LEARNING *IN* OR *WITH* GAMES? QUALITY CRITERIA FOR DIGITAL LEARNING GAMES FROM THE PERSPECTIVES OF LEARNING, EMOTION, AND MOTIVATION THEORY

Jan Hense[1] and Heinz Mandl[2]
Ludwig-Maximilians-Universität München, Dept. Psychology
Leopoldstr. 13, D-80802 München, Germany;
[1]+49 89 21803257 / [2]+49 89 21805145

ABSTRACT

This conceptual paper aims to clarify the theoretical underpinnings of game based learning (GBL) and learning with digital learning games (DLGs). To do so, it analyses learning of game related skills and contents, which occurs constantly during playing conventional entertainment games, from three perspectives: learning theory, emotion theory, and motivation theory. It is assumed that by an analysis of the processes leading to implicit learning in conventional digital games, the underlying principles can be made explicit and subsequently used for designing DLGs effective for curricular learning. Theoretical approaches which are used in the analysis include behaviorism, cognitivism, individual and social constructivism for the perspective of learning theory. For the perspective of emotion theory, research on learning related effects of positive and negative emotion is used, and for the perspective of motivation theory constructs and approaches such as self-efficacy, locus of control, interest and self-determination theory are drawn upon. All of these theoretical perspectives help to understand how players of conventional entertainment games acquire a wide range of skills and contents while playing, and why they do so with immense motivational and emotional involvement. The results of the theoretical analysis are subsequently used to deduct criteria and guidelines for designing and applying digital learning games as powerful learning environments. Early experiences derived from the checklist's application are reported.

KEYWORDS

Game based learning; digital learning games; theory; learning; emotion; motivation

1. INTRODUCTION

Game based learning (GBL) or learning with digital learning games (DLGs) has been one of the most discussed and propagated forms of media based learning in recent years. Some programmatic authors (e.g. Gee, 2007; Prensky, 2007) are extremely optimistic in regard to the potential benefits of GBL, and there is a growing corpus of empirical research on educational uses of DLGs (e.g. Shelton & Wiley, 2007; Tobias & Fletcher, 2011). However, little effort has been spent until now in systematically analyzing the theoretical underpinnings of learning with digital games (cf. Moreno-Ger et al., 2008).

This theoretical paper aims at closing this theory gap in research on DLGs. This seems a particularly important task, as at the moment there is little but experiential knowledge on what makes a DLG effective for learning. Methodologically, therefore we will analyze learning in conventional digital games from the theoretical perspectives of learning theory, emotion theory, and motivation theory. Undoubtedly, players of conventional digital games are often acquiring a range of skills and contents while playing, and they do so with immense motivational and emotional involvement. It is assumed that by an analysis of the processes leading to these kinds of implicit learning, the underlying principles can be made explicit and subsequently used for designing effective DLGs. Accordingly, we will subsequently deduce criteria and guidelines for the design and application of effective DLGs from the previous theoretical analysis. We conclude with an outlook on possible applications and further challenges for the theoretical foundation of learning with and in digital learning games.

2. THE PROMISE OF DIGITAL LEARNING GAMES

After a period as the "new kid on the block", digital learning games have been developing into the next "big thing" in the area of media based education approaches. Similar to earlier trends such as e-learning, many have set enormous expectations in this area. On one hand, these expectations relate to profitability aspects, as the market for DLGs is believed to have an enormous potential for growth (see Picot/Zahedan/Ziemer 2008). On the other hand, even greater are the expectations of some advocates of digital learning with computers in regard to their potential for educational effects.

Authors such as Gee (2007) or Prensky (2007; 2011) are at the helm of this movement. Their simple, but also persuasive argumentation is as follows: computer games that originally were only designed for entertainment purposes most often invoke substantial learning processes in players, which vary depending on the nature of the game. For example, action and racing games are expected to increase motor and perception skills, while design and strategy games will increase forward-planning skills, and adventure games can foster complex problem-solving skills. In addition, depending on the background story and scenario of the game, users may acquire substantial content knowledge as well. This can occur through the challenging complex tasks of a special force commando team in the context of a tactical "Ego-Shooter", or players may develop knowledge of history through historically-based trade or strategy games. According to the proponents of this line of argumentation, all these learning processes occur without the learner feeling as if the process is difficult, burdensome or uncomfortable. On the contrary, digital games are able to generate an enormous amount of motivation which leads to intensive, sustained and emotional engagement with the game contents and mechanisms. To some degree, this engagement can extend far beyond the reaches of the game, either when users create online communities to exchange information about the game or when they develop their own game content in the form of "mods" (modifications).

