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The Asia-Pacific Journal of Health, Sport and Physical Education has a particular focus on social science research-based articles (approximately 6,000 words) that make reference to other critical work in the field and/or discuss particular issues of practice-focused research within the specific professional fields of health, sport and physical education. Editorial will privilege those articles that explore and provide a depth of understanding of the complex inter-relationship between developing/improving practice through the production of knowledge. The Journal will focus on the forms, contents and contexts of health education, sport and physical education as they relate to schools, universities and other forms of educational provision. While the Journal will give primacy to articles from, or focus on, the Asia-Pacific region, manuscripts from beyond this region are welcome – providing they have relevance to the readership.

The Asia-Pacific Journal of Health, Sport and Physical Education encourages submissions from social science researchers, academics and other commentators seeking to make contributions to the educational development of health, sport and physical education.


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Welcome to another edition of the *Asia-Pacific Journal of Health, Sport and Physical Education*. In keeping with our mission, this edition continues to mark our trajectory as a preferred publishing outlet for leading scholars in the fields of health, sport and physical education. As the journal gains traction amongst researchers we are already seeing considerable growth in its market reach. In this edition we present manuscripts from leading scholars in Canada, UK, Australia and New Zealand.

This edition follows the 27th ACHPER International Conference, held in Adelaide during April. As a direct outcome of the Conference, the Editorial Committee has decided to publish the Fritz Duras lecture delivered by Professor Alan Reid. Alan is a very distinguished scholar in the field of Education Policy and Leadership addressing audiences around the world. In his lecture Alan presents an engaging critique of the place of health & physical education in the emerging policy landscape, and the challenges and opportunities that may present themselves. We are also fortunate to be publishing a manuscript from one of the Keynote Presenters at the Conference. In this paper Tim Hopper explores connections between the sophisticated decision making that is required to participate in video games and the goals and practices of the Teaching Games for Understanding model. I'm sure, like me, you will find Tim's paper very interesting, creative and engaging.

The manuscript from Casey and Jones also takes up the challenge of exploring how technology might play a more important role in the development of learning in physical education. Central to this is the use of video recordings of performance to develop understanding and decision making. Peter Whipp and his colleagues explore the extent to which externally provided physical education programs might be successfully implemented in primary schools to offset the lack of expertise that exists in many of these settings. Foremost in their work is the extent to which such provision can be used to up-skill classroom teachers.

Garrett and Wrench open up the old chestnut of equity and tolerance in the context of physical education. They take up the long held challenge to make physical education a more inclusive and inviting space for all participants. Central to their research is a set of strategic interventions wherein student teachers develop pedagogic resources to challenge the inherent presence of competition and meritocracy. Rounding out the collection is Wayne Smith's critique of the David Kirk's theorisation about the future of physical education. In this paper, Smith draws on a range of ‘other’ views to present a very engaging dialogue around this important work.

I hope you enjoy this edition of the Journal. Although the Excellence in Research Australian (ERA) have discontinued the journal ranking process, we will continue to strive to attract and publish high quality manuscripts and grow our profile across the profession. Thank you to everyone who has given support to the development of this edition.
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Game-as-teacher: Modification by adaptation in learning through game-play

Tim Hopper - University of Victoria, British Columbia

This paper will explore how game-play in video games as well as game centered approaches in physical education (PE) such as Teaching Games for Understanding (TGfU) can draw on complexity thinking to inform the learning process in physical education. Using the video game concept of game-as-teacher (Gee, 2007), ideas such as enabling constraints from complexity thinking (Davis & Sumara, 2006) and information-movement couplings from motor learning (Davids, Button, & Bennett, 2008), learning will be framed as emergent, adaptive and self-organizing. To explain these concepts the following examples will be used (1) an auto-ethnographic narrative of the author’s memories learning to play tennis with his father, (2) an account of a beginner learning to play as an avatar in the video game Guild Wars, and (3) a group of beginners learning to play tennis using a TGfU approach. Drawing on the author’s narratives and the video game concept of game-as-teacher, the paper concludes by emphasizing the principle of modification by adaption as a way to engage players of different abilities to experience worthwhile game-play in PE.

