and games
(11) engage in free and open enquiry
(12) understand their responsibility to protect individual and collective rights and freedoms (Castle, 1990; Butler, 2005)

Etiology (Where do these ideas come from? How were they constructed?)

Ecological Complexity is woven from three theoretical strands: social constructivism, complexity thinking, and ecological thinking.

Social constructivism and complexity thinking

While social constructivism (cognition is collective and situated) and complexity thinking (holistic conceptions of learning) are different theoretical entities, they both focus on the notion of construal (Davis *et al.*, 2008), which can be described as the kind of individual sense-making we engage in as we reach beyond the known in order to grasp what is unknown, or not yet known. When these construals are made unstable by incompatible experiences, for instance in moments of aporia, reconstruals are forced upon the learner. The learner, therefore, is constantly construing and reconstruing in an effort to maintain a coherent system of interpretation (Davis *et al.*, 2008, p. 100).

Although individual sense-making is important to both social constructivism and complexity thinking, it is also true to say that in both perspectives, individuals are framed as complex learning systems nested within the larger learning system of the collective:

> . . . cognition is always collective, embedded in, enabled by; and constrained by the social phenomenon of language; caught up in layers of history and tradition;

> confined by well-established boundaries of acceptability; defined by joint interests, shared assumptions and common sense. (Davis *et al.*, 2008, p. 103)

When learners are placed in small groups and asked to co-create and negotiate a task, as they are in Inventing Games, the collective becomes more intelligent than the sum of its individuals, though as Davis *et al.* point out, the collective is also embedded in its culture, history, and language. This belief that learning is both individual and collective or social is key to understanding the Ecological Complexity worldview.

Ecology

The word 'ecology' best refers to the study of relationships, and in particular, the ways in which our thoughts, actions, and values all impact the world around us—both the non-human and the human. It is through this lens that we can come to appreciate that teaching and learning games cannot be done in isolation. Rather, the learner both affects and is affected by the collective, making the two hard to separate. As Davis et al. suggest, 'an agent's learning is simultaneously about its *memory* (i.e. internal co-activities of subagents) and its *knowing* (i.e. the ways its actions are entangled with others' action in grander systems)' (p. 107, italics original). In order that these systems remain sustainable, close attention must be paid to how the actions of various agents affect the system as a whole.

In PE, this is true at both the micro level (the game) and the macro level (the groups of students and the community of which they are part). The originators of the TGfU model (Bunker & Thorpe, 1982; Waring & Almond, 1995) suggest that its underlying purpose is to maximize appreciation, enjoyment, and growth so that participation continues. Game play is both the beginning and end of a cyclical and iterative process wherein new learning is constantly fed back into the spiral curriculum (Butler, 2006). The systems view of learning taken by TGfU is also inclusive, in that it recognizes the diversity of participants and attempts to foster co-evolution from heterogeneity. Ecological views of learning embrace the importance of all 'agents' (learners, teachers, curriculum, school, community, culture) in a learning system. The pedagogical and curricular principles of sampling, modification-representation, modification-exaggeration, and controlling tactical complexity (Thorpe *et al.*, 1986) offer enabling constraints that serve this adaptive, evolving, and sustainable system (see Figure 1).

Ecological complexity in game play

Complex systems evolve and adapt as they respond to constraints that enable their growth. In game play, these consist of two distinct types of constraints, game structure constraints, and game play constraints. The latter are ever-present and represent the combined knowledge, skills, and affective constraints players embody at any given moment in a game. Game play constraints are fluid and change with each subsequent adaptation a player makes (see Figure 1). The constraints of ability

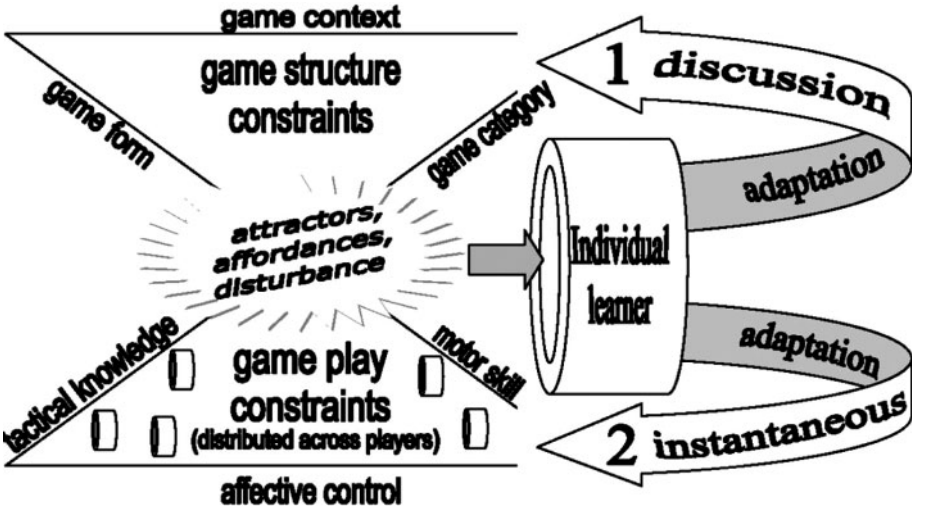

Figure 1. The balance of game structure, game play, and individual learner constraints leading to disturbance, learning, and a need to rebalance the game structure and game play constraints (Storey & Butler, 2012).

