



**Complexity Thinking: Creative Dance Creating Conditions for Student Teachers to Learn how to Teach**

*Complexité de pensée et danse créative : Favoriser un nouvel apprentissage au niveau des étudiants-maîtres*

**Timothy Hopper  
University of Victoria**

*This paper will draw on Davis and Sumara's (2006) idea of complexity thinking to understand learning as an emergent process for (1) students in a creative dance lesson, and (2) generalist elementary pre-service teachers within a school integrated teacher education (SITE) course. Focused on a two-term generalist physical education preparation course, images from digital video clips, course materials and pre-service teacher reflections are presented as evidence to show the creative dance process and the pre-service teachers' responses to this material. The paper introduces complexity thinking to the reader through ethnographic fictional representation of an actual creative dance lesson analyzed through a complexity lens. Drawing on pre-service teachers' insights, this paper will conclude with speculations on how teacher education course experiences could be informed by how creative dance and SITE based courses create recursive tasks that allow bottom-up, peer-shared, decentralized and emergent learning experiences.*

*Cet article s'inspire du concept de Davis et Sumara (2006) portant sur la complexité de pensée. Ce faisant, il enchâsse l'apprentissage dans un processus émergent qui vise (1) les élèves qui suivent un cours de danse créative et (2) les étudiants-maîtres qui se destinent à une carrière de généraliste à l'élémentaire et dont les cours de formation sont intégrés au fonctionnement d'une école. L'auteur présente des images de segments vidéos numériques, ainsi que du matériel pédagogique et des réflexions d'étudiants-maîtres recueillies lors d'un cours de formation axé sur l'enseignement de l'éducation physique pour généralistes étalé sur deux semestres dans le but de démontrer le processus de danse créative et la réaction des étudiants-maîtres à ce matériel. L'article initie le lecteur à la notion de complexité de pensée à l'aide de représentations ethnographiques fictives d'un véritable cours de danse créative analysé sous l'angle de la complexité. Partant des réflexions des étudiants-maîtres, l'auteur termine en indiquant en quoi les cours de danse créative et les cours intégrés engendrent des tâches récursives favorisant l'apprentissage de bas en haut, la mise en commun entre les pairs, la décentralisation et la nouveauté, ce qui*

*contribue à enrichir les expériences des étudiants-maitres en formation préalable à l'enseignement*

### *Introduction*

This paper uses complexity thinking (Davis & Sumara, 2006; Waldrop, 1992) to understand how creative dance, taught within a movement education frame (Boorman, 1973; Carline, 2005), is effective in teaching young children (ages 5 to 11) to dance; and how, within a school integrated teacher education (SITE) course, creative dance is effective in teaching novice pre-service teachers to learn how to teach. SITE refers to the systematic incorporation of school experiences into the teaching and learning of core concepts within university courses. Creative dance and SITE learning experiences will be examined using a complexity learning lens (Colliers, 1998; Light, 2008). As a theoretical framework, complexity thinking endeavours to exist between chaos and order, between stability and instability, focused on “studying adapting, self-organizing systems...construed as the study of learning and learning systems” (p.104, Davis, 2004).

To help explain complexity thinking and creative dance the following story has been constructed drawing on an ethnographic fictional representation (Hopper et al., 2008; Rinehart, 1998; Sparkes, 2002). The story is constructed based on an interview with a pre-service teacher after her first elementary school-based practicum experience. The actual events happened for the pre-service teacher, but names have been changed and certain details highlighted to speak to the reader. The story captures how creative dance models an emergent process of learning. The story is based on actual events but it has been shaped to provoke a visceral response for the reader, a sense of being there in the creative dance lesson. The story will provide a vital reference point for this paper.

#### *Grade 6 creative dance class - “The class from Hell”*

*Mindy smiled as the grade six class stormed into the gym. The principal, who was also Mindy’s supervisor for the practicum, had described them as the ‘class from hell’. The girls in the class were reasonably well behaved but the boys, well they were an unruly bunch, many were big for their age, some were even bigger than Mindy; many of them were typical ‘jock’ boys.*

*Mindy wondered if the children had remembered that they were going to do creative dance. When she had explained the idea in the previous lesson, Jason, the leader of the unruly bunch, had said, with a resistant stare, “Oh yeah, going to get us to be clouds are you?” What was going to happen? The principal must have wondered as well because she had come to watch.*

*“We are going to do creative dance,” Mindy started. “All I ask is that you give it a try. You might like it.” As she spoke she caught every child’s eyes, and their faces stared back blankly. Exuding enthusiasm Mindy, with the music ready, launched into the lesson.*

*Initially, the children treated the whole episode as a lark. Jason’s expression was ‘forget it lady’. Gradually Mindy introduced the movement ideas to the children and coaxed from them first a fast walk, then a pivot, then sleeping positions.*

*“The idea of the dance is that you are late,” Mindy explained. “You have over slept, that is why you are in a rush. Now take up your sleep positions. Oh*

*nice flop, Shaun. Good Kirsty, it really looks like you are leaning against something."*

*The infinite variety of sleep positions at different levels, using different combinations of body parts signaled a personal quality to each shape.*

*"Now I will clap beats of eight. You do your fast, tense walks followed by a spin on each phrase of eight...really whip off into the next walk and so on...CLAP!"*

*The children burst into action, in different directions, their bodies taut and stiff.*

*"CLAP four, CLAP five and pivot for three. Well done. That's it, keep control...but fast!!"*

