Developing competencies by playing digital sports-games

Rolf Kretschmann

(Department of Sport and Exercise Science, University of Stuttgart, Stuttgart 70569, Germany)

Abstract: The idea of digital game-based learning (DGBL) is that students (or players) learn something by playing a computer or video game and that an educator can employ digital games to assist and boost both formal and informal learning. There is game software that is not specifically produced for educational use but which is nonetheless regularly implemented in educational settings by educators. These so-called COTS (commercial off-the-shelf) games are particularly effective in socialization processes. COTS sports computer and video games can be divided into three main categories: sports simulation games, sports arcade games and sports management games. After taking a closer look at these sports computer and video games, specifically sports simulation games, it is possible to posit dimensions of competencies that are developed by playing those games. Various examples for each dimension of competencies can be generated: motor competence, cognitive competence, meta-cognitive competence, social competence, emotional competence, personal competence and media competence. Furthermore, examples of implementing digital sports-games in physical education can easily be generated. After comparing the postulated dimensions of competencies of COTS digital sports-simulations with those of "real" sports, the following question arises: Are their respective educational results comparable?

Key words: game-based learning; physical education pedagogy; sport pedagogy; competence development; sports computer-games; sports video games; digital sports games

1. Introduction

Computer and video games have become important in today's leisure time (Kirriemuir & McFarlane, 2004). Nearly all "digital natives" (Prensky, 2001) have gathered experience in diverse computer and video games. There are plenty of approaches within the scientific world attempting to utilize the hypothetical fact that such media have an enormous impact on the socialization of the youth (and adults as well). These game-based approaches are subsumed within the term "digital game-based learning" (DGBL). The idea is that students (or players) learn something by playing a digital game and that an educator can employ digital games to assist and boost both formal and informal learning.

Serious "game scientists" appeal for different kinds of settings. The use of digital games in education differs depending on the type of software. On the one hand, there is specific software that is designed for educational use involving a game-based approach produced by professional manufactures specialized in this kind of software or produced by the educators themselves using simple means (e.g., commercial office applications or tools). On the other hand, there is game software that is not specifically produced for educational use but implemented in the educational process by educators. These so-called COTS (commercial off-the-shelf) games allow ample opportunities for the development of competencies in educational affairs.

Rolf Kretschmann, assistant professor, Department of Sport and Exercise Science, University of Stuttgart; research fields: sport pedagogy, media pedagogy, sport philosophy.

Game researchers like Aldrich (2005), Kirriemuir and McFarlane (2004), Gee (2003), Prensky (2001; 2006), Johnson (2005), Shaffer (2006), etc., focus on the entire sphere of the game world. The focus of this paper is on the area of interest as a representative of sport science, physical education and sports pedagogy: sports computer and video games. The question whether electronic sports (e-sports) is sports or not, or whether an electronic athlete (e-athlete) is a "normal" athlete will both not be covered. The main focus is on digital games which are connected with the subject sport by means of their content and game-play.

For outlining the pedagogical benefit, it is not enough to highlight the trivial fact that an experienced digital game player is more skilled in digital gaming than a beginner. The analysis of potential pedagogical outcomes needs a more differentiated model.

Thus the aim of this paper is to posit competencies developed by playing COTS sports computer and video games and to compare them with those developed by "real" athletes playing "real" sports. Moreover, the limits of current scientific research will be delineated, making clear the areas where further, more sophisticated and interdisciplinary research is necessary.

2. Types of sports computer and video games

Sports games are platformed on various hardware systems such as personal computers, consoles (e.g., Sony Playstation, Nintendo WII, Microsoft Xbox), and handhelds (e.g., Sony Playstation Portable or Nintendo DS) as all computer and video games are. Mobile phones and PDAs (Personal Digital Assistant) also offer platforms for sports games. Video arcades hosting a variety of game types, including sports-games, are also of concern.