Introduction

Have you ever played a game where the rush of the game, the flow of your action and that of your co-players gives you sense of being a part of something more than you, a type of out-of-body experience, a flow with others, the environment and the task intent (Lloyd & Smith, 2010). How do you teach games to get at this sense of connection with a game? In this paper I explore learning to play a game through a complexity lens as a means to get at this sense of learning in game-play. As noted by Hopper and Sanford (2010, p. 122), game-play “refers to an action space, or third space, that is developed by the player, teacher or computer programmer to enable play to happen, a place of uncertainty that is located within the structure of a game.” A central proposition informing the arguments promoted in this paper is that too often in learning to play games in PE we remove the complexity of the game, focusing on motor skills to play the game and that this results in boring lessons, or in novice learners, a feeling of failure. In contrast, successful video games effectively channel this complexity formed in the game-play action space into exciting challenges that enable skill learning to emerge in the game as players experience the flow of the game (Gee, 2007).
In this paper I will explore how the learning process in successful video games draws on contemporary learning theories associated with complexity theory (Gee, 2007). Critically, video games teach skills necessary to play the games from within game-play in a process Gee (2005, 2007) calls game-as-teacher, creating what motor learning theorists refer to as information-movement couplings (Davids, Button, & Bennett, 2008; Renshaw, Yi Chow, Davids, & Hammond, 2010). The game-as-teacher concept parallels the ideas from game-centered approaches in PE (Oslin & Mitchell, 2006). To explain complexity theory I will use an auto-ethnographic account of my experiences learning to play tennis, highlighting the key characteristics of complexity learning theories. These characteristics will then be applied to beginners learning to play: (1) a video game called Guild Wars; and, (2) tennis using a Teaching Games for Understanding (TGfU) approach (Bunker & Thorpe, 1986).

**Information-movement couplings in learning to play a game**

Play in both video games and games taught in PE happen in the action spaces developed by the player(s), constraints in the game set by teacher(s) and/or programmer(s), and the places of uncertainty located within game structures. Motor learning advocates of non-linear pedagogy note that if learners can engage in game-play then it creates the conditions for learners to adapt their perceptions and actions to the constraints of the game (Chow, et al., 2007; Davis & Broadhead, 2007). As the learner moves from the initial co-ordination of movements for a task they develop control over their play by developing game-play information-movement couplings. Chow, et al. (2007) suggest teachers/coaches should emphasize keeping information and movements together so that learners can start to associate movements with key information sources (e.g., hand movements with a moving ball or movement of a learner in relation to teammates in the situational game) (p. 264).

Successful video games create these information-movement couplings through a progression of nested simplified games, which Gee (2007) calls sandboxes. These simplified games are framed by the whole video game but focus on simple skills such as learning how to move one’s avatar and send a spell that need to be learned to lead to more sophisticated skills as the game complexity develops.

In PE, Bunker and Thorpe’s (1986) TGfU approach similarly advocates that this information-movement coupling idea can be addressed using modified games that preserve the intended tactical concepts of a game but with simplified skill requirements. This means that learners in the control stage of learning can adapt their game play, focusing more on the “tactical aspect of the game in terms of movement off the ball or concurrent movement by teammates in the surrounding environment” (Chow, et al., 2007, p. 264). Learning is more than information processing; learning the skill to then play the game is an embodied adaptation of the learner where cognition extends beyond the mind as a separate entity to include the body and all its senses. As noted by Light (2008), traditional notions of learning separate the mind from the body, instead, complexity thinking frames learning as an organic process that is emergent, self-organizing and adaptive.
Game-as-teacher: Video games and Games-centered approaches?

Video games have been identified as sites of powerful learning (Shaffer, Squire, Halverson, & Gee, 2004). Gee (2003) suggests that game “designers face and largely solve an intriguing educational dilemma, one also faced by schools and workplaces: how to get people, often young people, to learn and master something that is long and challenging--and enjoy it, to boot” (p. 1). In video games, the game-as-teacher concept means that problems are ordered to teach the player skills and understandings that lead to more complex challenges through progressions of sub-games (Gee, 2007). In other words, a video game programmer creates the conditions for players to create information-movement couplings from within the game through trial and error, transfer from one experience to another, through conversations with others and “just in time and as needed” prompts in game play (Gee, 2005).

Game-as-teacher expands upon the ideas in the TGfU approach. Too often the emphasis teachers and coaches placed on producing “skilful” players resulted in players with inflexible techniques, poor decision-making abilities and often an over-reliance on the coach or teacher. In addition, often novice players became de-motivated from the emphasis on skill development as they felt like failures before even playing a game. Bunker and Thorpe (1986) argued that learning from the rich context of the game, modified to the ability of the students, rather than programming students with skills to play a game, is a better way to learn.

Game-centered approaches can be traced back to the work of Mauldon and Redfern (1969) in the UK for primary/elementary school age children, and later in the US by Griffin, Mitchell, & Oslin (1997) who developed the Tactical Games model, in France Grehaigne, Richard, & Griffin (2005) who developed the tactical learning decision model, and in Australia Designer Games by Rick Charlesworth (1994), Game Sense (Brooker, Kirk, Braiuka, & Brangrove, 2000; Den Duyn, 1996, 1997; Pill, 2011) and “Play Practice” by Launder (2001). All these approaches critique the traditional skills approach of teaching games, advocating the game, not the skills to play the game, as the critical site of learning.