Advocates of games such as Gee or Prensky also argue that the undeniable potential of digital games to promote unsystematic and implicit learning processes can also be intentionally and directly used to facilitate the acquisition of curricular subject matter. They often refer to showcase model projects such as, to name one example, the program "Revolution" (www.educationarcade.org/node/357), which is based on a modification of the 3D role play "Neverwinter Nights". Set in the context of the American Revolutionary War, players of this game are able to experience social situations firsthand in order to develop historical knowledge about this time period (see Forman 2004). In this visually and technically well developed MMORPG (Massively Multiplayer Online Role Playing Game) learners are able to take on a variety of roles such as farmer, artisan or slave and move around in an authentic Williamsburg setting and interact with other human players as well as computer-controlled NPCs (Non Playing Characters). In the context of game episodes (chapters), a story thread is generated that enables users to better understand the path to revolution.

As impressive as milestone projects such as "Revolution" and others may seem, the question remains as to whether the principle can truly be applied on a broader scale, such as the proponents of DLGs claim to be the case. Setting aside the question of the resources needed to develop such complex learning games, the main problem concerns didactic quality. For without a doubt, it is not the games themselves that are effective for learning per se. This can easily demonstrated by drawing on negative examples of expensively designed DLGs which not necessarily provide an effective learning environment (cf. O'Neil et al. 2005).

3. LEARNING IN CONVENTIONAL ENTERTAINMENT GAMES

In order to answer questions regarding the quality of DLGs, we first need to have a better understanding of the learning processes that take place while playing the games (cf. Garris, Ahlers & Driskell, 2002). It makes sense to first analyze games that are intended not for learning but for entertainment purposes as the idea is to take the mechanisms that are effective for learning from conventional digital entertainment games and transfer them to the development of digital learning games. In addition, when analyzing computer games from the perspective of theory, it is important not only to look at aspects pertaining to teaching and learning theory, but also to consider at the motivational and emotional perspectives that play an important role while playing these games (see Bartlett et al., 2009).

3.1 A Learning and Instruction Theory Perspective

The first theoretical perspective used in this analysis is the perspective of learning and instruction sciences. Here, different theoretical approaches can be used to analyse the mechanisms which foster learning in games. The most important are behaviorism, cognitivism, individual and social constructivism (Hense & Mandl 2009; Woolfolk, 2004). In our context, these do not preclude one another. Instead they should be regarded as complementary, since the learning mechanisms proposed by the different theoretical approaches can be relevant for different learning goals and outcomes. Furthermore they may be activated to varying degrees in different game types and genres.

Starting with the *behaviorist perspective*, many games teach new skills and contents via operant conditioning with its main principles of positive reinforcement and punishment. Reinforcement in games is often realized by successfully mastering a sequence of tasks or levels, by collecting some kind of tokens or symbolic currency, or by beating a high score. Punishment, on the other hand, can consist in losing a virtual life, failing a level, losing a position in a race or ranking, or by being defeated by either a human or computer-controlled opponent. These behaviorist principles are most dominant in action, racing and sport games which need a lot of motor and perception skills with little cognitive processing. Here the players are continually receiving immediate feedback about the success or failure of their actions. Accordingly, behaviorist learning mechanisms can be expected to be most effective in terms of practicing and repeating routines, primarily in the areas of perception and motor skills, but they can potentially also be useful for the acquisition of factual knowledge.