Plenty of attempts at categorizing digital games into general genres have been made (Wolf, 1995; Fritz & Fehr, 2003), but these generally lack in precision and differentiation when it comes to the categorization of digital sports games. Kayali and Purgathofer (2008) tried to differentiate the genre of digital sports games into sub-genres: extreme sports game, fun sports game, sports simulation, team sports simulation and deep sports simulation.

To establish a simple model of digital sports games sub-genres, the ensemble of sports-games can be divided in three main categories: sports simulation games, sports arcade games and sports management games. These terms cannot be strictly defined, however, due to the broad and multi-faceted game-play and content some sports games have. These result in some games fitting into more than one category.

The following categorization relies on the constitutive elements of the specific sports game analyzed. Where a game series exists (FIFA, 1994-2009), only the latest title is referred to. Games for mobile phones and PDAs are not mentioned because, strictly seen, they are not COTS computer and video games. Only a brief overview is intended; the lists do not claim to be complete.

The special case of exergames (games that also provide exercise) will not be discussed because the following categorization is not affected by different user interfaces. The same game that is platformed on Nintendo Wii, Playstation or PC gets categorized the same way for each platform.

2.1 Sports simulation games

Sports simulation games have the aim to replicate (or to simulate) real-life situations within the world of sports in a computer or video game. This simulation is based on real life and details as many essentials and key features possible that a specific sport has in reality. The fidelity of the simulation is very important and is supposed to be as high as possible. Each player has the opportunity to take direct influence on game-play by means of a user interface (controller, keyboard, etc.) with all of the complexity of the computerized simulation.

The main difference to sports arcade games is the aim to represent all key features and scopes of a specific sport through software (e.g., realistic copy of racing tracks or racing gear, realistic replication of specific techniques). The gap between the skills of a beginner and an experienced gamer is very big.

Here are some examples: NASCAR 09 (driving), F1 Championship Edition (driving), Tiger Woods PGA Tour 09 (golf), World Snooker Championship 2009 (snooker), FIFA 09 (soccer), Fight Night Round 4 (boxing), Madden NFL 09 (American football), NBA Live 09 (basketball), NHL 09 (ice hockey), SSX Blur (snowboarding), Tony Hawks Project 8 (skateboarding) and Virtua Tennis 3 (tennis), etc.

2.2 Sports arcade games

Sports arcade games focus mainly on a specific sport itself and its constitutive sportive action and physical activity. They are referred to as action gaming and fun gaming and have simulation game characteristics in focusing on selected essentials of a specific sport. The main emphasis, however, is on action gaming. Specific to sports arcade games is their aim to allow a fluidly ongoing and easily manageable game-play, reducing the real sports complexity in the digital game (e.g., all kinds of shots in soccer are initiated with a single button on the controller; tennis characters running paths are controlled by the computer and the player only has to manage the racquet action). Fictional characters and unrealistic human body movement, as well as intuitive handling of interface and easily obtainable win-states are typical for this type of digital sports game. The gap between the skills of a beginner and an experienced gamer is small.

Here are some examples: Wii Sports Bundle (bowling, boxing, golf and tennis), Mario and Sonic at the Olympic Games (archery, athletics, gymnastics, table tennis and skeet shooting), mobile phone games, browser games (mini games that have a small size of bytes and that can easily be embedded in a web page being able to be player in a browser window).

2.3 Sports management games

Sports management games are to be placed in the category of role-playing games. The user (or player) assumes the leadership of a sports club or an athlete and has to deal with all the reality-based problems a person in that role has (e.g., economics and financials). Compared to sports simulations and sports arcade games, sports management games have almost real-life complexity but only from the view of a person in a leading position. They do not allow the user to intervene in the specific sports action “on the court” by playing an athlete in certain situations.

Here are some examples: Box Sport Manager (boxing), FIFA Manager 09 (soccer), Football Manager 09 (soccer), NFL Head Coach (American football).

