Accepted for publication in Physical Education and Sport Pedagogy
Date accepted: 09/09/2022

Developing a Love for Playing Games: A Clarification of Why Digital Video Games Approach is not Gamification

Corresponding Author: Amy Price, University of Edinburgh

amyprice10@yahoo.co.uk

Alex Beckey, Kingston University

a.beckey@kingston.ac.uk

Dave Collins, University of Edinburgh & Grey Matters Ltd

dave@greymattersuk.com

Abstract

Background: In recent years there has been a growing interest in potential pedagogical tools to be used in Physical Education (PE), and specifically in games. This has involved the exploration of both Gamification and Digital Video Games Approach (DVGA). Both are viable pedagogical tools for any teacher, and each have clearly different intentions for impacting student learning. Unfortunately, and despite several distinctions, they have been misinterpreted.

Purposes: The first purpose of the study is to offer a clarification of how these tools have emerged in PE and their underpinning mechanisms. This clarification explains their conceptual differences and similarities, with pedagogical implications. The second purpose is to highlight how understanding of this clarification can develop teachers' Pedagogical Content Knowledge (PCK) and support more optimal usage and better impact positive student outcomes in PE.

Key Arguments: PE teachers are responsible for delivering high quality teaching and learning experiences which are informed by well-reasoned decisions of which blend of pedagogical tools to use, when and why. Unless a clarification is provided concerning Gamification and DVGA, these tools will continue to be used sub optimally. In short, we clarify that Gamification is underpinned by increasing motivation in the short term, through improving the attention and engagement of students. In contrast, the underpinning of DVGA is metacognition, and this tool seeks to deepen student understanding; a distinct (we suggest) longer term agenda.

Discussion: There is ongoing debate concerning the importance of a meaningful PE curriculum and how to engage students through games using a range of pedagogical tools. Gamification and DVGA are tools which share some commonalities (such as choice, challenge and

feedback), but they also have distinct differences (such as planning, assessment and progressions, differentiation and the teacher's role).

Conclusions: By improving teachers' PCK about the purpose and underpinning mechanisms of Gamification and DVGA, they will be better equipped to decipher which pedagogical tool to use, when and why. As a result, teaching is more likely to deliver optimal impact for students to increase potential for developing a love for playing games.

Keywords:

engagement, metacognition, motivation, physical education, teaching

Developing a Love for Playing Games: A Clarification of Why Digital Video Games Approach is not Gamification

Physical Education (PE) is positioned as a subject that can provide students a range of health benefits as well as meaningful development in the physical, social, cognitive and affective learning domains (Bailey et al. 2009). A key aim of participating in quality PE, usually as part of a rounded school curriculum, is to support the development of lifelong engagement in physical activity (UNESCO, 2015). In particular, games (or game like activities) present an opportunity to engage students and develop their love for playing (Thorpe et al. 1986). However, a key part of meeting that challenge is to ensure that teachers understand the pedagogical tools they have at their disposal, especially how to use them and toward what objectives (cf. Mosston and Ashworth, 2008; Blair and Whitehead, 2015).

In recent years, two new pedagogical tools have emerged in both literature and practice; Gamification and Digital Video Games Approach (DVGA), which both stem from digital video games (Gee and Price, 2021). Gamification is making an activity feel more like a game by using game design elements to boost motivation and engagement (Fernandez-Rio et al, 2020). Whilst DVGA seeks to improve student understanding by using learning principles inherent in video game design (Price et al, 2017).

Both tools have a place in the PE teaching toolkit, and have potential to contribute towards a meaningful PE curriculum. Some of their similarities and differences can be found in Figure 1. However, we advocate that these tools (like any other pedagogical tool) must be understood and applied appropriately by teachers for optimal impact. Regrettably however, from the authors' experience as teachers, coaches and educators, these tools are being misrepresented in practice. To an extent this is understandable, perhaps because both stem from video games, and possibly, teachers are more concerned with using pedagogy which they perceive to be most relatable for young people. Additionally, due to the recent emergence of

these tools, there is little trustworthy critical discussion either in literature or within professional learning networks (such as Twitter), to demonstrate their differences. As a result, practitioners are overlooking their nuance, and thus misunderstanding how they work and what they are for.

Having a lack of clarity on the differences (and similarities) of Gamification and DVGA means these tools are unlikely to be utilised to their full potential. This is because high quality PE experiences for all students are dependent on the knowledge and skills of teachers themselves. Teachers with high levels of expertise are capable of making informed decisions on what tool to use with which students, when and why (Collins and Collins, 2020). As shown in the PE literature, teachers' knowledge is essential for delivering impactful teaching and learning experiences which engage students and develop a love for playing games in the longer term (Kim et al. 2018). Originally conceptualised by Shulman (1987), there is a range of teacher knowledge categories, including, Pedagogical Content Knowledge (PCK), Content Knowledge, General Pedagogical Knowledge, Curriculum Knowledge, Knowledge of Learners, Knowledge of Educational Contexts, and Knowledge of Educational Aims, Purposes and Values. PCK is of particular interest when discussing the potential for Gamification and DVGA in PE, and PCK suggests that teachers must know how to teach in ways that students will understand. This is the difference, for example, between a sports person and a sports teacher, or a scientist and a science teacher. In PE, Ward (2014) emphasise that PCK is context specific, and thus it is developed through experiences of teaching specific content to specific learners. Although content knowledge is related with mature PCK, Backman & Barker (2020) explains that in PE, this does not mean the teacher must be able to perform the sport or know all of the intricate details about the sport, instead they must make informed decisions about how to positively affect how students learn the content.

We aim to offer clarity on what is DVGA (see Table 1), and what is Gamification, and explain how both can be used to develop PE teachers' PCK, to provide more optimal learning experiences for students. We also suggest that teachers with mature PCK will find ways to combine elements of these two tools (and others), to deliver positive student outcomes.

Of course, misinterpreting teaching and learning approaches is not new in PE and sport coaching domains. For example, a distinction was recently made between Teaching Games for Understanding (TGfU) (Bunker and Thorpe, 1982), and a Constraints Led Approach (CLA) (Renshaw et al. 2015). This was followed up by Harvey et al. (2017) who explained how TGfU and a CLA 'rest on very different theoretical foundations' despite the perception that they may look alike in practice. Games-based coaching literature also explains how subtle (but important) differences exist between Game Sense (GS) (den Duyn, 1997) and TGfU (Jarrett and Harvey, 2016; Pill, 2018). Adding to the potential for confusion, and despite both subtle and obvious differences existing between pedagogical concepts, different teaching tools are often used in combination to achieve desired learning goals and outcomes (Casey and MacPhail, 2018). Freedom and flexibility for the teacher to demonstrate their PCK by making informed decisions about the blend of teaching styles, feedback, approaches and pedagogical tools demonstrates an awareness for learners and learning (Casey et al. 2021; SueSee et al. 2021). Furthermore, some PE teachers report greater motivation to teach when they experiment with innovative teaching approaches (such as Gamification and DVGA) and feel a sense of pedagogical freedom (Pill et al, 2021). Importantly, however, to apply a meaningful blend of pedagogical tools which impact positive student outcomes, teachers must understand when to use them, and be equipped with sufficient PCK about the purpose of these tools and their underpinning mechanisms.