distributed across players change every time players adapt to new challenges and use the new abilities that result. Game structure constraints are the rules and regulations that serve to define the game itself and distinguish it from others.

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. Each learner's adaptations, although bound by his or her structural determinism, contribute to the iterative learning spiral that constantly changes the system. In TGfU pedagogy, discussion about tactics, strategy, skill, or game form is often the catalyst for changes to games structure constraints (see Figure 1, adaptation arrow 1). Changes to game structure may come in the form of a democratic process (Butler, 2006), or by way of teacher direction. Adaptation arrow 2 in Figure 1 represents the fluid reintegration of learning fed back into a game in progress.

In this way, the Inventing Games classroom ideally exists on the edge of instability. It neither dissolves into chaos, nor settles into static balance, but continues to evolve by adapting as it goes.

To illustrate a systems view of game structure and game play constraints working together to create disturbance and adaptation, we offer consideration of the rule that disallows players from deliberately using their hands (except for the goalie) in soccer. Hitting an overhead ball with the hands may be a creative and worthy choice, however, it would be deemed a foul. The creative adaptation of the individual is subservient to the formality of the rules. Game structure constraints require the player to use another part of the body to control the ball, such as the head.

The player's confidence in heading the ball, his /her skill level, and whether or not she/he knows where to direct it further constrain her possible responses. Not only do they constrain her/him, but any response to a lofted ball in her/his direction is carried out by all the surrounding players to him/her at the time. If she/he cannot head the ball, they will not be expecting her/him to do so, and, therefore, will most likely prepare for another type of pass. The moment that player learns to head the ball, not only is she/he changed, but the game play abilities on the field will change in response to the new disturbance. Her/his new skill will not only have game play effects instantly, in the form of new possibilities for passing and shooting, but also will affect the game structure possibilities of all subsequent games. New mini-games can be formed to include heading or perhaps to improve the tactical use of skill by the team.

Values (What is valued and why? What should we do? What should we not do?)

This third component of the worldview gives us our moral compass—a direction or set of goals that helps guide our actions. These goals and directions arise naturally, as answers to the central question: What is of value? As we have already seen, what is valued in the ecological complexity worldview is the sustainability of the broad community of which the school, the classroom, the groups, the individual learners, and teachers form important and inseparable parts. What is valued then is the ability of individuals to recognize and acknowledge this role, and to develop the skills and attributes they need to become active, critical members of this community. These include the following:

(1) To develop awareness of the interrelatedness of all people(s)
(2) To develop awareness of the interrelatedness of human and non-human systems and an understanding of how these systems operate in relationship
(3) To think critically and ask questions, even when these seem like they might perturb the community, in the knowledge that communities are necessarily dynamic and evolutionary
(4) To acknowledge the importance of one's place in the community by making commitments and choices, understanding that non-action is itself a form of action when one is part of a greater whole
(5) To appreciate that everyone's contribution has equal weight and may be of equal value—an appreciation of liberty and justice
(6) To understand that this means that everyone is equally responsible for the health of the community and that this may mean putting others above self on occasion
(7) To work on developing the skills and abilities required for working cooperatively, including the ability to communicate respectfully and honestly, the ability to listen, and the ability to compromise, cooperate, and negotiate decisions.

A praxeology (theory of action)

Knowing what to strive for does not necessarily mean that we know how to get there. The next component of the worldview must be a theory of action (praxiology). This answers the question 'How should we act?'

Emergent learning focused teaching and learning

We suggest that the ELF teacher captures emergent learning, supports it with a cognizing moment, and fosters subsequent iterations of that learning back into a new game structure. Such teachers recognize that they are part of a larger learning system and, therefore, co-evolving with learners, but also understand that they are expert observers of such systems and its agents. ELF teachers make sure that game structure and game play constraints create the best possible disturbances for players, leading to desired adaptations. For instance, a two to one offensive overload can both help offensive players perfect a give and go, and at the same time, help the defensive player to predict the pass and learn to move into the space where it might occur, rather than mark one player. In essence, ELF teachers recognize the components of the complex adaptive system outlined in Table 1 and address (through their pedagogy) the disturbances and constraints of the system to foster positive adaptations by learners. This ability requires understanding of both the pedagogical and curriculum model employed and of the value orientation driving his or her choices.