To help develop this idea of modified games, Bunker and Thorpe (1986) suggested two guiding principles of game modification by representation and exaggeration:

1. Representation refers to mini games developed with the key features and tactical problems of the adult game but played with modifications to suit the learner’s size, age and ability, i.e., mini tennis in the service boxes with a sponge ball, or 3 on 3 soccer with two small goals.

2. Exaggeration refers to game structures or rules modified to stress a tactical problem in the game that requires the players to read the situation and apply skills to address the problem, i.e., long narrow court in badminton to stress deep shots and drop-shots.
Each of these principles structures learning by situating skill and tactical learning within the game, where by virtue of the game design and prompts from the teacher, the game teaches the learner how to play. It does this by asking learners to consider how the rules affect their ability to play and how their decisions affect the play of other players. Skill practice is advocated, but only when the learner is motivated to learn within game-like practice. These principles, therefore, relate to the game-as-teacher but with the teacher guiding the process.

A third principle related to video game design, and previously suggested by Hopper (2007), is modification by adaptation. In modification by adaptation the game is modified to increase the challenge to the player who was successful on the previous game encounter. Changes can be made in relation to the constraints of the game, such as space, scoring, or rules conditioning play or number of players, in order to ensure the outcome of the game is close, and for the unanticipated to happen during game play. For example, in badminton the court space could increase from quarter to half court and so on as each player wins a point. In this way the game structure adapts to the diverse ability of the players as the game-play accommodates players of different abilities. The adaptation leads to a situation where the game encourages a player, whatever their ability, to manipulate their actions to take advantage of changes in the game structure, such as an increased space to aim at in the opponent’s court.

**Complex thinking and learning to play games**

As noted by Davis and Sumara (2006), complexity thinking allows learning to be described in terms of living and social systems, creating a more dynamic interpretative process for understanding learning as emergent from experiences that transform learners (Richardson & Cilliers, 2001). With complexity thinking, we are concerned with a complex reality that is indeterminable but can be influenced by human action. In a complexity way of thinking, learning evolves in a non-linear form through exploration that results from learner adaptation as they interact with environmental constraints.

From a complexity perspective, in a PE lesson each student would be considered an agent of the system, a “complex structure” that adapts to an environment co-created by students in part through engagements with each other. Considering the notion of game-as-teacher, the “game” is set as the condition for the emergence of complex learning. This means that rather than breaking a game into parts (e.g., skills, rules, strategies and tactics) the game is seen as a system of interacting and adapting sub-systems. This whole of the game creates the conditions for complexity to emerge from learner/task/environment exploration. As Rovegno and Kirk (1995) note, teaching games then becomes “concerned with learners’ explorations and attention while performing appropriate tasks within an appropriate environment, an environment that is matched to the characteristics and capabilities of the individual” (p. 461). In relation to video games, Gee (2005) comments that “learning is based on situated practices... lowered consequences for failure and taking risks... [where] learning is a form of extended engagement of self as an extension of an identity to which
the player is committed” (p. 112). In both these perspectives learning is based on a relational and dynamic way of knowing that is the basis of complex learning systems (Barab & Plucker, 2002). As noted by Pill (2011), the Australian Game Sense approach emphasizes this relational dynamic still further framing skill as ‘intelligent’ motor performance as the ‘thinking’ player moves and acts to successfully meet the challenges of the game. Game Sense is therefore ‘why and how’ of game play and like video game learning, is based on situated learning and learners’ explorations and attention while performing appropriate tasks within an appropriate environment, an environment that is matched to the characteristics and capabilities of the individual.

There are other characteristics that have been identified with complex learning systems. To explain these characteristics I have developed the following accounts of my experience of learning to play tennis. The auto-ethnographic accounts offer a virtual, visceral perspective (Sparkes, 2002) on learning to play a game. The purpose of these accounts are to offer a personalized insight, based on events as experienced through the body of the author, but framed in such a way as to invite the reader to make meaning of the stories, to put something of themselves into the text, to identify with the author’s account (Hopper, et al., 2008). As Sparkes (2002) comments, auto-ethnographic accounts “allow another person's world of experience to inspire critical reflection on one's own” (p. 97).

I have highlighted in these accounts how complex learning characteristics have informed my development as a tennis player. Following the accounts the identified characteristics will be referenced to informed sources.