*The children whizzed off into tense walks...ready for another spin.*

*By focusing on the creative way in which children could drape and hang their bodies in sleeping positions, by stressing the dynamic effort quality of walking and pivoting with tension and urgency, by focusing movement in a direct path, the children, with Mindy's guidance, had discovered how to move expressively with their bodies.*

*The music was then added, broken into phrases of eight. This might have produced a worrying challenge for the child who felt unable to keep a rhythm, but somehow the supportive atmosphere of playing with the musical challenge created an expectant buzz in the air. As the music played the children used their fingers to mime out their movements. The children were ready.*

*"Right, into your sleep positions." Mindy ordered. The children rushed to take up their personal stance. Barely able to suppress the tension waiting to explode in their bodies they flopped in unique shapes. The music hissed, there was an expectant hush, the music started and...the children were seriously late.*

*As Mindy watched the class she could see Jason, with a huge grin fixed from ear to ear, rushing earnestly around the gym within the phrasing of the music. He, among others during the lesson, had received well-earned praises for creativity and the display of growing body awareness. The children's movements showed a sense of control, rhythm and purpose, their movements indicated focused, playful vitality.*

*The dance ran over three lessons, developing the idea of sleeping in and being late for school...missing several buses. The children were completely focused on creating the dance. They were completely focused on Mindy's guidance. They existed in their own special community place created by the imagery and the music. At the end of the lessons the unruly class that normally had to be policed into a line to exit the gymnasium lined up automatically and quietly buzzed with excitement. The principal was amazed, and so was Mindy.*

This story is typical of accounts from many pre-service teachers I have spoken with who have transferred creative dance ideas from a university course into practice. The key components of these courses I feel is that the pre-service students are able to integrate school experiences within a university course. The university instructor teaches children as pre-service teachers observe, and then assist. Eventually supported by the in-service teacher, pre-service students teach lessons independently while the in-service teacher observes. At our institution we have called this approach School Integrated Teacher Education (SITE) (Hopper, 2008; Hopper & Sanford, 2004). Within the course games and gymnastic content areas are also taught to good effect, but without a doubt the creative dance are a is

the most successful for all the pre-service teachers. I have often wondered why creative dance has been so successful within this model, especially as pre-service teachers tend to have more experience with games and even gymnastics than with dance. Many have not experienced creative dance before. This paper will examine the process of teaching creative dance that I have developed over the last decade with reference to the movement educators whose work I have used and adapted (Boorman, 1973; Carline, 2005; Joyce, 1994). In an attempt to explain this success I will connect to what learning sciences have discovered about optimal human learning as informed by complexity thinking (Davis & Sumara, 2006). Throughout this paper Mindy's story will be used to explicate this approach to teaching creative dance as well as connecting this approach to complexity thinking.

### *Creative dance approach*

Creative dance refers to a conceptual approach to teaching physical education that focuses students on generating expressive movement solutions to problem based stimuli structured by the teacher (Nilges, 2004). This approach encourages effective teaching by relying upon keen observational skills by the teacher. Because students do not need to be skilled to begin creative dance, it allows a more open skill focus from an interactive pedagogy. This approach was popularized in the 1960's and 1970's in the United Kingdom from the approach called "dance for all" advocated by Rudolf Laban (Wall & Murray, 1994). He advocated "four principles—body concepts, effort concepts, spatial concepts, and relationship concepts—deal with what the body does, where it moves, how it moves, and with whom or what it moves" (p. 7). He had a profound influence on the teaching of physical education in UK with "many teachers who had studied with Laban immigrating to Canada and United States, employing his movement concepts in their programs" (p. 8). The creative dance approach I have adopted originated with the work of these teachers in Canada and is characterized by their materials and their students' materials (Boorman, 1969, 1971, 1973; Carline, 2005; Joyce, 1994). However, though the approach was widely seen as successful, the technocratic rationality of scientific logic informing research on pedagogy during the 1970s and 80s (Singleton, 2009; Sparkes, 1993) did not lend itself to research on creative dance pedagogy or offer supportive theoretical frameworks for more emergent and dynamic learning processes.

### *Physical education teacher education for elementary generalists*

Critiques of teacher education programs include concerns of fragmentation between courses, maintenance of a theory-practice divide, and research on teaching that does not connect to the "real world" of school (Cochran-Smith & Lytle, 1999; Munby, Russell, & Martin, 2001b). Preparing pre-service teachers to teach physical education in elementary schools (age 5 to 11) has historically been a challenging endeavour. Typically elementary pre-service teachers are taught within a generalist model preparing them to be classroom teachers of a whole class of children for all subject areas. This is generally considered to be inadequate for effective learning in physical education with pre-service teachers lacking the pedagogical content knowledge (content knowledge and ability to teach it to children) to lead PE lessons (Locke & Graber, 2008), especially if they draw on a movement education approach (Rovegno, 1992). Most teacher

education programs rely on one or two courses in physical education teaching process to instill the attitude and ability to teach PE at the elementary level (Faulkner & Reeves, 2000; Martin, Kulinna, Eklund, & Reed, 2001).

However, drawing on Lave and Wenger's (1991) notion of situated learning, several authors have noted how pre-service teachers' experiential engagement in a school as they are learning to teach PE has had a positive influence on pre-service teachers' perceived ability to teach this subject (Chen & Rovegno, 2000; Hopper, Brown, & Rhodes, 2005; Rovegno, 1992). It is this situated learning experience that seems to support the successful adoption of creative dance by many pre-service teachers going through a SITE course.

