EDICIONES Universidad Valladolid

Game Design Fundamentals and Sport Coaching

Fundamentos del diseño de juegos y entrenamiento deportivo

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Recibido: 01-11-16. Aceptado: 11-12-16
Cómo citar / Citation: Pill, S., Price, A., & Magias, T. (2017). Game Design Fundamentals and Sport Coaching. *Ágora para la Educación Física y el Deporte 19*(1), 19-34.
DOI: https://doi.org/10.24197/aefd.1.2017.19-34

Abstract. It has been recognized for some time that computer and now digital online games have become an important part of young people's leisure (see for example, Kirriemuir & McFarlane, 2004). Predicated on the hypothesis that both digital game play and sport have the common participatory intention to get participants to enjoy learning a difficult and structured form of play we consider how digital game designers seek to power-up engagement in learning, and consider whether sport coaches can learn anything from the deliberate design pedagogy adopted by digital game designers. Applications of enriched task engagement from the educational design principles adopted by "good" (Gee, 2007) digital game design are demonstrated through the use of coaching examples. We conclude by proposing six pedagogical perspectives for the sport coach to enhance practice as a learning space using deliberate game design.

Keywords: game; deliberate; design; sport; coaching.

Resumen. Desde hace tiempo se sabe que los juegos de ordenador y, ahora, los juegos digitales en línea se han convertido en una parte importante del ocio de los jóvenes (ver, por ejemplo, Kirriemuir y McFarlane, 2004). Basándonos en la hipótesis de que los juegos digitales y los deportes comparten la intención de que los participantes disfruten aprendiendo difíciles y estructuradas forma de juego, consideramos el modo en que los diseñadores de juegos digitales activan el compromiso en el aprendizaje, y si los entrenadores deportivos pueden aprender algo del intencional diseño pedagógico adoptado por los diseñadores de juegos digitales. En este sentido, mediante ejemplos de entrenamiento, se muestran distintas aplicaciones de ricas tareas de participación basadas en los principios educativos del "buen" (Gee, 2007) diseño de juegos digitales. Concluimos proponiendo seis

perspectivas pedagógicas para el entrenamiento deportivo a fin de mejorar la práctica como un espacio de aprendizaje basado en el diseño de juego intencional.

Palabras clave: juego; intencional; diseño; deporte; entrenamiento.

INTRODUCTION

A highly directive style of coaching incorporating a practice task design for the replication of prescribed movement models for sport specific techniques is often described as a "traditional" coaching approach (Australian Sports Commission, 2006; Light, 2013). When executed well, it may provide a high volume of practice, however, much of it is not "game-like" and thus described as isolated. That is, technical aspects of performance are isolated into drill practices that are often not representative of the game context (Pill, 2006). This type of practice does develop the perceptual-decision making skill of practice and play opportunities that couples technical and tactical dimensions, such as in designer practice games (Charlesworth, 1994). Game-based practice environments engage the cognitive decision-making component of sport skill performance as much as the technical dimension of performance execution. We argue that the design and enactment of what has been described as a "traditional" coaching approach emphasising directive practice and isolated technical skill practices before game-based practice (Light, 2013) is an example of powering-down the engagement of players in their learning (Prensky, 2001). To sustain motivation to practice, we suggest what is needed is practice design and delivery that powers-up engagement of players in their learning.

We agree with Hemphill (2008) that sport needs to be described by coaches more expansively and conceptually than merely the demonstration of physical performance. We postulate sport needs to be described in an alternative manner that represents it as a way of "knowing" to engage better with a generation raised with immersion in digital technology. We argue that digital game design and game-based sport coaching face the similar participatory challenge to have partakers enjoying the challenge to master something that is complex, hard to master, and takes a long time to master (Pill, 2010a; 2014). Predicated on the hypothesis that both digital game play and sport have the common participatory intention to get participants to enjoy learning a difficult and structured form of play we consider how digital game designers seek to power-up engagement in learning, and can

sport teachers learn anything from the deliberate design pedagogy adopted by digital game designers. Applications of enriched task engagement from the educational design principles adopted by "good" (Gee, 2007) digital game design are demonstrated later in the paper through the use of coaching examples. We draw attention to digital game playing in this paper as the game medium has managed to capture and sustain children and youth's engagement. This engagement occurs despite the medium being one where skill learning to meet the game demands is challenging and the games themselves take a long time to master. To consider this point, we will use a few examples from the popular digital game, Halo (Microsoft Studies).