So, reflecting on our concerns regarding the ways in which Gamification and DVGA have been misinterpreted, this paper will: (1) explain the emergence and underpinning

mechanisms of Gamification and DVGA in PE, (2) detail the conceptual differences and similarities between Gamification and DVGA, (3) outline pedagogical implications, and (4) reinforce the need for teachers to think critically about their choice of teaching tools.

Emergence of DVGA in PE

Inspired by Gee's (2013) features of Good Game Design (GGD), Price et al. (2017) devised an alternative method for teaching sport (not just games); Digital Video Games Approach (DVGA) which is based on game design for teaching and learning (Gee and Price, 2021). The purpose of DVGA is to develop students who are good learners with a strategic understanding of how to play the game (Price et al. 2019). This was the first time where digital video game design was blended with sport teaching to create a pedagogical framework, despite the fact that digital video games and sport have much in common (Pill, 2014). Prior to the conception of DVGA, Price and Pill (2015) investigated the application of digital video game design in youth soccer using an action research design. The conclusions of this study described the challenge of applying design features from a virtual environment into a physical environment, and advocated the need (and benefit) for further exploration. Some of this exploration was later demonstrated by Pill et al. (2017) in their theory to practice analysis which relates various digital game design concepts to sport coaching pedagogy.

The origins of DVGA have stemmed from sport coaching, and both theoretical and empirical research that has sought to investigate its impact on player understanding. Thus far, this has been limited to high-level youth soccer coaching contexts (Price et al. 2020; Price et al. 2021). To date, neither of these empirical studies have tested the outcomes of applying DVGA; however, they have investigated the notion of game understanding amongst players and coaches. Evidently, further empirical insight over continued time periods is required for a more comprehensive understanding of the impact of DVGA.

DVGA: underpinning mechanics

159 Figure 2 provides an example of how DVGA might be designed for teaching soccer. It
160 illustrates the five pedagogical principles of a DVGA (missions, levels and level-ups, super
161 powers, saving, pausing). Importantly, this example does not illustrate the complexities of
162 teacher PCK, and therefore the effectiveness of these ideas is dependent on the teacher's ability
163 to relate their knowledge to the students in front of them.

164 Building on the role of understanding from TGfU (Almond, 2015), and Hopper and
165 Bell's (2002) introduction into strategic understanding in games, DVGA aims to deepen
166 understanding (Price et al. 2019). Metacognition is a central proponent of understanding and
167 underpins both how DVGA works and its design principles. Table 1 shows the design features
168 of Gee's (2013) GGD, and how these features link to the five pedagogical principles which
169 make up DVGA. These features are recognised by Gee (2013) as being a part of three
170 underpinning principles which inform GGD; empowered learners, deep understanding and
171 problem solving. Price and colleagues have made sense of GGD and taken this further by
172 crafting DVGA so that practitioners have tangible game design ideas to develop metacognition.
173 Metacognition is about the ways people monitor and intentionally direct their learning, and the
174 common conception of metacognition is 'thinking about thinking' (Brown, 1984). Put in the
175 context of teaching PE, if a student realises that what they are doing is not effective and
176 therefore they change what they are doing by implementing a more optimum strategy, then
177 they are thinking metacognitively (Kirschner and Hendrick, 2020). In PE and sport
178 (particularly games because of their complex and dynamic nature), having an awareness and
179 control over thought processes is particularly useful for learning how to make progress in an
180 activity.

181 To think on a meta level when playing sport, students require the ability to use
182 metacognitive skills. Detail of how metacognitive game skills might look in gameplay for
183 invasion and striking/fielding activities can be found in Price (2020). One example of a

metacognitive game skill is information gathering, which is the ability to detect (or test for) critical information from the game or it's players, as the game is happening. Therefore, the objective for any PE teacher who chooses to use DVGA should be to develop students' metacognitive game skills, so they can learn how to outwit their opponent. These metacognitive skills occur as the student is continually reviewing their use of knowledge of the task, the people playing (including themselves), and their cognitive strategies.

Using Flavell's (1979) definition of metacognitive knowledge, thinking about one's thinking regarding how a problem is solved in order to monitor progress (and not just make progress) is the fundamental basis for DVGA. Clearly, ways in which students approach and solve problems in PE is vital for their engagement and progression in the sport or activity: both now and, when established as a habit, in the future. For almost any PE teacher, having knowledge of what students are thinking, when they're thinking it, and how they're thinking is an extremely helpful mechanism to support learning. Some examples of cognition that students might experience when playing digital games, or when learning using DVGA are:

- detection of a problem made more obvious due to feedback provided by the game itself;
- setting goals to learn more about the nature of a problem and the people playing;
- deciding on possible solution(s);
- testing if and how a solution works best by applying cognitive strategies;
- monitoring if a solution has worked, and;
- using knowledge about the task, the people playing and cognitive strategies to tweak how to approach the same or a similar problem next time.

Emergence of Gamification in PE

Gamification has been defined as using features of video games in non-game like contexts (Kapp, 2012; Deterding et al. 2011). Since the early 2010's, Gamification in

educational contexts has become increasingly popular as a pedagogical tool (Dichev and Dicheva, 2017). This is because Gamification is understood to impact student behaviour and provokes emotions which influence attitudes toward engaging in a task, such as positive frustration, curiosity and excitement (McGonnigal, 2011). These feelings can be motivated intrinsically (commitment to a narrative or mission), extrinsically (desire for rewards and feedback) or socially (to compete, collaborate or compare) (Gonzalez-Gonzalez et al. 2018).

Most recently in PE, Self-Determination Theory (SDT) (Deci and Ryan, 2000) has been a driving theoretical force for understanding Gamification and its effect on positive student behaviour (cf. Fernández-Rio et al. 2021 for an in-depth review). Simply put, SDT explains that for optimal functioning and continued psychological growth, humans need to experience a sense of competence (to develop capacities), relatedness (to relate to others) and autonomy (to feel in control of their own behaviours). For PE teachers, the idea of enhancing levels of student motivation, and changing the behaviours of students' from disengaged to engaged is important for staying physically active and educated in the shorter term. To predict motivation for longer term engagement however, inside and outside of school, the need for competence has been evidenced as the most vital part of SDT for PE students (Fernández-Espinola et al. 2020).