From a *cognitive perspective*, as represented for example by the instructional design approach (e.g. Reigeluth, 1983), there are many digital games that can mainly be viewed as problem-solving activities and accordingly can train learners' problem solving skills in different content domains. This generally occurs when the players use the information that is embedded either within the game context or the game scenario to more or less solve complex cognitive problems. Games that operate on this principle contain a strong narrative component and players often have to decide between various potential solutions or alternative paths. Adventure and role playing games are classical applications for these principles. In addition to helping players build problem-solving skills, these kinds of games can also be used to foster knowledge acquisition and increase comprehension. This is accomplished by providing information within the narrative of the game, which needs to be applied to the solution of a given problem.

From a *individual-constructivist perspective* (e.g. Brown, Collins & Duguid, 1989; Resnick, 1989), games may be regarded as providing a rich, authentic and immersing environment for self-directed, discovery-, inquiry- or problem-based learning activities. The prerequisite for this are challenging tasks or problems that players regard as authentic and relevant, either in relation to the reality of the game that they can to relate to, or in relation to their own experiences. Based on such problems, the game then allows the player to analyze the situation and to test out a variety of solutions, as well as gain experience with and reflect on a specific subject area or phenomenon. Examples of this are strategy and design games, since they are more or less based on simulations or aspects from the real-world that serve as a context for the specific activities.

From the *perspective of social constructivism* (e.g. Bielaczyc & Collins, 1999), finally, the focus shifts to the social and cooperative aspects of computer games. Learning in the context of computer games can here be interpreted as the joint construction of socially shared knowledge, as this has been traditionally examined through research on learning communities or on collective information processing. The processes that can be examined most thoroughly occur in the context of MMORPGs. This is where the players come together as teams with clearly defined roles in order to master tasks when the solution requires a high degree of common planning and coordinated effort. The players communicate and cooperate with each other not only in the context of the game, but also often in community elements such as online forums, chats or instant messaging which allows players to coordinate and exchange ideas.

3.2 An Emotion Theory Perspective

The influence of emotions on the learning process have often been neglected to date in educational research (see Astleitner, 2000). Especially in the context of learning in computer games, it is important that emotions be taken into consideration as well. Even if the research to date has been relatively sparse, it can be said with a degree of certainty that positive emotions such as joy or satisfaction generally have a positive influence on

effective learning (Pekrun 1992). With respect to negative emotions, it is important to distinguish between deactivating negative emotions such as boredom or hopelessness and activating negative emotions such as fear or anger. While it can be assumed that deactivating emotions generally do not support learning processes, the influence of activating negative emotions is more complex. If these are present in the right amount, they can have an activating effect, but if they are excessive, they can have a blocking effect (see Rheinberg 1999). Even when there is the right amount of an activating negative emotion, it is wise to use caution because the motivational effect of negative emotions such as fear or anger is extrinsic and may actually detract from the actual subject matter and learning process.

Fun and joy are the two things that first come to mind when examining individual emotions more closely in relation to computer games. If one tries to identify exactly what makes a player experience fun and joy, you will hear many different answers (see Choi et al., 1999). Reasons may include aesthetics such as graphics, animation, music and sound effects or aspects of the game's narrative. In addition, games often provide players with the opportunity to immerse into a virtual world or to take on an artificial identity and to experience the joy of success and other social aspects of the game. It is also important that the joy of playing the game is not diminished by too low or too high a difficulty level, through subjective unfairness, or due to usability issues. In addition to fun and joy, there are also other positive emotions such as curiosity, satisfaction, and pride that can also be beneficial to learning processes.

With respect to negative emotions, it goes without saying that computer games aim to minimize deactivating emotions such as boredom or hopelessness. Activating negative emotions, on the other hand, are often specifically promoted. A certain amount of frustration when the goals of a game cannot be achieved on the first try is a pre-requisite to motivate players to try a second time. Fear can also play an important role in certain game genres such as ego shooters, especially when it plays a part in horror scenarios. However, this also highlights the ambiguities pertaining to negative emotions because there are certain mechanisms that would not be suitable to be used for processes intended to promote learning. When considering the use of computer games for learning purposes, the basic conclusion is that it makes sense to maximize positive emotions and to generally avoid negative emotions.