3. Dimensions of competencies in digital sports games

Gaming literature states several positive learning outcomes: the development of social skills (McFarlane, Sparrowhawk & Heald, 2002; Dondi, Edvinsson & Moretti, 2004), school achievement, cognitive abilities, and motivation towards learning (Rosas, et al., 2003), attention and concentration, complex thinking and strategic planning (Kirriemuir, 2005a; 2005b), information retrieval and multi-disciplinary skills (Mitchel & Savill-Smith, 2004), logical and critical thinking and problem solving skills (Inkpen, McGrenere, Booth & Klawe, 1997; Higgins, 2001; Rieber, 1996; Whitebread, 1997), collaboration with others (Williamson & Facer, 2003), meta-cognition skills and strategic decision-making skills (Bonk & Dennen, 2005), eye-hand coordination skills and rule learning (Dondi, et al., 2004), communication, team-building skills and strategic thinking (Dondi, et al.,

2004), spatial skills (Calvert, 2005; Gunter, 2005), sound learning (Gee, 2003), gross motor and fine motor skills (Becker, 2007), meta- /memorial- skills (Gunter, 2005), and rules (Juul, 2005).

This list could be drawn out even longer for digital games in general. However, the research and scientific models lack applicability to digital sports games which are the subject of this paper. Therefore, this chapter uses digital sports games as the initial point for creating a model of competencies. After taking a closer look at COTS sports computer and video games, specifically sports simulation games, it is possible to posit dimensions of competencies that are developed by playing those games. Various examples for each dimension of competencies can be generated.

Sports simulation games build the basis of the following model of developing competencies simply because they are closer to the actual sports performance of an athlete by trying to replicate it. Sports arcade games with humorous characteristics are not considered due to their lack of reality and their being based on fictional characters and settings. Sports management games are not considered because they lack the essential activity of controlling a sports character “in action on the court”.

The main competence of decision-making and responsibility is at the center of the model and subsumes the partial competencies shown in Figure 1. Every action of the user or player in conjunction with digital sports-games, especially sports simulation games, is based upon these competencies: motor, cognitive, meta-cognitive, social, emotional, personal and media competence.