Emergent learning focused (ELF) teaching requires teachers to work within sets of probabilities. For instance, they know from experience that a particular game structure may lead to certain outcomes for learners; however, they also accept that games are open to perturbation, that several viable strategies might be found to approach a particular situation, and that most problems result in approximate, rather than perfect, solutions. Short-term learning outcomes are emergent and, therefore, cannot be guaranteed. A closed-system teacher with rigid boundaries and set ideas will probably be fundamentally at odds with the open-system structure and emergent learning that are inevitable in TGfU, preferring set lesson plans that close down possibilities and target outcomes. In contrast, an ELF teacher may have difficulty following strict lesson plans beyond an initial game form set-up. For ELF teachers, lesson plans are visualization exercises that allow them to imagine how the lesson might go, while nurturing other possibilities.

Emergent learning focused (ELF) games teachers expand their observations or interventions from the psychomotor and cognitive domains into the social. The concepts of fair play, cooperation, and sportsmanship are as likely to emerge as concepts relating to offense and defense and their associated skills. As each topic takes its moment in the foreground of a game, a genuine learning opportunity is presented to the teacher to facilitate the weaving of experience and cognition together. The principles of enjoyment, participation, learning, and cooperation in

creating games overshadow the temporary competitive states that players enter into during game play. The creation and fostering of this belief in players and the facilitation of self-awareness around players' affective states is the responsibility of an ecologically minded ELF teacher.

Epistemology (Theory of Knowledge)

This answers the question 'What is true and what is false?' allowing us to distinguish between the theories and models we use to describe the phenomena we encounter:

> . . . for constructivists, the biological body is not a structure through which one learns, but a structure that learns. Individual learning is not a brain-based phenomenon, but an ongoing process of embodying one's history. For this reason, bodily action is not seen as a demonstration of internalized understandings; rather bodily action is understanding. (Davis *et al.*, 2008, pp. 100-101)

Earlier in this article, we suggested that in Inventing Games, the 'knowing' that learners achieve is embodied, social, and sustainable as learners construct knowledge and understand in the ethical, cognitive, and affective domains. Learners are invited to question and consider the purpose and meaning of game structures, rather than simply being presented with structures as fait accompli. Just as learners and teachers are part of larger systems, so is knowledge itself nested, and in Inventing Games, teachers themselves are seen as co-learners as well as expert observers. Metzler points out that Shulman's (1987) knowledge base for teaching is still most frequently (indeed almost universally) cited by the coordinators of teacher education programs that are undergoing accreditation. Yet, throughout Shulman's constructs of teacher ability runs the sense that a corpus of teacher knowledge pre-exists and can be drawn upon appropriately in given situations. Eisner (2004, p. 2), however, has suggested that teaching is more like a form of art than a series of closed skills, because teachers have the ability to pay attention to emergent features in the field of relationships offered by his learners. Just as Varela (1999) suggests that ethical decisions are emergent and situated, rather than proscribed by exiting rules and dogma, so we would suggest that the ELF teacher draws on the sum of his or her experience almost instinctively to respond to situations as they arise. We would, therefore, wish to add to Shulman's categories of teacher knowledge and, in particular, consider the tacit knowledge that teachers draw on as they adapt creatively to new situations. Of course, this situation has broad implications for teachers and teacher educators, since the facilitation of such fluid and open ended and learning situations, perhaps paradoxically, requires highly rigorous planning and organization, as the teacher attempts to prepare for a range of potential learning outcomes and directions. It requires the deep, expert knowledge of diagnostic surgery, rather than the predictable, technical knowledge required for a routine procedure such as removing an appendix.

Building blocks

As we consider change in the PE curriculum, we ask the following questions: 'How do we get from here to there?' What changes in the system might result in broad systemic change? We have identified three points in the system at which change might effectively occur: teachers, administrators, and researchers.

Teacher change and steps towards emergent learning focused teaching

Surface change (Sparkes 1991). The authors are somewhat wary of resources such as curriculum packs and lesson plans that move straight to the implementation of a TGfU curriculum (despite a strong call for these in the educational literature). These represent an instrumentalization and oversimplification of the curriculum that does not match well with the emergent learning focus we have described above. Rather, we would advocate workshops for practicing teachers and more systemic changes in Physical Education Teacher Education (PETE) programs.

Interim change. This involves the exemplification and introduction of new skills, teaching approaches, styles and strategies, combined with changes in teaching practices with attendant changes in the teaching role (Butler, 1993, p. 223). As we have argued, it is essential here that the ELF teachers identify with a coherent and comprehensive philosophical framework for TGfU, and that this can be articulated and shared with school colleagues through reflection and discussion. It is also necessary for teachers to examine the match between such theories and their current practices.