When analyzing the design of successful computer games from the perspective of emotion psychology, it becomes clear that these games generally succeed when they adhere to the principles discussed above. Examples of techniques that can be used for this purpose are state of the art design, an adaptive level of difficulty, target-group specific virtual worlds and plots, immersing narratives, and intuitive operation. It is also important to note that failing to meet one of these aspects may not prevent a game from being successful. This indicates that the different aspects that affect emotion psychology may compensate for one another to a certain degree. Therefore the individual and varied preferences of the players play an important role and should be given due consideration.

3.3 A Motivation Theory Perspective

The final important theoretical perspective for analyzing learning processes in computer games is motivation theory. There are a number of approaches can be drawn on to understand why computer games often are so attractive and motivating for players. The most relevant are constructs such as achievement motivation, social motivation, self-efficacy, interest and flow (Urhane 2008). Of particular interest is the self-determination theory of motivation (Deci & Ryan 1993), which integrates certain elements of some of the other approaches mentioned. It concentrates on explaining intrinsic motivation which is especially effective for learning because it is not fueled by external rewards, but is rather directed at the specific activity itself. In the context of learning in computer games, it makes sense to examine this approach more closely.

Self-determination theory postulates that intrinsic motivation depends on fulfilling three basic psychological needs: competence, autonomy, and relatedness. *Competence* relates to the construct of self-efficacy and describes the experience when an individual is in a position to be in control and master a situation. There is no doubt that this is one of the most important and most attractive characteristics of well designed computer games (cf. Salen & Zimmerman, 2004) since they continuously enable players to experience self-efficacy. It is also interesting to note that this often occurs through contexts that users often do not have access to in real life, such as driving race cars in a racing game, governing a city in a design simulation or fighting dragons in a 3-D role-play, a fact which refers to the role of interest in this context (see below).

In the context of the self-determination theory, *autonomy* describes the ability to strive towards one's own goals, interests, and aptitudes free from outside influences. While some computer games have a linear structure, most offer certain degrees of freedom in specific aspects. Examples for a high level of autonomy in computer games can be found in the aforementioned MMORPGs or in other games adhering to the "open world" concept. Their main appeal is that they provide a simulated reality and allow players to develop their character and its behavior in the direction of their choosing. In these cases, there is often no concrete goal or end to the game. Of course there are limitations to this autonomy through the rules of the simulation and its limitations. The game's designers' task therefore is to offer enough degrees of freedom and incentives to stimulate players' exploration.

The third important pre-requisite for motivating behavior postulated by the self-determination theory is *relatedness*. This can be defined as the feeling of belonging to a social community, whether it be with like-minded individuals, peers or colleagues. In this regard, the social elements that are part of modern multi-player games have enormous potential. Even outside of the game itself, this can be observed in the many online communities that are formed around popular games. It is also interesting to note that feelings of relatedness can also develop with virtual characters. This could be with virtual family members in simulations such as the popular "Sims" series, or computer-controlled "Party" members in adventure or conflict-oriented games that use the help of film-like interim scenes to breathe life into the individual characters.

Two other important motivational constructs beyond self-determination theory should be mentioned as particularly important in regard to games, namely interest and flow. *Interest* can be defined as the special relation between a person and a specific content domain or area of knowledge (Krapp, 2005). In regard to games, the motivational potential of interest is relevant, as it highlights the role of game genre and narrative. Both are important criteria for a game's success among different groups of players, and it is important to note that players of entertainment games are usually free to follow their specific interest in choosing a game.

A final construct to be mentioned here is *flow* (Csikszentmihalyi, 1975). Flow denotes an "optimal state" of motivated action, in which a person is fully immersed in a challenging task or activity while being skilled enough to master this task or activity. As cognition and affection both are entirely concentrated on the activity, flow allows a maximum level of performance. To induce flow, a task or activity has to meet a number of conditions: it has to have clear goals, the learner's subjective skills have to match with the task's level of challenge, and immediate and informative feedback has to be provided. As good game design is careful to meet these conditions, e.g. by successively and implicitly teaching players the skills needed in a game, flow can be considered a potent element of players' motivation.