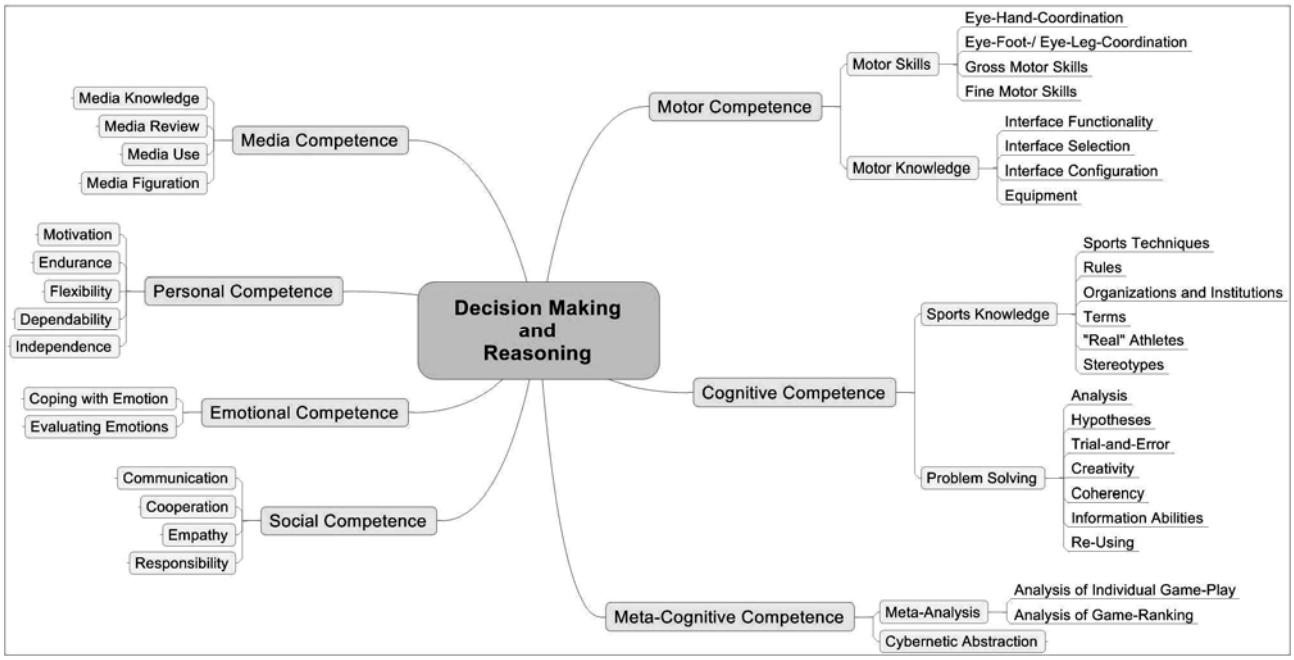

Figure 1 Dimensions of competencies in digital sports games

3.1 Motor competence

Motor competence subdivides into motor skills and motor knowledge.

Motor skills include sensorimotor coordination embracing eye-hand-coordination (e.g., screen action in coordination with mouse/keyboard/joypad/steering wheel) and eye-foot- /eye-leg- coordination (e.g., dance mats, accelerator pedal), gross motor skills (e.g., upper body and arm movement using a steering wheel, following and imitating/copying the movement of the controlled character on the screen), and fine motor skills (e.g., using

keyboard, mouse, joypad, steering wheel and accelerator pedal).

Motor knowledge includes user interface functionality (e.g., labeling buttons and controller directions using controller specific terms), user interface selection (e.g., selecting mouse or keyboard according to game efficiency), user interface configuration (e.g., individual configuration of joypad according to game efficiency and individual preferences), and equipment: knowing technical equipment dealing with the game and platform (e.g., special joypads, cables and batteries).

3.2 Cognitive competence

Cognitive competence subdivides into sports knowledge and problem solving.

Motor sports knowledge includes knowledge about sports techniques (e.g., jump shot or a slam dunk in basketball, header in soccer), rules (e.g., three-seconds-rule in basketball, offside in soccer), organizations and institutions (e.g., league system in soccer or basketball), specific terms used in a sport (e.g., slam dunk or lay up in basketball, commentator "slang"), and "real" athletes which includes real persons (e.g., David Beckham in soccer, Kobe Bryant in Basketball), and stereotypes of body images and clothes of a sport (e.g., height and weight, shirts and shorts, shoes), and typical sounds (e.g., the "swish" of basketball falling through the net of a successful shot, fan choirs in soccer stadiums).

Problem solving includes analysis (e.g., opportunities of action a basketball player has: shoot, pass or dribble), building hypotheses (e.g., basketball: faking a jump-shot brings the opponent into off-balance), trial-and-error (e.g., testing the developed hypotheses), creativity (e.g., soccer: searching for and trying different tactics to score), coherency (e.g., basketball: players are getting tired and performance is lagging when there is no exchange of players), information abilities (e.g., using the internet to find solutions to problems within a game), and re-using (e.g., using a specific tactic to win or score again).

3.3 Meta-cognitive competence

Meta-cognitive competence subdivides into meta-analysis and cybernetic abstraction.

Meta-analysis includes the analysis of individual game-play (e.g., specific tactics in a game or the most likely played parts and tournaments in a game) and the analysis of the ranking a digital sports game has in relation to other activities in a player's life.

Cybernetic abstraction means having awareness of all competence dimensions and the (possible) connections between them.

3.4 Social competence

Social competence includes the (soft) skills of communication (e.g., using sports-games as communicative vehicle to talk about, chatting with other players while playing in online leagues), cooperation (e.g., in team sports games, you have to cooperate with your teammate, especially when he or she is controlled by a real person and not by the computer), empathy (e.g., to feel empathy for a "real" opponent who has lost in a game), and responsibility (e.g., identification with a character played in a game: The player is the causer of a certain character action in the game and no one else).

3.5 Emotional competence

Emotional competence includes coping with emotions (e.g., the immersive character of computer and video games, success and disappointment, handling pressure and nerves and flow) and evaluating emotions (e.g., the question whether disappointment in the game affects disappointment in real life, mood management which allows identification of specific games or parts of games as the cause of good or bad emotions).