The results of using Gamification in PE consistently shows how student motivation and behaviour can be positively impacted in the shorter term. For example, a five-week gamified intervention program in secondary PE showed that students' need for autonomy, relatedness and competence were more satisfied after the intervention, which led to increased intrinsic motivation (Sotos-Martinez et al. 2022). Another study into the effects of Gamification in Primary PE suggests that it is a tool with potential to enhance intrinsic motivation of students because findings yielded a number of themes suggestive of meaningful experiences in PE (such as social interaction, fun, challenge and learning) (Fernández-Rio et al. 2020). More recently

Fernández-Rio et al. (2021) have added to the understanding of Gamification as a pedagogical tool, and suggested that Gamification enhances Secondary PE students' intention to be physically active because it provides an autonomy-supportive context for learning. The evidence base for gamified PE is increasing, albeit slowly, which is expected since Gamification is still currently considered as a contemporary pedagogical tool in education as a whole, and not just within PE. Clearly, however, to establish more profound conclusions about the impact of Gamification in PE, more empirical evidence is required and across a wider breadth of ages and stages. Specifically, investigation into the longer-term impact of gamified PE on student motivation is necessary.

Gamification: underpinning mechanics

Figure 3 provides an example of how Gamification might be designed for teaching soccer. Figure 3 illustrates a skill related learning objective (pressing the ball), combined with some dynamics, mechanics and components of Gamification (progressions, challenges, badges, chance and leaderboards). As we have explained previously, the complexities of teacher PCK is not represented in this example, and therefore the effectiveness of these ideas is dependent on the teacher's ability to relate their knowledge to the students in front of them.

In the quest to gamify some learning experiences in PE, there are particular dynamics (narrative, progressions, emotions), mechanics (rules, challenges, chance, competition) and components (badges, points, levels, leaderboards) which make up a gamified experience (Werbach and Hunter, 2012). For example, gamification will frame the game around a narrative which shows how challenges will increase, earning a badge after making an achievement, or accumulating points on a leader board to show who has performed best and worst. These examples can be found in educational literature (Zichermann and Cunningham, 2011; Simões et al. 2013), and are aligned with popular principles of educational Gamification such as visible status, rapid feedback and social engagement (Divecha, et al. 2015). Principles such as these

cater for the unique characteristics of Generation Z students (born after 1996) who have grown up in a highly connected and completely digital environment (Twenge, 2017). Indeed, it has been suggested that a highly digital world has resulted in short attention spans, poor communication and the need for frequent feedback (Gould et al. 2020). There is no surprise, therefore, why PE teachers may consider Gamification as a tool to satisfy student preferences and to imitate the social context to which they function outside of school.

Vive La Difference! Conceptual Differences between Gamification and DVGA

For this section we will address some of the key *differences* between Gamification and DVGA in a point-by-point discussion, in reference to Figure 1. Importantly, these differences are nuanced, and therefore we encourage teachers to appreciate the subtleties of these differences.

Planning for learning:

(1) All teachers are expected to plan for teaching and learning objectives and align this to short, medium and longer term goals, for individual students. The key difference when planning using Gamification compared to DVGA is that the latter requires the primary focus of planning in the cognitive domain. Due to the purpose of DVGA being to enhance metacognitive skills, the development of these skills is always the primary objective(s) for any DVGA lesson. Conversely, primary learning objectives which align to Gamification might be across a number of domains (such as social, affective, physical and psychomotor). A further distinction is the role of the student in their planning and goal setting during learning. In DVGA, students are required to devise their own goal(s). Students will monitor and evaluate their own progress against the goals they set themselves, and decide when these goals need tweaking. However, Gamification requires the teacher to plan a gamified activity where goals are pre-set for

students. The game itself monitors student progress through issuing rewards when goals are achieved.

Assessment & progressions:

(2) There is much debate in PE literature concerning the most appropriate methods for student assessment, particularly for games (Williams et al. 2021). In simple terms, assessment can be formative (assessment for learning) or summative (assessment of learning). In games, formative assessment is advocated (Hopper, 2007). In video games, assessment is mostly formative, embedded into game design through mechanics such as levels and challenges, and happens as a result of playing (and progressing) (Salen et al. 2011). Summative assessment happens at the end of a level, sometimes known as playing against the 'the boss' (Gee, 2013). Both DVGA and Gamification are designed on this basis, however there is a subtle but important difference. In DVGA, students' progress (level-up) when a problem is solved. Levels start simple and gradually increase in complexity. Though similar, the difference in Gamification is the focus tends to be more focused on the motor skill application in a practice like situation, rather than solving a problem, though not exclusively and can be combined to good effect. Comparatively in Gamification, students' level-up as a reward when a challenge is complete. Levels start easy and gradually progress in difficulty. Due to the cognitive domain being the key learning focus when using DVGA, assessment should reflect these key differences. Therefore, in DVGA level design should exploit elements from the sport which influence complexity, and not difficulty. For example, in tennis, complexity is influenced by time, space, risk, and force. Conversely, difficulty involves execution of skills such as serving, volleying or rallying. Of course, it is possible for a student to find a complex level difficult, or a simple level easy, but we stress to teachers the subtle conceptual differences when deploying these approaches.

Role of the teacher during learning:

(3) In any teaching and learning approach the teacher is not (and should not) be redundant despite levels of student or teacher centredness (Goodyear and Dudley, 2015). However, depending on the learning goals of the students and the context of the learning situation, the teacher will have varying degrees of direct and indirect impact. In video game play there is no teacher involved; yet the player has a choice to engage with support mechanisms at any time (such as peers, tutorials, and cheats), to gain feedback, sense make or receive helpful information. In other words, the player decides when, how and why they want to be supported in their learning. The idea of players (students) being in control of their learning is also the case in DVGA because students have opportunities to 'pause' and decide to use the teacher and other support mechanisms. Here, if a student pauses to use the teacher, the teacher's role is to decide how best to appropriately support positive student outcomes, and to execute this effectively. This is important for developing students' metacognition because, amongst other benefits, the option to pause is a prompt for students to reflect on how they are thinking about their progress in the activity. Therefore, the role of the teacher in DVGA mirrors the intentions of the approach; metacognition. Like DVGA, Gamification has stemmed from video games where there is not an actual teacher present. However, in contrast DVGA, the teacher (not the student) decides when it is appropriate to intervene with learning or pause the activity to support positive student outcomes. Therefore, when using Gamification, the number of opportunities for teachers to impact student learning through their interactions and interventions with students are greater than that of DVGA, however in both cases the teacher has the choice to adopt whichever teaching and learning strategies they see fit (e.g., feedback, questioning, instruction,

demonstration, peer to peer, etc.) How and why a teacher adopts different strategies is dependent on their PCK.