### *Complexity Thinking and Learning*

As noted by Davis and Sumara (2006) complexity science is new in the educational landscape but is gaining popularity (Clarke & Collins, 2007; Davis & Sumara, 2005; Light, 2008). Complexity science has been dominated by physicists and seen as a way of understanding the nature of reality, based on the assumption that reality is determinable. However, since being adopted by more applied sciences such as biology and social sciences, it has been used to describe living and social systems, creating a more dynamic interpretative process of knowing identified as complexity thinking (Richardson & Cilliers, 2001). Complexity thinking focuses on adaptive, self-organizing systems where learning emerges from experiences that trigger transformations in learners. With complexity thinking we are "concerned with the philosophical and pragmatic implications of assuming a complex universe" (Davis & Sumara, 2006, p. 18). Learning evolves in a non-linear form from discovery that results from exploration of the interacting constraints on a learner. Key task constraints are manipulated to facilitate the emergence of functional movement repertoires (Chow, et al., 2007; Davids, Button, & Bennett, 2008).

Traditionally, learning has been framed as a change in behaviour caused by environmental affects. Informed by behaviourism, the idea of stimulus leading to a certain response that allows behaviour to be trained, is a view that has implied a deterministic nature of learning (Light, 2008). Such a view leads to dance being taught as a repetition of steps, modeled by a teacher who then corrects students' errors until a synchronized movement to the model synchronized to music is created. Learning to dance then becomes a mechanical process with actions reduced to simplest components. The mind is separate from the body. Through rehearsal the mind is able to govern the bodily actions. It is this form of dance teaching that has discouraged all but the most musical and coordinated from learning to dance. In Mindy's story the children did learn simple steps. For example, they rehearsed, "*fast walk, then a pivot*" but not to a model. They developed different ways of moving with fast walking patterns and then learned to pivot as the idea of being hurried was developed. In other words, the actions, with variability, were practiced as the meaning of the actions in the dance was gradually developed.

Though behaviourism does inform the learning process, more common in academic writing is the idea of constructivism. In a constructivist approach to learning, learners are complex systems with different prior experiences that interact and adapt differently to the learning situations created by the teacher. Learning is more than modification of behaviour; it is better understood in terms

of experiences that trigger transformations in the learner's collective structure. Learners engaged in an experience change structurally, conditioned by the experience, but with personal variability based on their "complex biological-and-experiential structure" (Davis & Sumara, 2006, p. 13). As noted by Light (2008) in constructivism, cognition occurs not only in the mind, but is embodied, "it is seen to include the immense range of implicit learning and knowledge that is enacted" (p. 23). Rather than the mind learning through the body as with behaviourism, with constructivism the body itself is seen to learn. In Mindy's story we get this sense of embodied learning in the comment "*children burst into action, in different directions, their bodies taut and stiff.*"

However, as Light (2008) explains, constructivism has taken on many forms that have broken into two main camps. Psychological constructivism is concerned with individual sense and meaning making, and social constructivism stresses the role played by social processes in how we know what we know. The problem that constructivism creates is the impossibility of teaching a class of children the same thing at the same time; each child brings a life of different experiences, social interactions and understandings, as well as biological predispositions, to any given learning experience. This means that teaching cannot determine learning but can only create the conditions for certain things to be learned. As noted by Davis, Sumara and Luce-Kapler (2008), from a constructivist understanding of human learning "teaching is not about telling, but about organizing experiences that orient learners' perceptions to particular details and prompt them to associate those details with other details" (p. 168). In relation to living systems, both constructivist camps reject the Cartesian notions of linear cause and effect learning associated with internalizing an external reality are rejected. Instead, metaphors of organic growth associated with notions of ongoing adaptation and transformation are seen as key features of existing in a dynamic world that is inseparable from us. In Mindy's story, the children created the dance, through Mindy's guidance, in such a way that they *became* the dance, became "*I'm late...*" as "*The children's movements showed a sense of control, rhythm and purpose, their movements indicated focused, playful vitality...they existed in their own special community place created by the imagery and the music.*"

Complexity thinking advocates that a class of children learning to dance be treated as a learning system made up of individual agents. Each agent is itself a "complex structure" that will adapt to an environment; one the agent in part co-creates through its engagements. In complexity thinking the class of children can be seen as a system that learns. As the system learns the dance, each child who is an agent of the system learns to dance. This feature is known as self-organization where a collective of individual agents bootstraps itself into existence. As noted by Davis and Sumara (2006), this emergent quality to a complex system "is most important and the most difficult to appreciate. Somehow agents which need not have much in common—much less be oriented by a common goal—can join into collectives that seem to have clear purposes" (p. 81). This joining or coupling, in a shared experience allows a co-evolving process to happen where the students learn from each other as they respond to teacher prompts, feedback comments and tasks. As noted in the story, the children drew on past experience and each other's actions, prompted by Mindy, to create the dance that they owned. The "*class from hell'... unruly bunch*" came together as they learned from each other. In the story the pre-service teacher was able to teach from agents'

responses as the system started to self-organize around the dance. As noted in the story,

*The idea of the dance is that you are late," Mindy explained; "you have over slept, that is why you are in a rush. Now take up your sleep positions. Oh nice flop, Shaun. Good Kirsty, it really looks like you are leaning against something.*

Identifying body actions and relationship ideas, Mindy allowed the system to learn from actions of agents within it. She encouraged the self-organization of learning.