4. QUALITY CRITERIA FOR DIGITAL LEARNING GAMES

What conclusions can be drawn from our analysis of educational, emotion and motivation theories of learning in computer games? If one agrees with the argument that digital learning games can make use of the mechanisms that are used in conventional entertainment games in order to support intended learning processes (cf. Linehan, Kirman, Lawson & Chan, 2011), then it should be possible to use the results of our analysis to derive theoretically well supported quality criteria for DLGs. On the basis of these considerations, we have developed a list of quality criteria for DLGs (Figure 1).

In the recent past, we have used this list of criteria in a number of practice related projects, which were either concerned with supporting the conceptual design phase of DLGs, with quality analyses of early versions of DLGs, or with the formative evaluation of nearly finished games. Some important experiences have come from these applications. The most important observation was that the full educational potential of computer games, as indicated in our list of criteria, is often used only to a little degree. On the surface, it is often immediately apparent that many DLGs cannot keep up technically with commercial games due their smaller budgets. However, as already indicated, a simpler design may not necessarily prevent a (learning) game from being successful, as can be seen in the growing market of casual games and mobile phone games. Far more important than technological inferiority, however, would be inferiority relating to educational aspects that can be identified using the criteria list. Three problems seem common to many DLGs.

1. Clearly define the learning goals of the game without neglecting the playful elements
2. Make use of the full spectrum of learning principles used in digital games
   a. *Behaviorist principles*
      - provide direct feedback (particularly reinforcement) on learners' actions
      - give opportunities for exercise and practice
   b. *Cognitivistic principles*
      - embed complex problems within the game context
      - embed information needed to solve the problems within the game context and narrative
   c. *Constructivist principles*
      - create realistic problems which are authentic and personally relevant to the players
      - offer different perspectives and contexts for a given content
      - create a social context for learning
      - provide instructional support
      - offer opportunities for learners' own construction processes
3. Evoke positive emotions
   a. Guarantee that learners have fun, e.g.
      - provide an attractive game design
      - maximize usability
      - avoid frustration and disappointment
   b. Provoke learners' curiosity, e.g.
      - offer different choices
      - offer opportunities for exploration
   c. Allow for satisfaction and pride
      - provide positive feedback for learners' accomplishments
      - create opportunities for presentation of learners' accomplishments
      - don't let learners fail (too often)
4. Evoke and keep up motivation
   a. Foster intrinsic motivation
      - make learning and playing intrinsically attractive
      - avoid too much focus on extrinsic rewards (score, awards etc.)
   b. Allow for feelings of competence
      - set goals which are challenging yet realistic given the learners' ability
      - give learners complete control over their success (reduce influence of chance)
      - ensure frequent and constant opportunities for feeling competent
   c. Provide autonomy
      - provide freedom choice, but avoid too muach uncertainty about possible negative consequences
      - provide freedom of action
   d. Enable social relatedness
      - provide in-game cooperation with real and/or virtual partners
      - create game-related communities of learners
   e. Meet learners' interests
      - tailor game subject, narrative, and genre to learners' interests
      - offer choices for the different interests of different learners
   f. Enable flow
      - clearly state learners' goals at each stage of the game
      - adapt difficulty level to learners' ability and skills
      - provide constant, immediate and informative feedback

Figure 1. Quality criteria for the design, quality analysis, and evaluation of DLGs.
Note: for the sake of applicability the criteria here are presented in the form of recommendations

Firstly, it is sometimes the case that unsuitable learning mechanisms are used for the wrong learning goals and contents. Behaviorist learning through reinforcement has its place, but more when it is important for learners to practice and repeat facts rather than when learners must learn new information or when the goal is to reach a more in-depth understanding of the subject matter. So it is important to provide for a close match of learning goal and learning mechanism in each specific case.

Secondly, it is often the case that the wide-range of possible cognitive, emotional, and motivational mechanisms to promote learning are not utilized and combined in meaningful ways. Instead, there is often a one-sided focus on individual aspects such as attractive design, frequent incentives or a strong narrative element. However, a good design doesn't compensate for a less attractive game or learning mechanisms.