Differentiation:

(4) An ongoing challenge for PE teachers is to provide learning experiences which cater for a diverse range of abilities and preferences (Colquitt et al. 2017; Jarvis et al. 2017) where students have varied levels of readiness (Thomlinson, 2001). Differentiation has been explored by Hopper (2011) who shows how games can be modified to cater for the needs of all players, which is typical of a video game. Nonetheless, differentiated teaching strategies are particularly challenging to apply in PE settings due to the different ways in which student knowledge can be demonstrated. For example, in sport, there is a high degree of procedural knowledge required (doing a sport), which is enhanced by levels of declarative knowledge (knowing about a sport). Knowledge is therefore not always visible for teachers to see. In video games, the player is invited to make numerous choices about how the game is designed and experienced. For example, choosing a character with specific abilities or choosing a level with particular challenges. In DVGA it is the students' choice making which demonstrates their (metacognitive) knowledge. Therefore, the purpose of these choices is to develop students' (rather than the teacher's) ability to monitor their problem-solving abilities. In other words, demonstrating a strategic knowledge of when and why to make a choice to alter the complexity of a challenge. For example, the choice of when and why to use a smart tool or super power to enhance effectiveness. In Gamification, differentiation by design of choices also occurs; however, choice making is not strategic. Differentiation is planned on a basis of student preference, and not readiness. This is because choices are often presented to students using chance (e.g., students will choose a card, or roll a dice), where there is limited scope to think deeply how their decision

will impact the difficulty of a challenge. Differentiation by choice which is based on student preference has potential for short term engagement benefits, and can maintain a feeling of excitement for a task.

But might there be useful overlap? Conceptual Similarities between Gamification and DVGA

As mentioned preciously there are some *similarities* between Gamification and DVGA. As advocated in the previous section, teachers are encouraged to consider the subtleties of these similarities. The similarities are considered now, in reference to Figure 1.

Choices:

(1) We have explained that both approaches provide student choice, but for different reasons. Choice for Gamification is to boost attention and engagement, whilst choice for DVGA is strategic and aims to develop metacognition. In the case of Gamification, choice can be underpinned by autonomy which is a central component of self-determined motivation (Ryan and Deci, 2017). Whereas, for a DVGA, choice can be underpinned by Gee's (2013) principle of empowered learners where the more design features present, the better the experience is for learning. For example, see Figure Two for application of DVGA and various design features. Nonetheless, choice in both cases has the potential to positively affect student learning outcomes. In both Gamification and DVGA, motivation and empowerment are a result of choosing characters, levels and challenges. However, in DVGA, further choices include smart tools or super powers and pausing.

Challenge:

(2) Creating a challenge point which is relevant for all students is one reason why both Gamification and DVGA have the potential to engage students in games and develop their love for playing, albeit with varying levels of sustainability. Both tools seek to

individualise the challenge level for all students. However, as we have explained already, challenge is conceptualised differently. In Gamification, challenge is designed based on perceived difficulty of a skill or task, whilst in DVGA challenge occurs as a result of complexity in problem solving. Notwithstanding which pedagogical tool is being used, however, all students will experience a game which is 'playable' (Casey et al. 2011). This is because all video games have high levels of playability where the player-game relationship is carefully balanced between challenge and engagement (Hopper et al. 2018). The concept of engaging with a playable game does not mean the teacher has no role during learning, despite that *one* important method of learning in games is through teacher led guided discovery where students draw upon the teacher as a learning resource (Harvey et al. 2017; SueSee et al. 2020). In both approaches, challenge can be maintained by the teacher through their chosen teaching and learning strategies which demonstrate their PCK. However, in DVGA the students themselves have more control over how, when and why the teacher (or other resources) can be used to impact challenge.

Feedback:

(3) In any video game, there is feedback from the game which indicates when progress is being made (or not). Learning goals are explicit and so is success and failure. These factors (amongst others) impact the nature of feedback and its impact on learning (Hattie, 2012). Due to the way in which Gamification and DVGA use levels and challenges, feedback is a prominent component of both tools. For example, in Gamification feedback includes rewards and punishments which can include points, badges and leader boards. This can be highly motivating, assuming the students have appropriate support and challenge. Feedback using DVGA is less about reward and punishment, and more about developing metacognition which in turn develops

students' ability to find and use information (feedback) provided by the game (Gee and Price, 2021). For example, testing a new skill against an opponent to establish an advantage, which might be supported through how the teacher supports student reflection. Therefore, both tools advocate the importance of explicit feedback where failure is a part of learning, though the type of feedback and how it's consumed is different.

Pedagogical implications for developing students' love for playing games

In this section we will provide suggestions to our clarification, which is supported in Figure 1. This summary aims to provide some pedagogical guidelines for PE teachers to inform how Gamification and DVGA can help deliver a meaningful PE curriculum where students develop a lifelong love for playing games.

Similar to Renshaw et al. (2015) and Hopper (2002), we draw upon Bunker and Thorpe's (1986) seminal work which raises issues still relevant today associated to a 'one size fits all' approach, when seeking to engage students in playing games. Despite any conceptual, theoretical or epistemological differences, we suggest there is a place for all pedagogical tools, with the skill of the teacher being about how, when and why to use their tools in relation to the needs and wants of the students. Therefore, the role of PCK is key for teacher effectiveness and impacting positive student outcomes. We explain how both Gamification and DVGA can be used independently or in combination for optimal impact.

1. Focus on learning

Have learning objectives for all lessons and explicitly share these with students. Aim to be clear about which learning domain(s) these objectives are primarily focussed on, and why. Encourage students to set themselves goals or develop goals together with the students. Provide students with opportunities to talk about their thoughts and feelings throughout the lesson, linked to their goals. Pay attention to what they say, and not just how they play because

this demonstrates their depth of knowledge and the types of knowledge they use (and when). Use mechanisms which make success and failure explicit with caution (e.g., leader boards), and if providing rewards and punishments (points and badges) ensure the challenge is achievable for all students.

2. Students who can respond appropriately to the game's challenges

Design game like experiences where students are encouraged to find multiple solutions to the same or similar problems. Encourage students to identify the game problem(s) and provide them with time to practice solutions. Importantly, time is equally required to develop process of problem solving itself. If skill execution and technical refinement are the primary objective, provide students with opportunities to practice under varied conditions, unopposed and opposed. In any case, design learning experiences where the challenge level gradually increases once the player becomes more confident and competent (levels). Try to use levels to demonstrate when progress is made because this helps to develop metacognition and has potential to maintain motivation. Be cautious about whether students can level down, as well as levelling up, due to rewards and punishments negating attitudes towards risk taking. Highlight opportunities where students have made effective decisions, and use a range of deliberate teaching and learning strategies to support players' understanding of their skills and decisions. Maximise opportunities for students to discuss their learning with peers, and encourage students to base their decision making on a range of factors which could impact how they outwit the opponent.