What makes digital game play so appealing?

Interactivity and co-design are characteristics of the digital gaming experience. Before commencing the game of Halo, players can choose their character from a list of options and customise the starting look of their character through choice of things like weapon and armour, and colour of uniform (Figure 1). The choices are not unfettered, but restricted to what is appropriate for the starting level. As player ability improves, demonstrated by the successful completion of challenges as a player progresses through the level, the opportunity to upgrade the customisation is offered as the player has repeatedly demonstrated consistent competence, and the new choices will provide the tools to meet the next level of challenges presented in the game. In this way, players in the digital game environment are provided "practice repetition", repetition is varied in that the same skill is practised but applied in a slightly different situation, and thus practice volume for skill development and then consolidation before completion of a level and the choice to advance to the next level via a new game scenario. The digital game design therefore deliberately builds-in coherent progressive complexity via structured scenario evolutions.

Digital games frequently provide another type of choice into the game interactivity with players. This is the feature whereby the game level or scenario has more than one possible entry point (Figure 2). This flexibility is posited as adding to the investment in the game through another option for customisation. This design allows for players to enter a new game world that they have not yet explored, or to continue to explore a world they are familiar with. For example, in the game Halo players can decide from a range of "playlists" or game worlds, that all have similar intentions, but which all have different visual, audio and kinaesthetic designs. From the

perspective of customising learning, this design encourages players to learn within a domain of their choice, where they can operate in a game world that is built from characteristics that appeal to the player (and often built by the player). By this design, investment in the game is enhanced because players have an extended commitment to the game world, and therefore more greatly value how the world promotes particular sets of attitudes, beliefs and actions.

Figure 1. Halo character customisation stage – character choice and starting customisation of things like weapons and armour (Screen shot from https://www.youtube.com/watch?v=6f-Dm-VdaXs)

Figure 2. Halo character customisation tutorial - players can choose the entry point for engagement in the level from a list of options (Screen shot from https://www.youtube.com/watch?v=6f-Dm-VdaXs)

What we have described so far is the utility for digital games to encourage curiosity by creating scenarios identified as, "What happens if I do this?" (Kirriemuir & MacFarlane, 2004). The digital game itself acts as a "safe haven" for choice making, "where failure is part of the fun and central to learning" (Gee, 2013, pg. 32). As players feel safe (and curious) to invest different ways of learning and playing the game, new areas of the game world become unlocked, requiring players to think differently about how they play the game. An example of this choice making from the game Halo is customisation of character at the start, and throughout game play, where there is a choice of smart tools that will extend effectiveness in the game world (armour, weapons, objects in the game, character skills). The player learns to understand how these smart tools can be used to carry out goals, and therefore the player's power over how the game world is investigated is enhanced through such tools.

From a learning design perspective, knowledge is shared between the player and the smart tools; the smart tools act as a tool to set possible solutions to common problems in the game. Therefore, the choice of solutions implicitly on offer to players is also customisable, and so while

game players are likely to describe digital games as challenging they are also likely to list "fun" as the number one reason they play digital games (Kirriemuir & MacFarlane, 2004). In essence, the right constraints are in place for learning from the game experience as there are boundaries on action creating optimal challenge, or the right challenge point, for players.