**Keep Up**

As a young child of six my first memories of playing ball games are with my parents and particularly with my dad. He was a keen sportsman playing soccer, hockey, squash and tennis as a young man. I remember playing games with a bouncy soft rubber ball striking it continuously against a wall or trying to keep it going after one bounce. Dad would always challenge us to go higher than our previous best before we could go in for supper. Often the pressure was on, with Mum calling us in to eat, but I always remember getting at least one higher. Sometimes Dad would give me pointers but until I struggled I rarely listened to him. I wanted to find out myself how to do it.

From a complex learning system perspective, my initial learning was a co-mingling with my father’s ongoing history of playing sport. There was an intimacy through our entangled play as we adapted to each other’s emergent participation with skills developing in games context. Learning was characterized by trial and adaptation through decentralised control, with successful actions repeated, adopted and continuously adapted. My dad did not control my learning, he contributed in a shared game. Learning was not centralized from any one source but came with repeated experiences I selected.
Topspin Backhand

As a young teenager I played tennis in tournaments. I never really had a coach like the other boys, but I was a determined player with a big forehand, fast serve and a slice backhand. My style of play was like my father’s. As I played at higher levels the boys I played hit the backhand with topspin and I would often lose close games to highly ranked players. On vacations my dad and I would play tennis. Usually I could beat him in a game of singles, but I could not hit a topspin backhand. So we made a rule, I could only win points with a backhand. Initially I lost and was frustrated, but we practiced the backhand, experimented with the stroke pattern and grip change. When we returned to the game I started to win points with my backhand and the game became close. By the end of the vacation I had developed a reasonable backhand stroke with the ability to hit over the ball; I still favored the slice, but unexpectedly in a game now I would occasionally flash a winning backhand topspin.

In all the games my father and I created we manipulated game structures to create enabling constraints of the game, changing space, equipment and conditions of play. By setting the simple rules we proscribed, the backhand behavior allowing the topspin skill to unfold from the bottom up, from repeated trials, experimenting and refining, we created a movement-information coupling within the context of a game.

“Still got the touch”

As a young man I competed in provincial and national tennis competitions. As my father got older he needed knee operations and gradually lost the ability to play tennis. He often used to come to tournaments to watch me play. The last time he played tennis was when he was 68. I needed to hit some balls for a tournament and had nobody to practice with. He came on the court dressed in sandals, slacks and a cotton cardigan. Using my spare racquet Dad stood at the net and volleyed the ball I hit to him. After a few rallies he started volleying the ball to spaces, sometimes dropping it short, challenging me to move to cover the court. We then created a game where my dad, not equipped to move, stood inside and guarded the service box. I stood behind the base line. I had to cover the singles court and the doubles tramlines. We then played a tiebreak. If I fed the ball into play, Dad would often hit a winner. So to allow the game to get going we adjusted the rules so that he had to feed the ball into play and then after my return, the point would start. I did not hold back. I do not remember who actually won the game but I remember the rallies being long and scrambling to keep the ball in play. I remember hitting backhands and dad reminiscing about that time in Spain when we created the backhand game. I also remember whipping the ball at my dad, probably my best chance to win a point, and then Dad with glee instinctively using a backhand volley to drop the ball short in space, remarking, “Still got the touch.” Even now when I see my father he remembers the last time we played tennis, recalling the backhand drop shots.
This last anecdote shows how the nested self-similar nature of the games that my dad and I played offered the key organizational features of tennis. The common experiences (redundancy) of playing our invented games allowed us to create a game that adapted to our structurally determined abilities. Similarly to when I was a young child, the spontaneous energy exchange between the game environments we created and ourselves re-invigorated my father, allowed him to call on the skills learned through his youth as we once again played a game of tennis.

**Analyzing the anecdotes**

A critical component I have come to recognize in my anecdotes is the idea of modification by adaptation. My father and I continually adapted the structure of tennis, developed enabling constraints on game-play, to create a play space where our difference in ability became an asset to creating a dynamic game where the result was uncertain. It is this idea of adapting the environment based on the outcome of the game that created the conditions for complex learning to emerge. Video games also use this principle to good effect to draw people into the play space of the game.

Drawing on complex learning theories and the highlights in the previous accounts, I have identified the following characteristics of complex learning systems that can be applied to games teaching and learning to play video games:

- **Energy exchange between learners, the system they create together and the environment** (Gibson, 1979).
- **Complex systems made up of nested self-similar simpler systems** (Davis & Sumara, 2006).
- **Neighborly interactions based on redundancy between players** (Davis, Sumara, & Luce-Kapler, 2008).
- **Diversity for generative possibilities** (Davis & Sumara, 2006).
- **Enabling constraints based on simple rules that proscribe system opportunities** (Davids, et al., 2008; Davis, et al., 2008).
- **Skills learned in context, distributed across body, people and tools through participating in comingling roles** (Ovens & Smith, 2006).
- **Learners’ actions adaptive but structurally determined** (Davis & Sumara, 2006).
- **Decentralized control leading to bottom-up organization** (Davis, 2008; Davis, et al., 2008).