3. Students who can think independently and recognise what they need

Games of any kind provide choice to players and choice making encourages better decision making, especially when supported appropriately by a significant other (such as a teacher or peer). The careful design of choices in games (see Figure 2 and Figure 3) should have a purpose, which is linked to the lesson's learning objectives. Therefore, avoid providing

choice to students for the sake of providing choice. Depending on the nature of choices available to students, decision making can be technical, tactical or strategic (or all three!). However, good decision making can only occur if the players have a sound base of declarative knowledge (knowledge about the sport). The teacher must continually judge students' knowledge and their ability to achieve the game's challenge. If knowledge is sufficed, providing players with more control over how the game is played can result in less reliance on the teacher and more accountability for students. Having an option to use the teacher (and other resources) is an idea that develops metacognition (pausing), but students' engagement with this concept may take time to master because it is a high-level thinking skill.

4. Students who know why they deploy certain skills and tactics

For students to execute effective actions in games which outwit their opponent, higher levels of declarative knowledge are required (knowledge about the sport). Therefore, just 'playing games' is unlikely to be sufficient (on its own) for longer term engagement and learning, although it might increase motivation in the short term. When educating students about a sport or game, consider teaching and learning strategies which enable students to understand the reasoning behind skills, tactics and strategies. In addition, showing and telling using tutorials or examples is another possibility for enhancing student knowledge and increasing motivation to learn. Aim to have chunks of a lesson which are fast and dynamic (playing without interruptions) and chunks which are slow and deliberate (playing with some interruptions and structured thought). Fast and slow engagement in games can help to develop metacognition where players are required to verbalise their thinking and actions. Notably, this 'thinking slow to think fast' approach is a common feature of games coaching at the top level (Richards et al. 2017).

For school level groups, this can be integrated into the game design itself by providing choice to students and encouraging collaborative choice making between peers (such as

pausing to change the game design or deciding on a character at the start of a mission). Furthermore, despite which blend of pedagogical tools are being used, plan for and save time to debrief with students at the end of the lesson. This is an opportunity to review progress against goals and primes reflection prior to the next lesson. Students are then more prepared to tackle the challenge again in the next lesson.

Summary

Our aim in this clarification is to explain how a DVGA and Gamification differ both conceptually and mechanically, and to highlight pedagogical nuances. In addition, we aim to recognise where commonalities exist and guide PE teachers towards application of these tools, either in blended and in combination or independently and separately. In doing so, we note the important role of PE teachers and how their knowledge of pedagogy affects students' learning experiences and development of longer-term engagement in playing games. We recognise the skill of teaching is to make informed decisions about which tool(s) to use, how, with whom, when, why (and why not), which is the essence of PCK in PE teaching. This is also the meaning of teaching expertise and has been characterised in sport coaching domains as Professional Judgement Decision Making (PJDM) (Collins and Collins, 2020). Literature from PE teaching continues to advocate for blended approaches for teaching PE so that all students participate in personalised and optimal learning experiences (Casey and MacPhail, 2018; SueSee et al. 2020).

Gamification is an approach to enhance levels of motivation and engagement in the shorter term. In educational settings, self-determination theory (Deci and Ryan, 1985) has been used to understand the impact of Gamification on student behaviours. Gamification in PE has started to explore the use of various video game concepts to sustain students' involvement and commitment to physical activity. Examples of mechanics (rules, challenges, rewards), dynamics (narratives, levels) and components (points, badges, teams) can be used to plan PE lessons which use Gamification.

In contrast, a DVGA has been shaped by concepts from Gee's GGD (2013) which is a game-design teaching and learning approach (Gee and Price, 2021), and is not theoretically driven by motivation. Although longer term motivation will likely be impacted as a result of a DVGA, it is not the primary purpose. The aim of a DVGA is to deepen student understanding and its underpinning mechanism is metacognition. In other words, pedagogical principles of a DVGA (see Table 1) get students to think about their thinking. This leads to more sophisticated problem-solving processes and better decision making about how to make and monitor progress in learning.

Other key distinctions between the approaches include: planning (for objectives and goals); assessment and use of progressions; differentiation strategies; and the role of the teacher in learning. Although there are distinctions, the two pedagogical tools can overlap and be used in combination. Some key similarities include: choice; challenge; and feedback. Both Gamification and a DVGA are shaped by the design of video games. In addition, both tools seek to create learning experiences which engage students in PE and develop their love for playing games.

References

Almond, L. (2015). Rethinking teaching games for understanding. *Ágora Para La Educación Física Y El Deporte, 17(1),* 15–25.

Australian Sports Commission. (1996). Game sense: Perceptions and actions research report. Belconnen, ACT: Author.

Backman, E., & Barker, D.M. (2020). Re-thinking pedagogical content knowledge for physical education teachers – implications for physical education teacher education. *Physical Education and Sport Pedagogy, 25(5),* 451-463. doi:10.1080/17408989.2020.1734554

Bailey, R., Armour, K., Kirk, D., Jess, M., Pickup, I., & Sandford, R. (2009). The educational benefits claimed for physical education and school sport: an academic review. *Research Papers in Education, 24(1),* 1-27.

Blair, R. & Whitehead, M. (2015). Designing teaching approaches to achieve intended learning outcomes. In Capel, S. & Whitehead, M (Ed) *Learning to Teach Physical Education in the Secondary School: A Companion to School Experience.* 4th Edition. London: Routledge.

Brown, G. (1984). Metacognition: New insights into old problems? *British Journal of Educational Studies, 32(3)*, 213–219. doi:10.1080/00071005.1984.9973688

Bunker, D. J., & Thorpe, R. D. (1982). A model for the teaching of games in secondary schools. *The Bulletin of Physical Education*, *18*, 1.

Casey, A., & Kirk, D. (2020). Models-Based Practice in Physical Education. Routledge.

Casey, A., Hastie, P. A., & Rovengo, I. (2011). Student learning during a unit of student-designed games. *Physical Education and Sport Pedagogy, 16(4),* 331-350.

Casey, A., & MacPhail, A. (2018). Adopting a models-based approach to teaching physical education. *Physical Education and Sport Pedagogy, 23(3),* 294-310.