The ideas presented from digital game design so far in this paper suggest that the game world is co-created between the player, and the game designer. In digital games, the player's decisions and actions matter, and will trigger how the game reacts back, which then triggers how the player responds. The interactivity between player and the game dictates trajectory through game world, and makes the player feel like he is a "producer" of the game, rather than a "consumer" (Gee, 2013). Co-designing learning is a tool used in digital game design to develop "buy in" where players feel motivated to engage. From a learning design perspective, co-design is used to help players to more deeply understand the game world, so that they can make measured choices about how they can affect the world, in order to achieve the game's overall goal.

Design of "good digital games" that we have so far explained uses learning principles that are common (or have informed grounds to be common) in modern education. Gee (2013) has explained that games developed from good digital game design theory use the hypothesis that humans learn best when they are faced with situations that they believe to have meaning, and thus the game world itself acts as the space where action is situated, and therefore knowledge of how to play the game is contextualised from the beginning of engagement with the game. This is unlike "traditional" coaching pedagogy where game involvement has often been presumed to require the development of specialised movement skills prior to their application in context of the game play.

1. TRANSFERING DIGITAL GAMES PEDAGOGY TO SPORT COACHING – THINKING LIKE A GAME DEVELOPER

1.1. Plan carefully

We see the notion of "game as teacher" in sport coaching aligning game design that is planned carefully, so that problems encountered are progressed from simple to more complex – a type of tactical periodisation. Using the lens of complex systems from Ecological thinking (Davids, Araujo, Vilar, Renshaw, & Pinder, 2013; Davids, Button, & Bennett, 2008), like digital

games, sport practice may be constructed as a designed space. From this perspective, game components (players, technical skills, tactical strategies, playing space, and rules, to name a few) are conceptualised within a flexible organisational relationship, capable of interacting with one another. These interactions, referred to in the literature as "phase transitions" (Davids et al., 2008), have the capacity at intra and inter-individual levels to influence tactical and technical dimensions of sport. Intra-individual refers to intrinsic coordination dynamics within individual participants and may include the emergence of specialised sporting techniques such as a basketball jump shot action to meet the situated performance demands of the game moment. As a game designer, the role of the coach is to construct games that couple the solution (such as a jump shot in basketball) to the planned emergence of a game situation that preferentially selects that solution. Enacted team strategies or set-plays occur at the inter-individual level. For example, team player and ball movement that are designed to create the situation in the game for a jump shot. Games become designed spaces where the coach deliberately manipulates game components (also referred to as constraints) in order to bring about desired outcomes.

In this process we have just described, individual player system components (i.e. players' individual coordination dynamics that result in their enacted technical and tactical skills) link together to shift in and out of synergies that satisfy the games task constraints (i.e. rules) in a defined performance environment and achieve deliberately intentioned game outcomes. This understanding challenges traditional coaching ideologies that focus practice on technique replication in reproduction drills (Light, 2008; Stolz & Pill, 2012), compartmentalising technical and technical skill competencies to be practiced separately prior to reassembly for game play at the end of practice. This traditional emphasis directs coaches to what has been described as a linear-approach (Davids et al., 2008), whereby technical aspects of performance are assumed needed to be mastered before games can be played. In contrast, non-linear coaching considers games from a dynamic systems perspective where emphasis is instead placed on the players' ability to predict and adapt movements within constantly shifting game dynamics (Magias, Pill & Elliott, 2015). This is very much in line with the good game design theory of digital games we described earlier. In this paradigm, the skilled performer is not necessarily the player with the "best" technical model but the one with more accurate anticipation and perception-decision making ability, and a technique that holds up to the performance demands (Williams & Ford, 2013).

Through an application of ecological thinking, we argue that coaches may use designed game spaces as the site for perception-decision development whereby the "openness" of the player as a complex system to perceiving environmental energy or information which may regulate movement (Davids et al., 2008). Environmental influences (or constraints) influence the direction of behaviour, and therefore, movement objectives are not entirely a product of a learner's will, but are also inextricably limited to the possibilities afforded by the environment of the game. Stelmach (2014) used the term "event" to reflect this idea, whereby learners are seen to control the functional description of the event rather than purely the functional control of their own body. This idea was first pioneered in a seminal work on this topic by Gibson (1979), who states "*we must perceive in order to move, and we must move in order to perceive*" (p. 223), emphasising that just like involvement in a digital game, in sport practice games the relationship between perception and action is continuous.