In the next two sections these characteristics will be applied to experiences learning to play the video game Guild Wars and learning to play tennis in a TGfU approach. The final section draws these examples together returning to the notion of modification by adaptation.
Video game play and complex learning: Learning to play Guild Wars

In this next section I will explain how successful video gaming, such as role-play games, realize the characteristics of complex learning and help us apply them to game-centered approaches. As noted by Gee (2007), the “teacher” is predominantly the game itself, created by a behind-the-scenes programmer who has attempted to create a game environment that actively engages the player in meaningful experiences related to the game.

The following accounts describe how complexity learning emerged from a novice player learning to play Guild Wars over a five-hour period. Guild Wars is an on-line multiplayer, role-playing game within an episodic series (ArenaNet, 2005). Hosted on ArenaNet servers, Guild Wars provides two main modes of game-play: (1) a cooperative role-playing component; and (2) a competitive player vs. player component. The games portray the history of a fictional fantasy world called Tyria. Campaigns in the game focus on events in disjoint sections of the world, but roughly parallel in time (Wikipedia, 2008). Examples from the game will be highlighted in italic.

Customizing Game-play: Identity through selecting structurally determined actions

As players engage in video game play, they find that “the virtual worlds of games are rich contexts for learning because they make it possible for players to experiment with new and powerful identities” (Shaffer, Squire, Halverson, & Gee, 2004, p.6), to “imagine (simulate) an experience in such a way that the simulation prepares them for actions they need and want to take in order to accomplish their goals” (Gee, 2005, p. 24). In Guild Wars there are customizing options a player has for their avatar. Different accessories and characters offer different potential game-play attributes such as casting spells, fighting or healing other players. As players select from the tools and characters available they start to own their identity, they select a way of playing. For example, our character Tomahawk is created as an elementalist who can therefore use spells in combat to defeat foes.

Purposeful Engagement: Energy exchange through neighbor interactions and feedback loops

Video games designed with learning principles in mind allow for diverse players, with varied skills, interests, and background experiences to come together in a meaningful way to achieve a common goal (Gee, 2007; Sweetser, 2008). Players would not spend hours and hours of their time playing games if they did not find purposeful engagement and pleasure in the activity.

Problems are created in the game through constraints that allow a trial and adaptation learning process that, as Gee (2007) describes, has to be “pleasantly frustrating” (p. 36) but doable, with any effort ‘paying off’. The players get continuous feedback loops about their progress even if they do not succeed. As players engage in game-play, they draw upon previous play experiences,
eliminating possibilities that did not work, selecting alternative choices, determining the result, and then moving on to the next problem-posing interaction. As they learn to read the game they select possible moves, they learn what works, what are the best choices, and they develop theories (albeit implicit) about the reasons for some choices being better than others. And although the goal is to progress as far as possible through the game, there is the knowledge that if they ‘fail’, they will be given more opportunities to try again, this time as more informed and experienced players.

For example, initially the avatar in Guild Wars discovers the limits of his world, he cannot go through the large iron gates to the village, but he can see inside so he wants to get in. So after a few frustrating attempts the player starts to recognize the map with an arrow showing him the way to go. As Tomahawk explores the map, he receives messages indicating possible missions to acquire new abilities and portals into new areas.

A critical element in this learning process, especially with role-playing games like Guild Wars, is the characteristic of neighborly interactions offering “teacher-like” comments as part of ongoing feedback loops within the system. Gee (2007) refers to this idea, suggesting that “games almost always give verbal information either ‘just in time”—that is, right when players need and can use it” as indicated above when the map is used “—or ‘on demand’, that is, when the player feels a need for it, wants it, is ready for it, and can make good use of it” (p. 37-38). In Guild Wars the avatar gains information from other characters as he connects to them, they direct him on where to go next and what to look for to gain spells. Feedback information within the game structure increases the player's awareness of what will lead to success and completion of a challenge. Skill learning is then distributed across activity in the game, across roles, tools and other characters in the game.

**Enabling constraints in Fish tanks and Sandboxes for purposeful repetition**

The video game is programmed in such as way as to scaffold learning at a rate that the player (whether novice or expert) can manage. Gee (2007) refers to this concept as sandboxes (like exaggeration games in TGfU), where players can play with “risks and dangers greatly mitigated, they can learn well and still feel a sense of authenticity and accomplishment” (p. 39). Sandboxes refer to enabling constraints placed on players that limit their options causing them to focus on certain skills or strategies in the game. These sandboxes exaggerate certain game-play problems that develop particular skills that create more in-depth understanding of how to play, enabling more advanced play later in the game.