3.6 Personal competence

Personal competence includes motivation (e.g., winning a tournament, beating a certain opponent and game-based character of games in general), endurance (e.g., a soccer season has an amount of games to play that cannot be finished in one day), flexibility (e.g., time management: when and with whom to play the game?), dependability (e.g., every mistake causes instant feedback in a game), and independence (e.g., while playing a game the player is on his own to explore and play the game and to cope with game requested actions).

3.7 Media competence

Media competence includes media knowledge (e.g., knowing different kinds of platforms, types of games and representations in mass media), media review (e.g., criticism of illogical game-play or ethical implications), media use (e.g., using the computer system Microsoft Windows), and media figuration (e.g., creating and designing an own player or own challenges and tournaments).

4. Dimensions of competencies in digital sports-games from the view of sports science and physical education pedagogy

Reviewing the postulated dimensions of competencies and specifications with tangible examples, a strongly positive appraisal of digital game-based learning through sports computer and video games emerges. Nonetheless, from the perspective of a sports scientist and a physical education researcher, the question of the obsoleteness of real sports activities arouses—especially regarding the enormous potentials in competency development players of digital sports games have. The question as to the specificity of developing competencies through digital sports games as compares to that of non-sport-content digital games remains. To sidestep this problem the author will exemplarily concentrate on the competence dimensions obviously related to sports by their sports content: motor and cognitive competence. These both are also developed in real sports; the ends (the above-mentioned competencies) are the same; the means (the specific activities) are different.

Digital athletes and real athletes both have dimensions of competencies in common, but digital athletes clearly have less bodily movement than real athletes (e.g., a person playing a digital basketball game compared to a person playing in a real basketball game). When focusing on motor knowledge, therefore, it is necessary to account for diverging concepts of movement. Both movements are “real”, but the real athlete is not acting in the same range of physical activity that the digital player and the character, he or she controls on the screen does. Hence, the real basketball player (some less, some more) knows the movements and techniques he or she is doing through physical action itself. The digital game player knows only his or her “finger action”.

Through his or her cognitive competence, the digital player makes up for a possible lack of motor knowledge of real sports techniques. He or she can claim the same cognitive and theoretical knowledge level as the real sports player. The digital player might even surpass the real player in knowledge about real sportive personalities, commentators and information abilities (This is mere speculation).

To abbreviate the discussion of all dimensions of competencies and their examples, the parallelism of the dimensions and content between digital sports games and real sports cannot be overseen. However, the main difference of lack of motor activities cannot be overlooked either. A wide field of scientific research is certainly necessary and the developed model serves as a starting point for further analysis.

5. Integrating digital sports games in physical education and training

Although Mitchell, McKethan and Mohnson (2004), and Mohnson (2008) describe dance mats in the game

DDR (Dance Dance Revolution), Gamebike (cycling fitness device connected with a digital cycling game), Nintendo Wii, and Playstation, only the use of dance mats in physical education is forwarded. In general, scanning through literature and searching for the implementation of digital sports games in physical education is to no avail, but one can easily form scenarios in the field of physical education and training.

Relating to the cognitive competence sports knowledge and its subcategory sports techniques, a digital sports game can be used to illustrate the wealth of techniques in a sport and its inner rules. For example, a basketball beginner can experience different types of shooting (dunk, jump shot, set shot, hook shot and lay up) in the basketball game NBA Live 2009. Therefore, the beginner gets a notion of the "right" techniques and of the situations where these techniques are applied. Experiencing and knowing different kinds of shooting in the digital game, which would probably not appear in a beginner basketball game in real life, could be an initial point for building motivation to work on those techniques in the real world for real basketball games.

Relating to the subcategory rules, NBA Live 2009 gives a true example that what kinds of rules are essentiall for the game of basketball. Digital players come to know about court limitations, time limits, fouls, exchange rules, etc., and what happens if those rules are violated. The CPU does not make mistakes. If you do not shoot within 24 seconds, it is a shot clock violation. The advantage of learning those rules on the digital court lies in reduction. On the "real" court, the beginner is overstrained with applying new rules while managing motor behavior and cognitive thinking of rules.