Real change. This can involve a major reorientation of philosophy and self-image, as teachers change their beliefs, values, ideologies, and understanding with regard to pedagogical assumptions and themes. It may also require adjustments to pedagogical practices on the ground, as teachers come up with new ways to design the curriculum and implement their chosen orientations.

Administrators

We believe that it is in the best interests of schools and schooling that innovative approaches to teaching be implemented, particularly an educational climate in which critical thinking, problem solving and decision-making are valued. Administers are frequently unwilling or unable to provide the necessary infrastructure to sustain change in curricular design or implement a curricular innovation. Unless administrators provide the necessary infrastructure, it is hard to sustain any change in curricular design or implement any curricular innovation.

Research

In 1986, Thorpe and Bunker challenged researchers to answer the question, 'Does TGfU work?' and urged us to undertake studies that involved questionnaire design, attitude measurement, and the collection of performance data. We break down their suggestion as follows:

(1) Establish strong empirical data that would support our intuitive sense that this approach works for learners (e.g. Bunker & Thorpe, 1986; Rink, 2001, 2010; Kretchmar, 2005). Many TGfU advocates have made this request.
(2) Continue to explore and examine subjective outcomes (e.g. to play well and to enjoy playing) as well as objective outcomes (e.g. skill acquisition) and to value both, regardless of how difficult they are to assess and measure.
(3) Focus on all aspects of the child—examine the outcomes of the affective domain as well as the increasingly well-documented cognitive and psychomotor domains (Holt *et al.*, 2002).
(4) Continue to consider the nature of understanding, and to consider its place in the learning environment (Rink, 2001; Kirk & MacPhail, 2002; Kretchmar, 2005)
(5) Continue to ask relevant and probing questions and to involve all major players in finding answers—practitioners, curriculum designers, researchers, administrators, and learners (Macdonald *et al.*, 2002).
(6) Examine student learning outcomes of different putative methodologies to determine if what we think we are teaching is actually what we teach.
(7) Develop research studies that examine the curricular and pedagogical principles (Thorpe *et al.*, 1986):
    - Sampling,
    - Modification-representation,
    - Modification-exaggeration
    - Tactical complexity in order to guide the practice of planning the games curriculum (Wilson, 2002)
    - Authentic assessment (Oslin, 2005)
(8) Continue to make connections with the coaching community, e.g., Games Sense (Australian Sports Commission, 1995; Kidman, 2005; Kidman & Lombardo, 2010).
(9) Continue to develop and validate authentic assessment instruments such as Team Sport Assessment Procedure (TSAP) and Games Performance Assessment Instrument (GPAI) (Butler *et al.*, 2003).

Conclusion

When teachers are made more aware of their teaching behaviors and teacher philosophies, they become more conscious of the gaps between their stated curriculum theories and their actual teaching practices. Indeed, these disconnects

can provide those instances of aporia or breakdown described by Varela (1999) as disruptive of habitual responses and productive of new insights and learning. Just as learners in TGfU game play come up against new situations and tensions and are required to come up with new ways of approaching and navigating them, so ELF teachers must constantly examine their practices, not in order to codify them, but to imagine new ways to take the learning situation forward. As their practices become more visible, teachers are more likely to engage in real change.

Defining one's perspective on games-based PE is a deliberate and conscious choice. Some teachers are not aware of their perspective, because it is a lens 'they look through, rather than at, when teaching' (Jarvis-Selinger *et al.*, 2007). The choice of perspective for games teaching is defined by the external constraints within which teachers operate, what they believe to be the 'value' of PE to learners, and their awareness and understanding of their current practices. We propose that learners will benefit if PE teachers are exposed to and adopt an ecological integration values orientation towards games teaching, and when their attention is drawn to the ways in which they implement their stated values. If teachers trust the processes of co-dependence of players in the complex adaptive systems known as games, then they will be interested in seeking the teaching behaviours that promote these processes.

We also suggest that an ecological complexity perspective on learning through games holds more promise than zero-sum views of games education. TGfU, as practiced within an ecological complexity perspective, provides us with the opportunity to create PE lessons that are supportive of sustainable and generative learning. Sustainability in our teaching is measured by the ability and motivation of the learners in our classes to continue playing, and generative learning is represented by their constant adaptation to changing game structure and game play constraints. Through the processes of embodied learning and socialization in sports, the suggested benefits of ecologically minded teaching of games may even stretch past the boundaries of our fields and into the dominant culture in which games are embedded.

Acknowledgements

Thanks to Drs Linda Griffin, Ellen Singleton, and Len Almond for their suggestions and guidance in this study.

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