Frequent incentives lose their motivating power when they are too easy to achieve. And a strong narrative element is only captivating when the players have enough opportunities to interact within the virtual world. So care has to be taken in cautiously balancing the spectrum of possible learning mechanisms.

Thirdly, and herein seems to lie the biggest challenge, it is always important that game play and learning are synthesized in a meaningful way. Our experience has shown that some products announced as DLGs are in fact mere e-learning programs to which a number of game elements have been added. Although there is a game-like aspect to these programs, the actual contents might still be transmitted through slide presentations or spoken instructional passages, the difference being that these elements have been more or less cleverly embedded within a game context.

5. CONCLUSION

Our theoretical analyses demonstrate that digital games in fact have a lot of inherent potential to foster learning via a number of theoretically well established cognitive, emotional and motivational mechanisms. At the same time it is evident that, given the state of the art of DLGs, many applications still fall short of making use of the full range of mechanisms and often only realise the most basic promoting functions, such as positive reinforcement. Accordingly, the results of the above theoretical analysis can be used to derive a systemized list of criteria and guidelines for designing effective DLGs.

The educational significance of this paper is twofold. For the practice of designing and applying DLGs in educational contexts, it gives guidance on what criteria need to be met to make them effective learning environments. For further research, it provides a general framework which can be applied for the empirical analysis of learning with DLGs.

Until today, the fact that computer games can provide influential learning environments had mostly been considered in the context of research conducted on the effects of media. In the past, this research focused primarily on the effect of depictions of violence and has brought forth evidence how these can have short- and long-term effects on the experiences and behaviors of regular players (see Barlett et al., 2009). Despite these negative aspects, we do not see any reason that the learning potential of computer games cannot be used in a positive sense for productive learning processes.

The accompanying challenges can be seen in the challenges presented in this article that many DLGs have been struggling with to this day. At the core of all of these difficulties is a basic issue relating to the hypothesis that the advantages of entertainment computer games can be easily transferred to DLGs. The basic problem lies in the fact that learning *in* computer games is something different to learning *with* computer games. The hypothesis above can therefore only be fulfilled if it is possible to truly synthesize intended learning processes with game processes.

However, we see positive opportunities for the effective use of DLGs when central principles of educational psychology are considered, as we have summarized in our criteria list. It would be a mistake to rely too heavily upon the learning effectiveness of the medium of the computer game alone. The risk is that we would again take a promising approach with a lot of potential to effectively promote learning processes and ruin it by deficits in the aspects relating to educational theory. This would lead to great disillusionment, as has been the case with e-learning before.

REFERENCES

Astleitner, H., 2000. Designing emotionally sound instruction. The FEASP-approach. *In Instructional science*, Vol. 28, pp. 169-198.

Barlett, C. P., Anderson, C. A. and Swing, E. L., 2009. Video Game Effects--Confirmed, Suspected, and Speculative: A Review of the Evidence. *In Simulation & Gaming*, Vol. 40 No. 3, pp. 377-403.

Bielaczyc, K. and Collins, A. M., 1999. Learning communities in classrooms: A reconceptualization of educational practice. In C. M. Reigeluth (Ed.), *Instructional design theories and models. Volume II: A new paradigm of instructional theory* (pp. 269-292). Erlbaum, Mahwah, NJ, USA.

Brown, J.S., Collins, A. and Duguid, S., 1989. Situated cognition and the culture of learning. *In Educational Researcher*, Vol. 18, No. 1, pp. 32-42.

Choi, D., Kim, H. and Kim, J., 1999. Toward the construction of fun computer games: Differences in the views of developers and players. *In Personal Technologies*, Vol. 3 No. 3, pp. 92-104.

Csikszentmihalyi, M., 1975. *Beyond boredom and anxiety.* Jossey-Bass, San Francisco, USA

Deci, E. L. and Ryan, R. M., 2000. The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. In *Psychological Inquiry*, Vol. 11, pp. 227-268

Foreman, J., 2004. Video game studies and the emerging instructional revolution. *In Innovate*, Vol. 1 No. 1, http://www.innovateonline.info/index.php?view=article&id=2 (12. 5. 2009).