1.2. Affordances

The careful design of games requires the game designer to understand how to create conditions for the gamer to perceive 'affordances' (Gibson, 1979) – i.e. opportunities for actions that can achieve action to meet the goals of the game, called "win states" (Gee, 2013).

In the digital game world, every possible action of the game player is bound by a carefully designed relationship between affordances and win states, using a customised design to control difficulty levels. We argue for sports practitioners to assume the role of 'practical theoreticians of learning', so the learning design of a virtual game experience can be translated into a physical game experience. Take the game of soccer; an invasion game bound by variations of time and space (Mitchell, Oslin & Griffin, 2006). Time and space are factors that will dictate the affordance-win state relationship.

1.3. Recognisably literate

Gee (2003) suggests that digital games considered from the perspective of a learning environment provide a context for game engagement where players learn how to understand and produce meaning as players become recognisably "literate" (images, words, sounds, movements, kinaesthetic feelings and emotions are recognised and provide evidence of learning

emerging from game engagement) to those affiliated with the field. Corbin (2016) has explained that in its broadest sense, "literate" has traditionally referred to being either "educated" or "cultured" – in other words, knowledgeable or informed. Literate in this context recognises the functional use of knowledge and understanding (Pill, 2010b). Descriptions of literacy relevant to sport include education about the tactical and technical principles of play associated with games literacy (Mandigo & Holt, 2004), knowledge because, about and through movement described as movement literacy (Kentel & Dobson, 2007), and education in, through and about sport described as sport literacy (Pill, 2010b).

Further, it has been suggested that in digital gaming, as players becoming recognisably literate they learn to think at a "meta level" enabling players to produce novel and sometimes creative or unpredictable thinking in response to game problems and challenges. In other words, players learn to think critically and creatively as they come to understand games as systems and designed spaces (Kirriemuir & MacFarlane, 2004). However, it is worth remembering that digital game design does not promotes both convergent "ideal solutions' and divergent creative problem solving, because creative problem solving doesn't necessarily develop thinking that works well for future game scenarios that have similar but more developed problems in the game

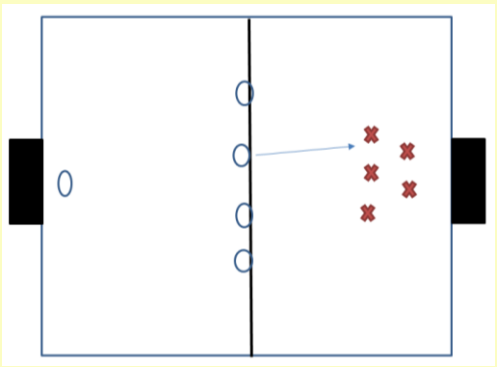
2. DISCUSSION – THEORY INTO PRACTICE

The invasion game design pictured below (Figure 3) will provide a practitioner perspective of how the ideas presented in this paper regarding digital game design have potential to develop a physical game world for soccer.

2.1. Designing the game world

The initial design question one must consider is: "*What does my game world (soccer) look like?"* Soccer has primary rules, such as outfield players use their feet, two teams with a goal to defend, an off-side rule, and an end-goal to score that determines the "logic" of the game (Grehaigne, Richard & Griffin 2005). The game design then considers, "*What broad aspect of my game world do I want players to learn more about?"* Soccer is built from principles of play stemming from the game phases of attack, defence, transition, starts and re-starts (Mitchell et al, 2006). In planning the

game scenario, all will be present all the time, but one must be a particular focus; for this game (Figure 3) we will be using the "attack" phase. In addition to the games primary rules, there are secondary rules that the game designer can manipulate and they will not change the logic of the game: *What are the secondary rules of the game?* In this game (Figure 3), we manipulate the starting point for the attack. In this way, we are narrowing the focus of players by a design that indirectly manipulates how players' will see affordances and take action for win states. In this game, "attack" is narrowed to "counter attack". Therefore, a manipulation to the rules of the game concerned with starts and re-starts to encourage counter attack play will be play starting from the scenario "you have won ball in defensive half of pitch" before attempting to score.