Casey, A., MacPhail, A., Larsson, H., Quennerstedt, M. (2021). Between hope and happening: Problematizing the M and the P in models-based practice. *Physical Education and Sport Pedagogy, 26(2),* 111-122. doi: 10.1080/17408989.2020.1789576

Collins, D., & Collins, J. (2020). Developing coaches' professional judgement and decision making: Using the 'Big 5'. *Journal of Sport Sciences, 39(1), 115-119.* doi: 10.1080/02640414.2020.1809053

554 Colquitt, G., Pritchard, T., Johnson, C., & McCollum, S. (2017). Differentiating Instruction
555 in Physical Education: Personalization of Learning. *Journal of Physical Education,*
556 *Recreation and Dance, 88(7),* 44-50.
557 Deci, E. L., & Ryan, R.M. (2000). "The ''What'' and ''Why'' of Goal Pursuits: Human
558 Needs and the Self Determination of Behavior." *Psychological Inquiry, 11(4),* 227–
559 268.
560 den Duyn, N. (1997). *Game sense: Developing thinking players – a presenters guide and*
561 *workbook.* Belconnen, ACT: Australian Sorts Commission.
562 Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). *From Game Design Elements to*
563 *Gamefulness: Defining "Gamification".* In A. Lugmayr et al. (Ed.), MindTrek 2011
564 (pp. 9-15). Tampere, Findland: ACM.
565 Dichev, C., & Dicheva, D. (2017). Gamifying Education: what is known, what is believed
566 and what remains uncertain: a critical review. *International Journal of Educational*
567 *Technology in Higher Education, 14(9).*
568 Dicheva, D., Dichev, C., Agre, G., & Angelove, G. (2015). Gamification in Education: A
569 systematic mapping study. *Educational Technology and Society, 18(3).*
570 Fernández-Espínola, C., Almagro, B.J., Tamayo-Fajardo. J.A., Sáenz-López. P. (2020).
571 Complementing the Self-Determination Theory With the Need for Novelty:
572 Motivation and Intention to Be Physically Active in Physical Education Students.
573 *Frontiers in Psychology*. doi:10.3389/fpsyg.2020.01535
574 Fernández -Rio, J., de las Heras, E., González, T., Trillo, V., & Palomares, J. (2020).
575 Gamification and physical education. Viability and preliminary views from students
576 and teachers. *Physical Education and Sport Pedagogy, 25(5),* 509-524.
577 Fernández -Rio, J., Zumajo-Flores, M., & Flores-Aguilar. G. (2021). Motivation, basic
578 psychological needs and intention to be physically active after a gamified intervention

programme. *European Physical Education Review.* doi: 10.1177/1356336X211052883

Flavell, J. H. (1979). Metacognition and cognitive monitoring. *American Psychologist, 34(10*), 906–911.

Gee, J. P. (2013). *Good video games and learning*. New York, NY: Peter Lang Publishing Inc.

Gee, J. P., & Price, A. (2021). Game-Design Teaching and Learning, *Strategies: Educator's Corner,* 34, 35-38.

Goodyear, V., & Dudley, D. (2015). "I'm a Facilitator of Learning!" Understanding What Teachers and Students Do Within Student-Centred Physical Education Models. *Quest, 67(3),* 274-289.

Goodyear, V.A., Parker, M., & Casey, A. (2018). Social media and teacher professional learning communities. *Physical Education and Sport Pedagogy, 24(5),* 421-433.

González-González, C. S., Gómez, N., & Navarro, V. (2018). Exploring the benefits of using gamification and videogames for physical exercise: A review of state of Art. *International Journal of Interactive Multimedia and Artificial Intelligence 5(2),* 46–52.

Gould, G., Napela, J., & Migano, M. (2020). Coaching generation Z athletes. *Journal of Applied Sport Psychology, 32(1),* 104-120.

Harvey, S., Pill, S., & Almond, L. (2017). Old wine in new bottles: a response to claims that teaching games for understanding was not developed as a theoretically based pedagogical framework. *Physical Education and Sport Pedagogy.* doi: 10.1080/17408989.2017.1359526

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. Routledge.

Hopper, T. (2007). Teaching tennis with assessment 'for' and 'as' learning: A TGfU net/wall example. *Journal of Physical Health Education, 73(3).*

Hopper, T. (2011). Game-as-teacher: Modification by adaptation in learning through game-

play. *Asia-Pacific Journal of Health, Sport and Physical Education, 2*(2), 3–21. https://doi.org/10.1080/18377122.2011.9730348

Hopper, T., & Bell, R. (2002). Games classification system: Teaching strategic understanding and tactical awareness. *CAHPERD, 66(4),* 14-19.

Hopper, T., Sanford, K., & Hong, F. (2018). Video gaming design: Insights for teaching games for understanding and Sport Education. In book: *Digital Technology in Physical Education: Global Perspectives.* Routledge: Falmer.

Jarrett, K., & Harvey, S. (2016). Similar, but not the same: comparing the game based approaches of Teaching Games for Understanding (TGfU) and Game Sense. *Ejournal de la recherche sur l'intervention en education physique et sport eJRIEPS* [Online], 38. doi:10.4000/ejrieps.900

Jarvis, J.M., Pill, S., & Noble, A.G. (2017). Differentiated pedagogy to address learner diversity in secondary physical education. *Journal of Physical Education, Recreation and Dance, 88(8),* 46-54.

Kapp, K. (2012). Games, Gamification, and the Quest for Learner Engagement. *T+D Magazine, 66(6),* 64–68.

Kim, I., Ward, P., Sinelnikov, O., Ko, B., Iserbyt, P., Li, W., & Curtner-Smith, M. (2018). The influence of content knowledge on pedagogical content knowledge: An evidence-based practice for Physical Education. *Journal of Teaching in Physical Education, 37*(2), 133-143.

Kirschner, P. A., & Hendrick, C. (2020). *How Learning Happens: Seminal Works in Educational Psychology and What They Mean in Practice.* Routledge, Taylor & Francis Group: Florence.

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world.* London: Penguin.com.

Mitchell, S. A., Griffin, L. L., & Olsen, J. L. (2020). *Teaching sport concepts and skills: A tactical games approach.* Illinois, USA: Human Kinetics.

Mosston, M., & Ashworth, S. (2008). *Teaching physical education* (1st online ed.). Retrieved from http://www.spectrumofteaching styles.org/ebook

Pill, S. (2014). What does it mean for pedagogy to think like a game developer? *Journal of Physical Education, Recreation and Dance, 85(1),* 9–15.

Pill, S. (2018). The Game Sense Approach; Developing Thinking Players. In: Runner: *The Journal of the Health & Physical Education Council of the Alberta Teachers' Association. 49(1),* 32-39.

Pill, S., Harvey, S., & Hyndman, B. (2017). Novel research approaches to gauge global teacher familiarity with game-based teaching in physical education: an exploratory #Twitter analysis. *Asia-Pacific Journal of Health, Sport and Physical Education, 8(2),* 161-178.

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. Available online

Pill, S., Hyndman, B., SueSee, B., & Williams, J. (2021). Physical Education Teachers' Use of Digital Game Design Principles. *Journal of Teaching in Physical Education, 40(1),* 1-9.

Price, A., & Pill, S. (2015). Can Gee's Good (Digital) Game Design Features Inform Game-Based Sport Coaching? *Research Journal of Sport Sciences*, 4(8), 257-269. Available online

Price, A., Collins, D., Stoszkowski, J., & Pill, S. (2017). Learning to play soccer: Lessons on meta-cognition from video game design. *Quest, 70 (3),* 321–333.

Price, A., Collins, D., Stoszkowski, J., & Pill, S. (2019). Coaching Games: Comparisons and Contrasts. *International Sport Coaching Journal*, *6(1),* 126-131.