Garris, R., Ahlers, R. and Driskell, J. E., 2002. Games, motivation, and learning. A research and practice model. *In Simulation & Gaming*, Vol. 33, pp. 441-467.

Gee, J. P., 2007. *Good video games + good learning. Collected essays on video games, learning and literacy*. Peter Lang Publishing, New York, USA.

Hense, J. and Mandl, H., 2009. Bildung im Zeitalter digitaler Medien - Zur wechselseitigen Verflechtung von Bildung und Technologien [Education in the age of digital media. On the reciprocal interrelation of education and technology]. In Henninger, M. and Mandl, H. (Ed.). *Handbuch Medien- und Bildungsmanagement [Handbook of media and education management]*(pp. 21–40). Beltz, Weinheim, Germany.

Krapp, A. (2005). Basic needs and the development of interest and intrinsic motivational orientations. *In Learning and Instruction, Vol.* 15, pp. 381-395.

Linehan, C., Kirman, B., Lawson, S. and Chan, G. (2011). Practical, appropriate, empirically-validated guidelines for designing educational games. *Proceedings of the 2011 annual conference on Human factors in computing systems - CHI '11*. New York, NY, USA, pp. 1979-1988.

Moreno-Ger, P., Burgos, D., Martínez-Ortiz, I., Sierra, J. L. and Fernández-Manjón, B., 2008. Educational game design for online education. In *Computers in Human Behavior*, Vol. 24, pp. 2530-2540.

O'Neil, H.F., Wainess, R. and Baker, E.L., 2005. Classification of learning outcomes: evidence from the computer games literature. *In The Curriculum Journal*, Vol. 16, pp. 455-474.

Pekrun, R., 1992). The impact of emotions on learning and achievement. Towards a theory of cognitive/motivational mediators. In Applied Psychology: An International Review, Vol. 41, pp. 359-376.

Picot, A., Zahedani, S. and Ziemer, A. (Eg.), 2008. *Spielend die Zukunft gewinnen. Wachstumsmarkt Elektronische Spiele [Playfully winning the future. The growing market of electronic games]*. Springer, Berlin, Germany.

Prensky, M., 2007. *Digital Game-Based Learning.* Paragon House Publishers, St. Paul, MA, USA.

Prensky, M., 2011. Comments on research comparing games to other instructional methods. In Tobias, S. and Fletcher, J.D., (Eds.), *Computer games and instruction* (pp. 251-278). State University of New York, Albany, NY, USA.

Reigeluth, C. M., 1983. Instructional design: What is it and why is it? In Reigeluth. C. M. (Ed.), *Instructional theories and models: an overview of their current status* (pp 3-36). Erlbaum, Hillsdale, NJ, USA.

Resnick, L. B. (Ed.)., 1989. *Knowing, learning, and instruction: Essays in honor of Robert Glaser*. Erlbaum, Hillsdale, NJ, USA.

Rheinberg, F., 1999. Motivation und Emotion im Lernprozess. Aktuelle Befunde und Forschungsperspektiven [Motivation and emotion in learning processes. Current research results and perspectives]. In Jerusalem, M. and Pekrun, R. (eds.). *Emotion, Motivation und Leistung [Emotion, motivation and performance]* (pp. 189-204). Hogrefe, Göttingen, Germany.

Salen, K. and Zimmerman, E., 2004. *Rules of play: Game design fundamentals*. MIT Press, Cambridge, MA, USA.

Shelton, B. E. and Wiley, D. (Eds.), 2007. *The Educational Design and Use of Simulation Computer Games*. Sense Publishers, Rotterdam, The Netherlands.

Tobias, S. and Fletcher, J. D. (Eds.), 2011. *Computer games and instruction*. State University of New York, Albany, NY, USA.

Urhahne, D., 2008. Sieben Arten der Lernmotivation. Ein Überblick über zentrale Forschungskonzepte [Seven kinds of learning motivation. A review of current research perpectives]. *In Psychologische Rundschau*, Vol. 59, pp. 150-166.

Woolfolk, A., 2004.. *Educational psychology.* Pearson, Boston, MA, USA.