5v5 Counter-Attack Game
(Game Constraints)

- Defensive team (indicated by circles) line up on the half-way line (four players) and one player as goal keeper.

- Attacking players can start anywhere in their defensive half.

- Play commences with a simulated loose ball to the counter-attacking team (indicated by crosses).

- Defensive player passes to a counter-attacking player who nominates to receive the "loose ball" by raised hand.

- Defensive players can move after counter-attacking team has first touch on the ball.

- Counter-attacking team has 10 seconds to score.

Figure 3. 5v5 Soccer as a game world – using attacking as a broad focus for interactivity

We mentioned previously that time and space were two movement dimensions we wanted to focus on in this practice. In this game, the pitch is wide and short, meaning there is plenty of width to attack. The distance to goal on gaining possession for a counter attack is relatively small, meaning the counter attack must be quick or the defending team will recover defensive position. By manipulating the dimensions of the play space as well as the start/re-start conditions we have customised the affordance-win state relationship by this altering of how time and space exist in the game.

The game designer must also define the win state of game and how achievement of this state will be rewarded. *How will individual players, and teams, achieve win states?* In this game (Figure 3) a win state is achieved by scoring within 10 seconds (or less) of "regaining possession". This win state is reversed from a defensive point of view. Reward is always delivered through game design. In this game (Figure 3), if a team score 3 goals, the length of the pitch is decreased. Decreasing pitch length makes achieving win state more difficult (less time and space for attack), yet is still treated as a reward because in digital game terminology, this scenario is considered as "level up".

Finally, the game designer needs to ask, "*What happens if the time is up and the game isn't complete?"* In the digital game worlds players normally pick up where at the level where they left the game unless they make a purposeful decision to go back and repeat play in a previously conquered level. It is not possible for soccer practice to last for hours on end; therefore, good design should automatically include deliberate recording of players' progress so that next practice, players can enter the game at the same point to which they left the game.

2.2 Creativity

Earlier in the paper we discussed that in digital game design, game developers bring a focus on players learning to think so as to produce novel and sometimes creative or unpredictable responses as they come to understand games as systems and designed spaces (Kirriemuir & MacFarlane, 2004). Creativity is also an essential component of sport performance (Memmert, 2011, 2015). Memmert (2015) has defined tactical intelligence as convergent thinking by players that delivers an ideal solution to the game problem specific to the moment of play. On the other hand, tactical creativity he defines as innovation or uniqueness of solution to the game problem specific to the moment of play. While both are essential for successful player performance unexpected and original solutions provide great potential for a competitive performance advantage. The creative process from which tactical creativity occurs is not developed through the narrow attentional focus of drill-based practice tasks (Memmert, 2011, 2015; Pill, 2016). Perception developed from action immersion in many different game situations however, does appear advantageous to the development of tactical creativity. Coaching through deliberate and designer play that immerses players in a wide breadth of attention at an appropriate

representative level for the readiness of the players appears advantageous to the development of creative thinking.