Another key idea in complexity thinking is the idea of adaptation. The agents within the system need to influence and be influenced by their context through exchange of actions, ideas or both; their structures need to be open to adapting to the environment set by the teacher and to each other. Mindy encouraged the students to be open, "all I ask is that you give it a try. You might like it." Individuals bring a biological and experiential structure to the learning situation that then inter-acts with the learning context set by the teacher and each other. In the anecdote, Jason brought a negative notion of creative dance to the lesson, "*With a resistant stare; 'Oh yeah, going to get us to be clouds are you?'"* and "*'forget it lady!'"*. However, Mindy through positive feedback and a respectful relationship developed previously with the children in a games unit and classroom teaching, was able to get the established closed system of "*their faces stared back blankly*" to open up. Initially the system almost went out-of-control when students "*initially treated the whole episode as a lark*". But Mindy's focusing feedback became an open system where the "*children whizzed off into tense walks which were ready for another spin.*" The ability for the teacher to respond to the children in a playful relationship enabled the dance to happen with the teacher becoming a part of it, a dance that never quite became fixed, but always offered new possibilities within a bounded structure.

The poised instability created by Mindy in the tension between a unstable (almost out-of-control) and stable (all doing same thing) system invites the self-organizing process to emerge as the children, constrained by Mindy's tasks, are open to the energy from the dance they co-create as they realize a variety of movements showing "lateness". For example, "*By stressing the dynamic effort quality of walking and pivoting with tension and urgency*" Mindy invited variety, whilst maintaining coherence to the structure of the dance. As the dance progressed the tasks set by Mindy cultivated the collective energy of the dance surrounding the children. Greater than the sum of the parts, the collective energy allowed the system to self-organize into the "I'm late..." dance. As noted by dynamic systems theory (Davids, et al., 2008), this openness to the energy of the environment created by the teacher and the students' themselves, is a critical condition for the emergence of complex learning in a self-organizing system.

The other quality to note in a complexity approach to learning is that it happens from the bottom-up. In the story, Mindy creates the situation for complex learning to happen, but once the class engaged then a form of decentralized control emerged. A collective intelligence in relation to the dance started to develop from simple actions like "*fast walk*" that built into a complex dance containing multiple phrases of music corresponding to certain actions, each action having multiple generative possibilities. Each dancer's movements was coordinated and adapted to the movement of others. As noted in the anecdote,

*The children burst into action, in different directions, their bodies taut and stiff. "CLAP four, CLAP five and pivot. Well done. That's it, keep control...but fast!!"*

*The children whizzed off into tense walks...ready for another spin.*

Decentralized control means that teacher, though initially at the centre of the lesson, increasingly shifts from this role to initiating new tasks and prompts, to an engaged observer: guiding, encouraging and showing ideas from one student to others, encouraging diversity and self-organizing awareness.

### *Creative dance and basic task progression*

Creative dance is taught using Rink (1998) basic task progression approach that builds from simple actions that grow as connected and framed by an imagery theme, into a story or collective expression of an idea. Creative dance as part of a movement education approach is difficult to teach even though Mindy makes it seem so natural. As many scholars have noted, it is challenging to develop tasks (1) that capture children's interest, (2) that allow for the children's developmental range of ability and (3) can be used to develop their movement qualities (Chen & Cone, 2003; Rolfe, 2001; Rovigno, 1992). Mindy's ability to frame learning as a complex process seems to have enabled her to teach in such a way as to allow learning to naturally emerge from the class of children.

As discussed earlier, Laban's movement concepts offer a way of describing human movement that allows a teacher to elicit a variety of purposeful movements from a simple movement task. Briefly, the generative possibilities of this movement task can be described in terms of: (a) Body concepts - *what* the body does such as activities (locomotion or stationary) whole action (twisting) roles of body parts (supporting) and shapes during activity (wide); (b) Effort concepts - *how* the body moves with weight (firm or fine), time (fast or slow), flow (bounded or free) and space (linear or flexible); (c) Spatial concepts - *where* the body moves in personal space (direction, extension, air patterns and levels) and general space (levels, extensions, floor pathways and air patterns); and, (d) Relationship concepts - *with whom* or what the body moves based on people in the environment or objects in the environment.

The movement concepts allow the teacher to set a task and then see what the children do. Responding to the children's actions, the teacher encourages exploration of the movement potential for the task. The children's exploration generates new ideas. The teacher encourages the students to experiment with each other's ideas as they consider what moves, where it moves, how and in relation to what. As the children select the movement action, they then refine the movement further as the teacher develops the elements of the dance. This process can be repeated, as needed, developing more movement actions and different formations between dancers. Practicing combined movements with music is gradually evolved as the dancers prepare to perform the dance. Typically, half the class watches the other half or a teacher can use a video recording of the dance to be later analyzed. Figure 1 outlines the basic task model developed by Rink (1998) that helps to develop this responsive teaching process.