For example, as the avatar explores the Guild Wars world he discovers through trial and error how to cast a spell that kills monsters. Initially the monsters do not fight back. As the avatar succeeds he receives two more different spells to choose from (shown as glowing icons on the dashboard). Each spell offers a different killing technique that will be needed for more challenging foes. Soon after this initial trial the avatar has to face an opponent who fights back, resulting in a
loss of health points. With repeated use of his basic spell he eventually beats the opponent, but in a tight battle. The player then realizes that the new spells may be useful next time.

As players advance in the game they learn to make sense of the map and compass in relation to views they experience. As Gee (2007) notes, the sandbox experiences, which are designed for player success, lead into what he calls fishtanks (like representation games in TGfU) that denote “simplified systems, stressing a few key variables and their interactions, learners who would otherwise be overwhelmed by a complex system...get to see some basic relationships at work and take the first steps towards their eventual mastery of the real system” (p. 39). The player makes sense of variables in nested self-similar structures created by the emerging complexity of the game. For example, in the game the map corresponds to the world he sees, his path is tracked and markers on the compass highlight targets and sources of danger.

The game affords opportunities for the players to take advantage of the environment through exploration encouraging randomness of responses creating a non-linear process of learning. Challenges lead to the avatar being killed, however, each event leads to generative possibilities as learning emerges, each encounter leads to new insights and skills gradually form to overcome a challenge. The game structure offers decentralized control over the player as they adjust to the rules and the conditions of the environment.

**Decentralized control leading to bottom-up organization: Skills as strategies**

Gee (2007) proposes that the player’s mind works like a video game; productive thinking is like interacting in a game scenario or running a simulation rather than about forming abstract generalizations separate from experiential realities. As Gee continues, “effective thinking is about perceiving the world such that the human actor sees how the world, at a specific time and place (as it is given, but also modifiable), can afford the opportunity for actions” (p. 25). In this way skills are practiced by the player as they realize how they can be use them in combination as strategies to solve the current challenge. In complexity thinking this relates to how skills develop from the bottom-up notion in context, and are then combined to address more challenging problems. Such a notion means that the game-world created through the player’s engagement creates a mutually effective relationship to subsequent experiences in the game, where players’ actions are altered by virtue of how they perceive the demands of the game. In this way players’ perception of possible actions emerge as they couple actions to the recognition of certain patterns in the game-world, a world their actions create.

As the avatar advances in the game he gains many new skills, each from successful missions; eventually the avatar is working with a partner who demonstrates how to deal with difficult opponents and more challenging situations. For example, in the Guild Wars maze of catacombs there is an added challenge of toxic gas, so the avatar has only a limited time to complete the
mission. Initially the avatar dies many times before collecting enough information; the partner monk for example shows him which paths to take, how to cast powerful spells to overcome foes. Gradually from trial and adaptation a player figures out how to succeed first in combination with the partner monk, then on his own. The intent of playing is not to get through as quickly as possible, rather the goal is to learn from the environment created by the game, for example learning to work with another avatar in order to play more challenging levels.

Learning skills in context means that they then become strategies as separate skills are combined to create skilful play. This means the player’s avatar is engaged as an agent in the web of activity of the video game with other agents (avatars) to form a complex system. The player learns that knowledge is distributed across persons and particular contexts (Barab & Plucker, 2002; Ovens & Smith, 2006). As avatars take on legitimate roles they develop skills as strategies that enable them to engage further in the game.

The next section will build on this analysis of complex learning in video games and apply it to learning to play tennis in a TGfU approach. By sharing this parallel analysis I suggest that video games offer a frame of reference for how learning can emerge in PE games lessons using a TGfU approach.

**Example of complex learning in Tennis using TGfU**

In this section I will focus on how the teacher taught using a TGfU approach in order to engage students in complex learning. The intent of the lesson was for the learners to develop their consistency in keeping the ball in play as they learned ball placement in the court and the related positioning. The focus on consistency, placement and positioning promoted the context for the learners to develop their skills in court positioning and basic groundstrokes (Hopper, 2003; Hopper, 2007).