We illustrate this point using a generic 6v6 invasion game in Figure 4. In this game, teams score by getting the object into the goals (represented by the triangle at the end of the rectangle play space). Play commences and recommences after a goal with a pass from the goal line back into play from the team defending the end at which the goal was scored. A common defensive solution in this scenario is to 'deny the corridor' by concentrating the defence mid-pitch to force the pass out from the goals to a wide position towards a sideline. This tactical scenario is common in Australian football from kick-ins after a point, soccer/football when the keeper looks for a quick pass back into the play after a save, in netball following a defensive rebound, in basketball following a defensive rebound, and in water polo following a goalkeeper save. It is therefore possible to develop player creative thinking from immersion in the tactical features of the problem through may different game situations arising from experience in a breadth of invasion game experience. According to Memmert (2015), "current theoretical approaches support the view that gathering diversified experiences over a number of years is ideal for the development of creativity" (p. 57). Thus, involvement in diverse games providing essentially similar tactical scenarios to solve albeit with the application of different motor skills may be valuable for the development of tactical creativity. Parallels exist here between the "repetition without repetition" provided to digital game players using the same technical and tactical capabilities but in what appear to be different scenarios to develop the skill competency of a game level (Salen & Zimmerman, 2004).

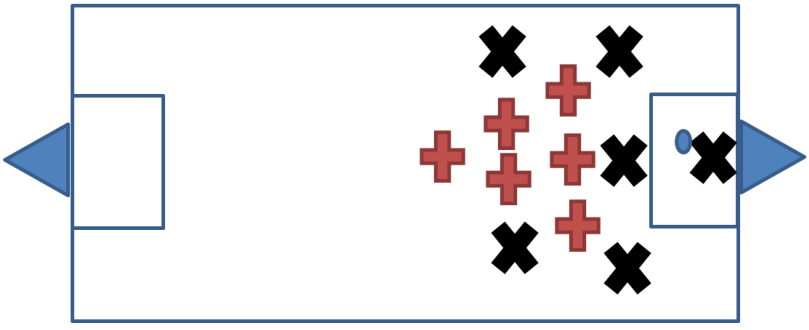


Figure 4. A common invasion game tactical scenario showing a defensive press concentrating numbers mid-field

Just like in digital games, in sports players have to perceive and process large amounts of information into tactical and technical actions within the game. Both game mediums are essentially about the development of proficiency. In digital game play, learning occurs through immersion in play-based experiences. Research is beginning to suggest that game-based play with purpose, including the experience of different sports within a game category, encourages greater learning for the developing player (Memmert, 2011; 2015). This has implications for the coach as a deliberate designer of practice that purposeful focusses on playing learning.

3. CONCLUSION

In this paper we have proposed that similar claims are made for sport coaching and the deliberate design of practice games (Charlesworth, 1994) as learning environments to improve players' performance abilities as Gee (2008) makes about digital games. This is, that "a game's design is inherently connected to designing good learning for players" (Gee, 2008, p. 21). In summary, we are promoting and have described in this paper the following pedagogical perspectives for sport coaching informed by digital game design:

1. Players have choices that enable customisation of practice games starting conditions;
2. Play feeds the learning process as "skills" are viewed as player strategies to produce good game outcomes;
3. Structured progression is based on the concept that games should be easy to learn but hard to master (Bates, 2004, p. 31);
4. The right constraints are in place for learning from the game experience: that is, there are boundaries on action creating optimal challenge/the right challenge point for players;
5. Explicit instruction is provided to players via quantifiable outcomes framed as achievement standards, or what in game design is known as "terminal conditions" (Adams, 2010); and
6. Learning achievement is recognised and rewarded.

We suggest theses pedagogical imperatives towards the primary aim of game design for sport practice as to create meaningful immersive experiences. We have also made parallels between the digital game world

and sport as complex dynamic systems as both are rich in player need for single "optimal" and flexible "creative" tactical solutions to the problems the play presents to players. Therefore, just as digital game designers deliberately build in to the game experience goals that can be achieved by different means (the tactical solutions) and structural components (the performance actions) the sport coach can similarly use designer games through which players learn the general principles for successful outcomes while practicing technical responses. In contrast to highly technical focussed coaching emphasising the modelling of solutions by the coach in drill based directive practice through which players demonstrate reproduction of the model, coaching like a game developer emphasises emergent behaviour. In this coaching context, both optimal ideal solutions can be generated as well as the potential for novel and flexible solutions through the nonlinear participatory fluency that can be purposefully encouraged through deliberate game design.

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