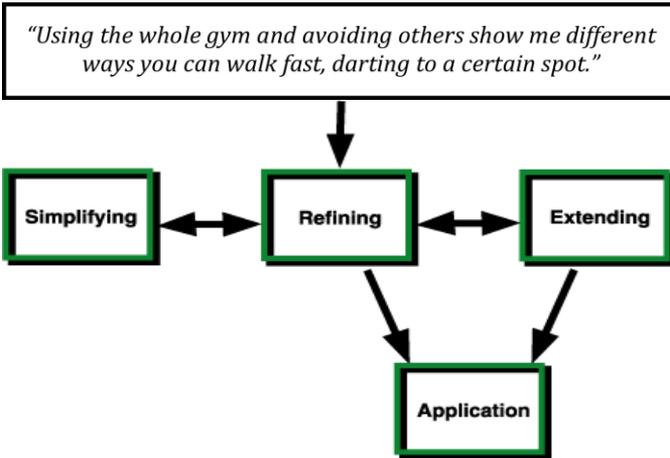


Figure 1 Basic task progression model

For example, from Figure 1 a task related to Mindy’s lesson such as “Using the whole gym and avoiding others, show different ways you can do a fast walk, darting to a certain spot” could be set. Then the teacher can refine the children’s walking movements suggesting more refinements like direct paths, stiff arms, fast legs, to open spaces. If the children had difficulty with this task, possibly knocking into each other, the teacher might simplify the task by spacing the students out more (general spatial concept). Or if an action proved challenging such as pivoting on a spot the teacher could stop, model it and then practice the movement showing student demonstrations from the class. If the students are able to do the task with refinements, an extension that feeds into the final dance might be added on such as a fast walk to the count of eight (relationship concept), or matching movements to the beats in the music. The teacher asking a relationship question like “how does it feel when someone walks fast in front and behind you?” could further refine the fast walk imagery. Focusing the children on the tense, rushing energy they were co-creating together would further encourage the self-organizational quality of the dance. The movement concepts allow the teacher to refine students’ movements, generating different possibilities, but also changing the learning environment that frames the movement (i.e., how to use the space, relate to other dancers or imagery idea). This focus on an onward orientation, simplifying/extending, and also on the each child’s inward movement ability, refining movement quality, allows a coupling between students’ actions and the simple structures of the dance. Each extension would lead to the application of parts of the dance or the entire dance, as the students gained an understanding of the movement possibilities within phrases of the music of the dance.

Carline’s (2005) handbook of creative dance offers wonderful resources of creative dance ideas that can be adapted for any theme, organized around developmental learning levels of students. In particular, she has evolved a dance analysis process from the work of Joyce Boorman (Boorman, 1969, 1971, 1973)

that enables teachers to develop a creative dance based on ideas that can easily connect to language arts, art, and social studies curricula (see for further discussion Gabbei & Clemmens, 2005; Purcell, 1994). Figure 2 shows a dance analysis for the “I’m late...” dance used by Mindy. Action words are used drawing on Boorman (1973) family of action words. The music La Petite Overture by Angré Gagon (Gägon, 1973) creates a high tempo direct rhythm (see squiggles for A in music emphasis), a short ditty (see B), then a repeated twice uplifting piece (see C) that are all contrasted by a slower meandering phrase (see D). This music allows the action words of “walk, pivot, jump/stretch and then reach...reach—fall”, to be associated to the phrases of the music. Each action word is then developed, drawing on the spatial, effort and relationship ideas noted in the dance analysis. The story line in the image sequence section allows the dance to carry a narrative quality that makes the actions more meaningful and encourages students’ memory, expression and ownership.<sup>1</sup>

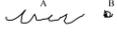
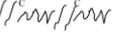
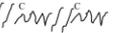
DANCE MUSIC ANALYSIS SHEET - “I’m Late...”			
<p><b>I. MUSIC EMPHASIS</b></p> <p>6 bars Introduction</p> <p>A B</p>  <p>B</p>  <p>C</p>  <p>A B</p>  <p>A B</p>  <p>D</p>  <p>D</p>  <p>D</p>  <p>D</p>  <p>REPEATS</p>	<p><b>II. ACTION EMPHASIS</b></p> <p>Sleep Shape</p> <p>Walk, walk, walk, walk Pivot</p> <p>Walk, walk, walk, walk Pivot</p> <p>Jump - Jump - Stretch/Stretch</p> <p>Jump - Jump - Stretch/Stretch</p> <p>Walk, walk, walk, walk Pivot</p> <p>Walk, walk, walk, walk Pivot</p> <p>Jump - Jump - Stretch/Stretch</p> <p>Jump - Jump - Stretch/Stretch</p> <p>Reach - Reach</p> <p>Reach - Reach / Fall</p> <p>Reach - Reach</p> <p>Reach - Reach / Fall</p> <p>Stamp/Stamp/Stamp/Stamp</p>	<p><b>III. DYNAMIC EMPHASIS</b></p> <p>Sleep floppy, indirect, no tension, loose.</p> <p>Walk in a hurry. Body stiff, arms stiff, forward lean exaggerated. Shoot off from pivot.</p> <p>Jump leading with knees in long stretch. Arms lift slow and long right to the finger tips. Sustained reach for length of 4 bars, then collapse.</p> <p><b>V. RELATIONSHIP EMPHASIS</b></p> <p>Partner work (1) and (2). (2) sleeps whilst (1) walks, pivot and stretches (ABABCC) freezes in waiting position at the bus stop. Then, (2) repeats ABABCC pattern. (2) ends up with (1). Two pairs join to make a groups of 4 at a bus stop. With hope the groups seeks the bus as they see it reach, reach, reach and reach, with despair fall, then again for another bus. Stamp legs in temper at the end. First time there is new hope because another bus stop, second time despair and collapse</p>	<p><b>IV. SPATIAL EMPHASIS</b></p> <p>Different levels, lean against something, extended or rapped up.</p> <p>Path direct, shortest distance to a point.</p> <p>Extend body parts and rise in air.</p> <p>Multi-levels in group reaching to a point on the horizon in the same direction, then slowly track as bus approaches.</p> <p><b>VI. IMAGES: SEQUENCES</b></p> <p>You over sleep for an important appointment. When you realize you rush to get ready then dash for the bus. When you get to the bus stop you meet other passengers who are also desperate for the bus. You see the bus...but it drives right past, you see another so there is hope but...it passes you by...Annoyed and frustrated you stamp your feet in annoyance. Then rush off to another bus stop only to fall again.</p>