**Customizing Game-play through selecting structurally determined action potentials**

As shown in Figure 1, and similar to the set-up in the video game, the players are offered an array of equipment to use to customize their tennis game play such as different rackets and a variety of balls of different weight, size and construction. In game-play learners could, for example, decide to use a one-touch control hit of the ball before sending it back into play. In selecting different potential game-play options, learners start to structurally determine their own tennis identity and their way of playing. Learners’ prior knowledge and experience, mediated by their choice of equipment and their perceived game play options, interacts with the conditions set by the teacher, affording students’ different learning opportunities. It is the experience of playing a game that affords players game-play identities where they can imagine themselves as tennis players.
Purposeful Engagement: Energy exchange through neighbor interactions and feedback loops

In our particular example, the teacher initially teaches the “Castle” game (shown in Figure 2). This is a representational type game that creates a tennis-like relationship in which students can engage. As noted by Hopper (2007), the aim of the Castle game is to hit the pylon to score. The following three rules create the enabling constraints for initial game play: (1) the ball must bounce once (so it can hit the target); (2) the ball must be hit above head height (height allows time to get to ball); and (3) the ball is hit by players alternately (tennis-like relationship). As an extension the challenge of keeping the ball in the space can be added.

In the Castle game the students are given the option to use hands to catch and toss the ball, to use one touch to control the ball, to grip the racquet from the throat or use a short-handled racquet. These choices provide the opportunity for students to gain some control over how they play the game. The teacher sets problems for the students by asking, “How should you stand to get ready to hit the ball?” and “Where do you go after sending the ball?” As noted in the video game example, students’ interest is maintained by actively engaging them in problem solving situations.
related to tennis, creating a trial and adaptation learning process that is “pleasantly frustrating”. The constraints of the Castle game focus the players on understanding how to move in preparation for hitting the ball as they anticipate the ball flight. Initially, the wide-base, staggered feet set-up for movement, labeled “base”, is discussed as players see the need to move in every direction with a push-off action.

After learners play the game again, an emergent realization in relation to the “Where do you go...” question soon comes as they answer, “On the opposite side of the castle from my partner.” This answer means that the player knows where to go even before their partner plays their next shot. This simple action represents a “decision making” movement for the players, a perception-action coupling, giving them time to play the next ball.

The pattern of play then becomes: hit, base, look to make a decision movement, then set-up for the next ball. Initially, players in the game have difficulty getting the movement patterns coupled with striking the ball, but with feedback from the teacher (“as needed” and “just in time”), guided questions and through observing each, the players learn to play with tennis-like actions. This enables the players to interact as a system of learners rather than individuals learning to play tennis.

Enabling Constraints in Representation and Exaggeration games for purposeful repetition

In the Castle game the base and decision-making movements enable tennis-like actions, and with striking the ball repeatedly, the learners develop a tennis identity, a sense of how to play the game of tennis. As shown by Figure 3, these two movement actions can be practiced by students on their own in a shared space, in a “keep-up” game (exaggerating consistency) where they try to hit the ball repeatedly just above head height after one bounce. As in the Castle game, the players practice moving to the anticipated placement of the ball (decision-making) and setting up with a base position. These repeated cycles of practice, made meaningful by the Castle game, allow the movements to become embedded in game-play. The teacher can use this context to ask, “Where is the best place to make contact with the ball?”

Again, through trial and adaptation, learners soon comment that the best place is striking a falling ball around waist or knee height in front of the body, known as the hitting zone. Watching others and practicing in this “keep-up” game (like “sandbox” notion in video games) students learn to make adjustments as the ball bounces. These adjust movements alter their base position as they prepare to strike a falling ball in front of their body. Further discussion can also be encouraged about how to grip the racquet in order to facilitate successful play. In this way the teacher focuses on creating the conditions, with feedback loops shifting the learners back and forth from in-control (stable) to out-of-control (unstable), necessary for them to experiment, finding responses that allow them to exceed themselves as players.
When players return to the Castle game there is rapid improvement. The players’ shared experiences allow joint activity that creates a learning system. This game-play happens because each player is adapting to the flight of the ball and to the position of the target as the ball is sent back and forth. Finally, to distribute the learners’ play across all the main components of the game the teacher can ask, “What do you do as the ball is sent by your partner?” This question asks a player to judge when their partner hits the ball. As the partner hits the ball, the player is shown how to do a jump step, putting their body in motion, allowing them to cover the target area as the ball leaves their partner’s racquet. The addition of this cover action fully connects the players to the flight of the ball, the target and the actions of each other, maximizing their capacity to keep the ball in play. This relationship creates an energy exchanging system between the players and the game-play environment. The beginning of each player’s forehand skill emerges from repetition motivated by the interactions with other players, constraints of the game, and the teacher prompts.

Continuing with a video game comparison, the base, decision, cover and adjust actions learned in the previous games allow the players to engage in system thinking where similar actions from the Castle game transfer into playing in a mini court hitting the ball, a transition or sponge ball, over the net, four times in a row before the point starts. The capacity of the novice tennis player to appreciate how a skill, practiced in a more simplified context, will relate to the game of tennis creates a tennis playing identity. The critical role of the teacher in the games lesson is to focus learners on the emergent moments when their actions successfully ‘fall together’ in the context of game. Exaggeration games like Castle game then transition into representation games in mini tennis-like courts.