Price, A., Collins, D., Stoszkowski, J., & Pill, S. (2020). Strategic Understandings: An Investigation of Professional Academy Youth Soccer Coaches' Interpretation, Knowledge, and Application of Game Strategies. *International Sport Coaching Journal, 7(2),* 151-162. doi:10.1123/iscj.2019-0022

Price, A. (2021). Digital Video Games as a Game-Based Coaching Tool. In S. Pill. (Ed.). *Perspectives on Game-Based Coaching* (pp. 11-22). London: Routledge.

Price, A., Collins, D., & Stoszkowski. (2021). How do high-level youth soccer player approach and solve game problems? The role of strategic understanding. *Physical Education and Sport Pedagogy.* doi:10.1080/17408989.2021.1967307

Renshaw, I., Araújo, D., Button, C., Chow, J. Y., Davids, K., Moy, B. (2015). Why the Constraints-Led Approach is not Teaching Games for Understanding: A Clarification. *Physical Education and Sport Pedagogy, 21(5),* 459-480.

Richards, P., Collins, D., & Mascarenhas, D. (2017). Developing team decision-making: a holistic framework integrating both on-field and off-field pedagogical coaching processes, *Sports Coaching Review, 6(1),* 57-75. doi: 10.1080/21640629.2016.1200819

Ryan, R. M., & Deci. E.L. (2017). *Self-Determination Theory: Basic Psychological Needs in Motivation, Development and Wellness*. New York: Guilford Press.

Salen, K., Torres, R., Wolozin, L., Rufo-Tepper, R., & Shapiro, A. (2011). *Quest to Learn: Developing the school for digital kids.* The MIT Press: Cambridge.

Shulman, L.S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-22.

677 Simões, J., Redondo, R. D., & Vilas, A. F. (2013). A social gamification framework for a K-6
678 learning platform. *Computers in Human Behavior, 29(2),* 345–353.
679 Sotos-Martinez, V.J., Ferriz-Valero, A., Garcia-Martinez, S., & Tortosa-Martinez, J. (2022).
680 The effects of gamification on the motivation and basic psychological needs of
681 secondary school physical education students, *Physical Education and Sport*
682 *Pedagogy.* doi:10.1080/17408989.2022.2039611
683 SueSee, B., Hewitt, M., & Pill, S. (Eds.). (2020). T*he spectrum of teaching styles in physical*
684 *education.* Routledge.
685 SueSee, B., Pill, S., Davies, M., & Williams, J. (2021). "Getting the Tip of the Pen on the
686 Paper": How the Spectrum of Teaching Styles Narrows the Gap Between the Hope
687 and the Happening. *Journal of Teaching in Physical Education.*
688 doi:10.1123/jtpe.2021-0164
689 Tomlinson, C. A. (2001). How to differentiate instruction in mixed-ability classrooms.
690 Alexandra, VA: Association for Supervision and Curriculum Development.
691 Thorpe, R. D., Bunker, D. J., & Almond, L. (1986). *Rethinking games teaching.*
692 Loughborough University of Technology.
693 Twenge, J. M. (2017). IGen: *Why today's super-connected kids are growing up less*
694 *rebellious, more tolerant, less happy–and completely unprepared for adulthood–and*
695 *what that means for the rest of us.* New York City, NY: Simon and Schuster.
696 UNESCO. 2015. Quality Physical Education Guidelines for Policy-makers. Paris: UNESCO.
697 Werbach, K., & Hunter, D. (2012). *For the win: How Game Thinking can Revolutionize Your*
698 *Business.* Philadelphia: Wharton Digital Press.
699 Ward, P. (2014). A response to the conversations on effective teaching in physical education.
700 *Research Quarterly for Exercise and Sport, 85,* 293-296. doi: 10.1080/0270136
701 7.2014.933653

Williams, J., Pill, S., Hewitt, M. (2021). 'I think everyone is on board with changing how we do things, but we are yet to find a best fit model': A figurational study of assessing games and sport in physical education. *Sport, Education and Society, 26(3),* 253-266. doi:10.1080/13573322.2020.1716212.

Zichermann, G., & Cunningham, C. (2011). *Gamification by Design.* O'Reilly.

Table 1: ***Pedagogical Principles of DVGA linked to Gee's (2013) Features of Good Game Design (GGD)***

Pedagogical Principle and Definition	Design Feature	Design Feature	Design Feature	Design Feature	Design Featur
Missions: subject specific learning objectives are not used, and instead students are set a mission (goal), which will involve a range of skills and knowledge.	Skills as Strategies	System Thinking	Identity	Meaning as Action Image	Co-design
Level-Ups: as students solve problems, the game becomes more complex. This is their feedback on progress, and failure says something about what might work next time.	Cycles of Expertise	Well-Ordered Problems	Pleasantly Frustrating	Fish Tanks	Information Just In-Time & On-Deman
Super Powers: students earn something to make them more effective for a short period of time. This opens up the game to see in ways they couldn't have otherwise have seen.	Manipulation and Distributed Knowledge	Meaning as Action Image	Co-design	System Thinking	Skills as Strategies
Pauses: students can decide when and how they require the teacher. The "4 C's" framework for pausing offers a continuum of teaching & learning options.	Co-design	Customise	Information Just In-Time & On-Demand	System Thinking	Pleasantly Frustratin
Saving Progress: students can decide when to save what they've already learnt, and students revisit the game from the point to which they finished last time.	Sand Boxes	Customise	Co-design	System Thinking	Pleasantly Frustratin