Figure 2 Dance Analysis of “I’m late...” dance

*Conditions for the emergence of complexity*

This model of teaching creative dance allows some of the key conditions for complexity to emerge. As described by Davis and Sumara (2006,p. 136) we can consider a set of complementary pairs that set the conditions for complex emergence: (1) Tension between diversity and redundancy; (2) Encouraging neighbour interactions through decentralized control; and (3) Enabling constraints—balancing randomness and coherence.

*Tension between diversity and redundancy (commonality)*

Internal diversity is critical in a complex system to allow a source of possible responses to emergent circumstances. The stages of “explore, experiment and select” in the creative dance process, guided by the teacher using the movement concepts, encourages this diversity to surface as students learn to move their bodies in different ways within the tasks. However, redundancy as the complement of diversity means that a complex system also needs a lot of shared features between agents such as common language, similar experiences and

related responsibilities. Such redundancies are the backdrop of social action and allow coherence to be maintained, enabling interactions among agents and allowing agents to compensate for others' weaknesses. The common experience of Grade 6 students of being late and rushing, as well as the shared enjoyment of the class developed from exploring the possibilities of action words, creates the redundancy that allows the diversity to flourish. Too much diversity would lead to chaotic actions, each agent specializing and disconnected from the other agents, and too much redundancy could lead to sameness, an inability to adapt and be creative. The creative dance allows this tension of diversity from each agent to inform the creativity of the system, whilst creating redundancy of common actions and understanding to maintain coherence in the creative dance

#### *Encouraging neighbour interactions through decentralized control*

Complexity thinking also offers insight into how individual interests and collective interests can be mutually supportive. A key idea is that agents within a complex system must be able to affect another's activities. As Davis and Sumara (2006) stress, it is critically important for a complex system to activate "these potentials in the hope that they might trigger others and, in the process, be blended into more sophisticated possibilities" (p. 142). The way to understand this is as a conversation as agents engage and exchange ideas around a common intent. Within the dance Mindy continuously comments on the students' actions within the task set, relaying these insights back to the other students. The benefit of feedback, skillfully used by a teacher, is well documented as a critical factor in effective PE instruction (Rink, 1998; Siedentop & Tannehill, 2000). In Mindy's lesson the students see and sense each other's ideas as they move and at times the teacher will stop the class to observe an example from a student, or get half the class to observe the other half and comment on what they see. The ability to watch others, to appreciate peers' actions in light of lesson content, is a critical social skill and something that Mindy had worked on with the help of her co-operating teacher. The ability to read, in the context of the lesson other dancers' actions, creates a self-organizing affect on the class as actions created by each student informs and adds on to actions created by another. Within the structure of the dance the students create a knowledge-producing system that increasingly relies less on the teacher to direct the learning and more on itself to produce the dance. In this way the authority for the dance becomes decentralized from the teacher to the class as they refine, practice and ultimately perform the dance.

#### *Enabling constraints—balancing coherence and randomness*

Enabling constraints may seem like an oxymoron, however it is critical for the emergence of complexity. Constraints enable the structural conditions that determine the balance between sources of coherence that allow the collective to maintain a focus of purpose, and sources of difference and randomness that compel the collective to adjust and adapt. The creative dance is a rule-bound complex system because the task progression, with ongoing adaptations, creates tasks that are neither too narrow nor too open. As Davis and Sumara (2006) note, for complexity to emerge you must have, "(1) sufficient coherence based on sufficiently constrained domain [i.e., *Now I will clap beats of eight. You do your fast, tense walks followed by a spin on the second phrase of eight*]; ...and (2) an openness to randomness in order to allow for the emergence of unanticipated

possibilities [i.e., *How many different ways can you show a sleeping shape?*]" (p. 149). This flexibility is a characteristic of being part of a complex emergent unity. This creates a tension for teachers who are concerned about creating a certain outcome whilst allowing the actions to be generated from within the diversity of the class.

When all these conditions for complexity are present within a creative dance lesson the property of self-similarity, a key characteristic of complex systems, becomes evident. This property implies that a part of the system resembles the whole. The nestedness creates dynamics in the system that emerges from the coupled interactions of other systems. In the creative dance process, the recursive tasks guided by the teacher, with refinements/adaptations (enabling constraints) balancing randomness and coherence, allows for diversity and shared understanding, as the teacher encourages neighbour interactions that lead to decentralized control. The movement concepts used to: (a) plan the dance; (b) generate diverse but coherent responses; and, (c) guide teacher/students' observations, enable each student as an agent of the system and the collective body of students who create the dance, to obey the same complex dynamics.

#### *Complexity thinking and SITE for learning how to teach*

The school integrated teacher education (SITE) project has been used with a two-term (seventy-two hour contact time) generalist physical education methods courses for the last decade. This PE course was part of the last three years of a five-year bachelor of education degree where students take three practicums and take courses in every subject area plus courses in other areas such as psychology, special education and administration. The popularity of the school-integrated experience has resulted in the continuation of this two-term course for pre-service students throughout various other program revisions. In SITE courses pre-service teachers, through continued participation in a school culture, gradually take responsibility for teaching episodes within a lesson, and continually reflect on shared experiences from a school context through systematic observation, active participation and joint reflection on practice.