Decentralized control leading to bottom-up organization: Skills as strategies

In all the games so far skills are learned within game-play, guided by the teacher and focused on being consistent. Game structures may change such as increasing the court size or changing the ball, but always in relation to the demands of the game as a system of rules, equipment and player roles.
As the players shift into a tennis court playing in service boxes, the area can be dividing into four quadrants, as shown in Figure 4, then the following modification by adaptation game can be used. Using a dense high bouncing sponge ball the “Space Adapt” game can be played where after one or no bounce between hits the ball is sent over the net to land in the opponent’s designated area of the service box. If the ball lands ‘out’ (outside the court) or in the net then the other player increases their court size. In Figure 4 the left side player won the first point so her space has increased.

![Figure 4](image)

*Figure 4*
Playing “Space adapt” game; an adaptation game designed to focus on space

In this adaptation type game, the players play to win the point, but the court they cover increases in size making winning the next point more difficult, the goal being to win four points. As can be seen in Figure 4, the far player has a dot marking a smaller court to cover but a larger court to aim at, indicated by the other spot on the line dividing two areas. This gives him confidence to hit with his backhand into a larger space. Players can also be encouraged, as needed, to use the one-touch to control the ball before striking the ball over the net. The game creates a self-organizing learning system where players draw from the previous games using the base, decision-making, cover and adjust movements as they strike the ball in the hitting zone. Prompted by a teacher or peer coaches, players cover their target area and, if possible, use their forming skills to strike the ball away from the opponent as the court increases in size. As the game develops, the players engage in game-play, becoming more decentralized from the teacher as they become engaged in the game that adapts to their play. This adaptation type game allows players of diverse abilities to interact and be immersed in playing a game. As the court size increases the less able players soon catches on to hitting to spaces and winning a point; the player gets caught up in the sense of winning a point and forget that the uneven court gave them an advantage. The key point here is that they learned how to win a point, not the number of points it took for them to use the open spaces.

Teachers need to design lessons that acknowledge skills as located in the game, as an expression of distributed knowledge located in the game-play from the interaction of players, object, roles, area of play and equipment (Barab & Plucker, 2002; Ovens & Smith, 2006). If the outcome of the game cannot be fully anticipated then the players are more likely to engage in game-play where their actions, within the constraints of the game, challenge their opponent. The adaptation game
adjusts automatically to the players, modifying game constraints, increasing the challenge to a successful player based on the outcome of the previous encounter. This process means that the game maximizes its potential to act as teacher with players learning in association with the activity of the system; in the space adapt game they learn to hit to the spaces in the opponent’s court and to cover the opponent’s target area as previously learned in the Castle game.

Conclusion: Game-as-teacher for information-movement couplings

The game-as-teacher concept applies to how I learned as a young child to play ball games by playing modified games. In addition, this concept is core to how successful video games model emergent learning in game-play contexts; from trial/adaptation and hints from the programmer, players create information-movement couplings for successful game play (Davids, et al., 2008; Gee, 2007). Similarly, game-as-teacher informs game-centered approaches, advocating learning within a social system that encourages learners to continuously adapt their actions to the constraints of the game and the play of others.

In conclusion, games should be programmed with enabling constraints in such a way as to scaffold learning at a rate that the player (whether novice or expert) can manage the information-movement coupling demands. These enabling constraints allow players to develop skills that create more in-depth understanding of the game rules, leading to more advanced play later in the game. Representation or “fish tank” games create self-similar game structures that feed into the advanced game. Exaggeration or “sandbox” modified game/tasks stress tactical problems in the game that requires the players to read the situation and experiment with how to combine skills as strategies to address the problems. Finally, modification by adaptation shows how the video-gaming concept of game-as-teacher can be applied to games teaching in PE to automatically challenge learners to exceed themselves as players. In adaptation games eventually the outcome is close; game-play engulfs the players, with the ultimate goal of engaging in the game being something more than winning. I believe that if such games are taught in PE, players will become immersed in the game, a flow sensation they will want to experience again and again as they become apart of the complex interactions of players, space, rules, equipment and shared intents.

References


Notes

1It is worth noting that the Game Sense model underpins the Australian Tennis ‘Hot Shots’ junior game development approach (see http://www.tennis.com.au/play-tennis/mlc-tennis-hot-shots), so the auto-ethnographic account adds insights to understanding of this pedagogical perspective for junior tennis sport learning.


Author notes

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