Relating to the cognitive competence problem solving and its subcategories analysis, building hypotheses, trial-and-error, and re-using, beginners can figure out tactical means in the digital game without pressure to succeed which is normally experienced as high on the real court. In NBA Live 2009, the player can analyze the possibilities the played character has shoot, pass or dribble. Shooting is allowed wherever the basketball player is located on the court. The idea of basketball is to make baskets (or to make more baskets than your opponent). The digital player can build the hypotheses that it is more successful to take a short distance shot compared with a long distance shot. After testing this hypothesis and having approved it, the player can re-use this strategy in upcoming games. The same process is to be considered for certain group tactics (e.g., pick and roll, give and go) and plays. Furthermore, the digital player can employ the experienced tactics on the virtual court for his or her action on the real court. Successful strategies in the digital games can now be tested and applied in the real games.

Teachers can support the learning process by using digital sport games in physical education classes by giving tasks in analyzing the variety of techniques and their structures, rules and their violations, or exploring successful tactics in the game. Moreover, homework and student presentations focusing on these tasks can also be established by the educator. However, the main focus has to be on transferring digital game experience into real life basketball. The connection or parallelism of digital and real games has always to be made clear to the students.

6. Future prospects of scientific research in sport science and physical education pedagogy using a digital game-based learning approach

The apparent parallelism between the two "worlds" of sports and digital sports gaming needs an empirical foundation. There is a lot of space open to work on. Especially hypotheses of transfer effects should be examined carefully and need a sophisticated research design. In this direction of thinking, there are four possible opportunities for developing competencies: (1) There is a (strong or less strong) influence on real sports by digital

sports-games; (2) There is a (strong or less strong) influence on digital sports games by real sports; (3) There is a (strong or less strong) interaction and interdependency between real sports and digital sports games; (4) There is no (strong or less strong) influence, neither on digital sports games by real sports nor on real sports by digital sports games.

From a physical education point of view, all competence dimensions generated by sports computer and video games are also intended in physical education. Physical educators (and sport scientists) should sensibly construct didactic settings implementing digital (COTS) sports games to effectively utilize their immense power in providing informal learning within sealed formal settings. Increasing individual motivation towards learning by combining the enjoyable with the intended is an important educational perspective.

In view of the central importance information and communication technologies have, and especially considering the mass influence computers and consoles have on the leisure time of the generation of so-called "digital natives" (and "digital immigrants") (Prensky, 2001), why not use these media in physically educating these "natives" and "immigrants"? In achieving educational goals such as lifelong learning and lifelong sporting, technologies such as digital sports games must be recognized. It is ultimately possible that digital game players may even be more likely to engage in sports than non-players (Phillips, Rolls, Rouse & Griffiths, 1995).

The author does not plead for abolishing physical action and movement, and replacing these with digital action and movement. Rather, the author pleads for formal and sensible inclusion of the latter in traditional and physical education contexts due to the parallelism within the dimensions of competencies. In the near future, game developers and physical education researchers should collaborate to make digital COTS sports games more effective in supporting traditional physical education. Efficient learning or development of competencies offers an opportunity for digital game-based learning to enter the world of "real" sports.

Another open question arises from the connection between fidelity and (motor) learning. How do sports simulation games support motor learning compared with sports arcade games? Is realistic motion of user interface (e.g., Wii remote controller) in exergames conducive for motor learning?

In conclusion, the developed model of competence dimensions can easily be used to analyze the pedagogical benefits of a digital sports game. The question: "What is it that one can learn by playing digital sports games?" can now be answered by using the provided competence model. Next the specific development of competencies of a certain sport simulated by a digital game could be compared with the specific development of competencies of the same "real" sport. Future researches will have to focus on empirical evidence of pedagogical implications and transfer effects in the field of digital sports games, including clear documentation and evaluation of didactic arrangements in physical education courses and training.

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