The SITE approach connects to what Brouwer & Korthagen (2005), and Bullough & Gitlin (2001) have framed as an *integrative* approach to the teaching of course content. In this way the school context becomes integrated with the teaching of course content, with prospective teachers and university instructors moving back and forth from school to university as they progress through the curriculum of a course. In our integrated approach the university courses, organized around a cohort of pre-service teachers with similar time-tables, creates field experiences in a school that offers shared experiences, building both narrative and paradigmatic teacher knowledge (Munby, Russell, & Martin, 2001a).

The SITE courses have increasingly drawn on the complexity thinking process. The nature of SITE courses is that a lesson planned and practiced at the university with pre-service teachers is then taught to a class of children. But when implemented in a school inevitably the lesson will be adapted to the children, sometimes changing radically from the lesson modeled at the university, as the university instructor models a responsive teaching approach. Pre-service teachers who learn to adapt, allowing a complex dynamic to start to form as pre-service teachers' self-organize around the lesson content of the class, quickly start to see

learning as a bottom up process. This means that they learn to draw on the repertoire of possibilities in the class, and then they learn to apply the movement concepts to discern the relative effectiveness of these possibilities.

As the instructor I create a shared experience of PE (redundancy) that pre-service teachers draw on as they select from their prior experiences (diversity); working with peers (neighbour interactions) they create their own lessons (decentralized control from teacher) that they teach first to their peers and then in the school with children. In the first term the pre-service teachers are given one lesson to teach after experiencing four lessons taught to children in the school by the university instructor (enabling constraint). This model is continued in the second term with lessons modeled at the university and then three lessons taught by the university instructor. In the second term after receiving peer and instructor feedback, pre-service teachers teach lessons with content they create in groups of three in consultation with the schoolteacher and university instructor. The idea of 'self-similar' is continuously modeled, with university lessons and school lessons obeying the same complex dynamics with movement concepts used to plan, adapt and refine teaching process. In addition, techniques such as demonstration, feedback and management are continually exemplified.

The SITE project has shown, through a quasi-experimental design measured by a psychometric instrument based on theory of planned behaviour (Ajzen, 1991), that pre-service teachers in SITE based PE courses, compared to campus based courses, report significantly higher levels of perceived competence, attitude and social support for teaching PE (Hopper, et al., 2005). Typical of the influence the integrated course has had on pre-service teachers is represented by the quote from a pre-service teacher from Hopper and Sanford (2008),

I think I had a breakthrough. We were teaching our PE dance lesson. There was a point when I caught myself, as I was teaching, watching the cute little things and wondering if they were getting it, and then realizing that they were learning. It was really quite neat. I think that because I knew the routine and lesson so well I could actually focus my attention on the kids! It seems so selfish when you realize how much time I've been thinking about myself! There are so many things that I am learning – it's great. (p. 38)

In an earlier study of the SITE course (Hopper & Sanford, 2005), another pre-service teacher Melanie commented,

I am totally amazed at the turnaround in attitude I have had over both terms regarding PE. My many positive experiences have turned my attitude of "I don't like PE, don't want to teach PE and I would like to work in a school with a PE specialist" to "I love PE, I can't wait to teach PE, and it would be fun to be a PE specialist". (p. 7)

At the end of her program during a program exit interview Melanie remarked that she had run a dance club at her practicum elementary school using the creative dance ideas. Over 40 children had turned out to dance. On her last day at the school a child was entering the school with her mother. The child introduced Melanie as her "dance teacher." Melanie was shocked and amused by the title. Later that year Melanie was hired into a full-time teaching position based on the school's principal's glowing report on her ability to teach dance.

Though mainly anecdotal, these recurring accounts from pre-service teachers regarding the creative dance approach to teaching has encouraged me to

develop an increased focus on teaching creative dance. With extensive coordination with a local elementary school, units of four lessons are arranged for groups of three pre-service teachers to plan, teach and assess. This extended period of teaching, before a formal practicum, allowed the pre-service teachers to develop a complete dance over four lessons drawing on the Carline (2005) resource. The final dances were video recorded and shared with the students. Figure 3 highlights images from one such creative dance performance taught to twenty-two kindergarten/grade 1 students based on the imagery of an elf caught in the snow.