725

Figure 1: ***DVGA & Gamification: differences and similarities***

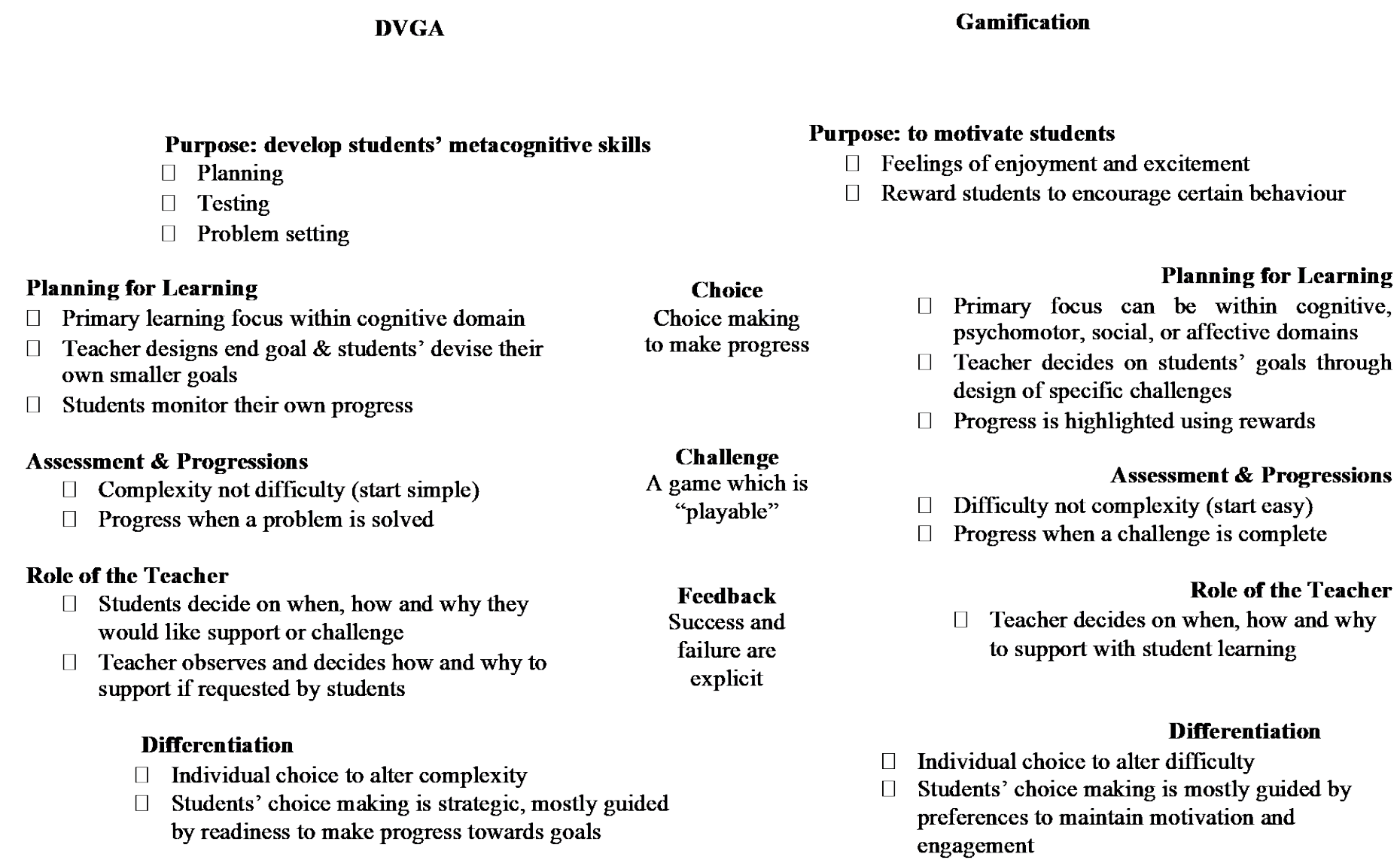


Figure 2: ***Example of DVGA in Soccer***

Mission: to stay in control on both pitches!

Level Up: if your team wins on both pitches
Level Down: if your team looses on both pitches
Tutorial test the games out
Level 1 choose one player who can play on both pitches
Level 2 choose two players who can play on both pitches
Level 3 choose three players who can play on both pitches
Level 4 choose four players who can play on both pitches
Level 5 choose five players who can play on both pitches
Etc.
Boss Level on both pitches, win, without conceding in the last 2 mins

Super Power: earn power by holding the bib when your team have possession of the ball

Ghost
play in wide lane unopposed (two touch max)

Save Progress: one opportunity to save on a level (can't level down)

Game Pauses: decided by the player or team

Cheat	**maximum support** *last goal wins*
Change	**impact the opponent** *decide which opposition player can play on both pitches*
Clue	**teaching moment** *teach what you think will help students to make progress*
Challenge	**stretch ourselves** *non foul restarts awarded to the opponent*

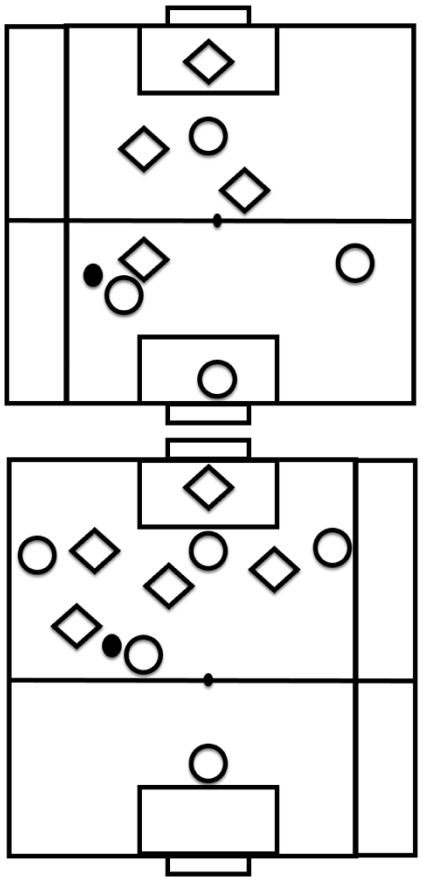


Figure 3: ***Example of Gamification in Soccer***

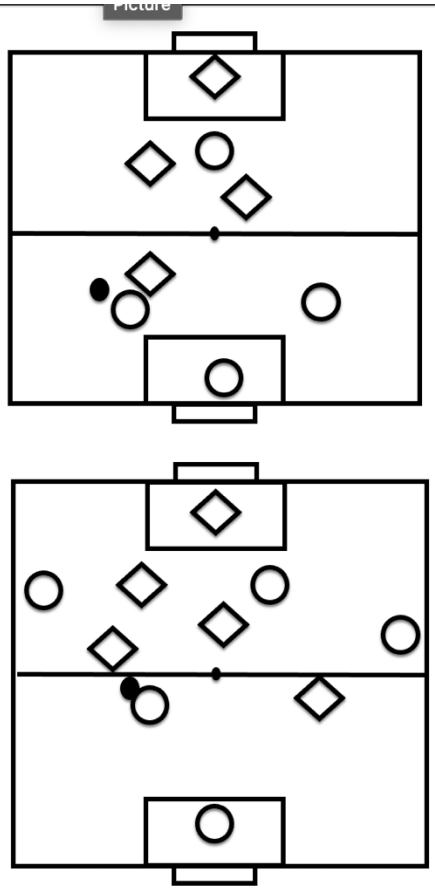
Objective: to press the ball as early as possible

Level Up: if your team regain possession
Level Down: if your team concede possession
Level 1 regain once
Level 2 regain twice
Level 3 regain three times
Level 4 regain four times
Level 5 regain five times
Etc.
Challenge to regain in less than 6 seconds!

Badge: your team is awarded a badge for regaining the ball in your attacking half and then scoring a goal.

Roll the Dice: your team can choose to roll the dice at the start of every level. Whatever number it lands on is the number of times your team must regain possession to level up!

Leaderboard: you can be at the top of the leaderboard for regaining the ball the most!



739

740

742

743

744