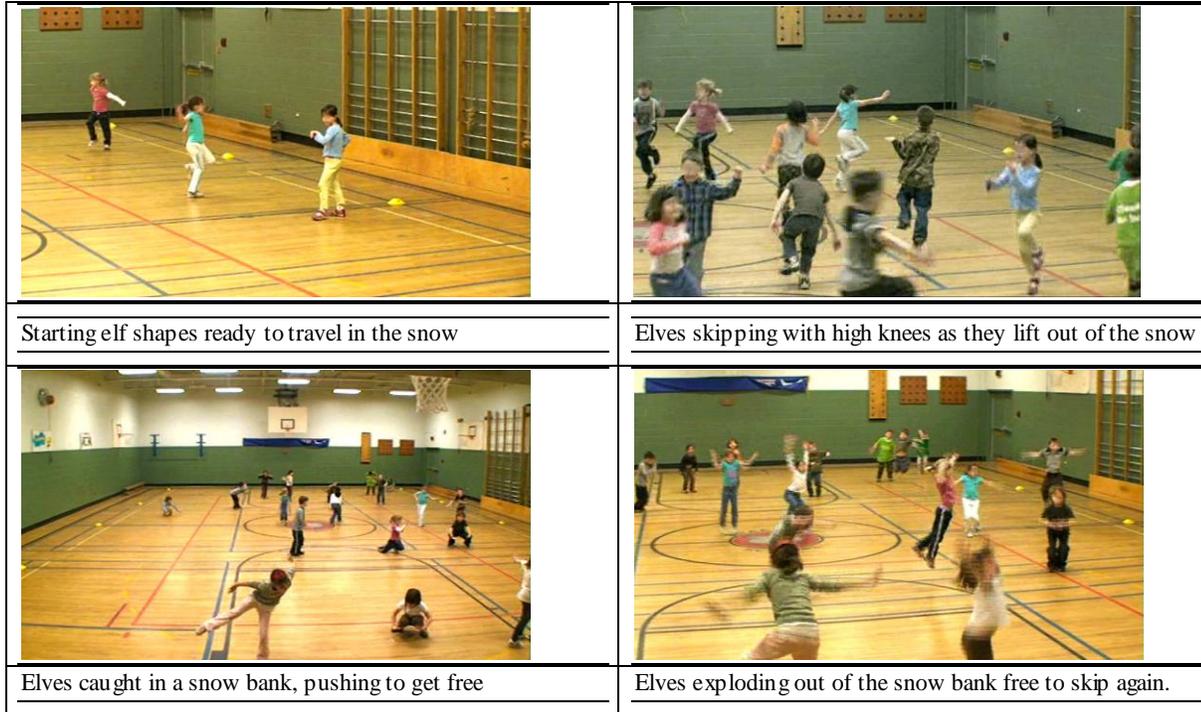


Figure 3 Images from pre-service teachers creative dance lesson “Elves and snowflakes” grade k/1 (age 5 and 6)

As can be seen, the children in Figure 3 move with a focused vitality, their faces beaming as they portray their elves. The skipping action was a challenge for the students to learn, especially for the five year olds. But with some focused repetition of skipping using floor patterns and matching relationships, the children learned to master this skill as they applied it to the dance. The snow imagery really seemed to help them lift their knees as if pulling their legs up above the imaginary snow, high knees being a critical cue for skipping (Gallahue, 1996). The children loved falling into the imaginary snow bank, pushing against the heavy snow, creating the constrained tension which they then released as they exploded from the snow bank, ready to immediately skip off in different directions.

As part of the PE methods course, pre-service teachers in pairs create an audio journal every two weeks to reflect on course content and focus questions. The audio journal represents a credit assignment that students do in order to collect their thoughts and ask questions of the course instructor. The following extracts from one student who taught “the elves in the snow dance” captured the sentiments of the class.

In the peer teaching and the dance unit teaching I had the most fun I have ever had teaching which really passed onto my students...teaching to my peers I discovered things I shouldn't be doing, as well as things that were positive... really liked getting the feedback from my peers as a teacher and a learner.

A real sense of self-organizing is evident in this previous quote. She continues... working with students in the lesson I learned to adapt. When I was struggling to teach the young Korean boy, who did not have any English, how to dance...initially I felt bitter... now more of a positive experience for me not knowing how to handle situation, it really helped me develop as a teacher...how to adapt which is essential for every teacher to know how to do.

Adapting became natural for the student teachers when they were confronted with a child struggling to learn. The student concluded with the following comment,

Teaching the dance lesson really taught me how to break down the skills like skipping...to refine the skills...to get the type of movements you want. Loved the experience in creative dance, would do again in a heartbeat. Really excited that I was able to show my friends and family what I got to teach these children and how I affected them.

The complexity of teaching a class of children was less threatening as the pre-service teachers learned to work from the bottom-up, learned to develop the skills children needed to do the dance they were creating together. Teaching skipping became an important skill and the children really wanted to learn to skip for the dance.

### *Conclusion*

Complexity thinking offers an exciting way of embracing teaching as an emergent process where student and teacher co-create the learning process. This perspective on learning connects to situated and ecological perspectives on teaching and learning in PE (Rovegno & Kirk, 1995). In relation to teacher education, the SITE program has opened a space for learning how to teach that enables teacher education to become less prescriptive, less fragmented, less of a

“training mindset” (Grimmett, 1998; Wideen, Mayer-Smith, & Moon, 1998). In SITE, practice and theory of teaching drawing on complexity thinking come together as teacher education becomes more experientially based, allowing pre-service teachers and their university instructor to situate their collective engagements in the complex dynamics of teaching process, child learning and their own learning. Within elementary physical education creative dance has offered a way of embracing the qualities of complexity thinking, offering a way to include every learner in a collective system greater than the sum of the individual parts.

In most elementary PE teacher preparation courses in Canada contact hours is 36 hours or less of instruction. The SITE courses are sequenced over two-terms with course content focused on student learning in a local school. Further research is needed to help understand how such situated learning (Barab & Plucker, 2002), understood using a complexity learning lens, can help us frame pre-service teacher education in PE as less about content to be covered and more about learner transformation. In this way teaching in PE is about creating the conditions, framed by enabling constraints, that allow bottom-up, shared with peers, decentralized and emergent learning experiences.

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#### Endnote

- <sup>1</sup> For archive of creative dance resources based on this dance analysis see <http://www.educ.uvic.ca/Faculty/thopper/Dance/Dance.htm>