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ENHANCING COLLABORATIVE LEARNING BY MEANS OF
COLLABORATIVE SERIOUS GAMES: PROVIDING REQUIREMENTS TO
COLLABORATIVE SERIOUS GAMES' DESIGN

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<p>Abstract</p> <p>The current study is a theoretical overview which aim is to define collaborative serious games, identify the problems arising in using and implementation of these games in learning and education and search of ways of improvement of the collaborative process by means of providing the requirements to collaborative serious games' design. The study makes connections among the following concepts: collaboration, gaming and technology and shows how they can be combined into a one study in order to improve the collaborative process of students and to provide a new solution to the pedagogical problems the modern teachers can face in their teaching practice (e.g. students' motivation, engagement in learning, self-regulation, developing of argumentation skills, ability to work collaboratively and etc.).</p> <p>The body of the thesis consists of three main parts that provides the basic ideas of serious games, computer-supported collaborative learning and collaborative game-based learning and answering the research questions of the study: <i>What are the benefits of using serious games in education and what are the "pros" and "cons" of using serious games as a technological tool?</i>, <i>What is collaboration in teaching-learning process and how collaboration can be supported by means of technology?</i>, <i>What are the main requirements and challenges in design of collaborative serious games?</i> and as a conclusion the thesis is completed by answering the primary questions of the study <i>'What is collaborative game-based learning?'</i> and <i>'How can learning be enhanced by means of using collaborative serious game?'</i> First two parts are the analyses of theoretical framework on serious games and collaboration, the third part is a synthesis that represents summarization of theoretical review fulfilled with the author's both learning and game experience that inspired to elaborate practical advice to designing collaborative serious games on the basis of entertainment games.</p> <p>Two different types of data were used in the study: 1) theoretical framework for digital game-based learning, serious games, collaborative learning, computer-supported collaborative learning, collaborative serious games (digital game-based collaborative learning); 2) empirical data collected from 8 engaging and popular games for entertainment by reading game reviews and analyzing games themselves while playing.</p> <p>On the basis of the results, it can be concluded that game based learning (GBL) has become an alternative to traditional learning concepts. "Serious games" allow reaching the new generation and at the same time to use new technologies for educational purposes as they combine a proper game entertaining component and a training component together. To develop a good collaborative serious game and thereby to satisfy students' learning needs is a big challenge as gameplay has to fulfill requirements of traditional single player games (fun, narration, video, audio), challenges of multiplayer games (concurrent gaming, interaction) and design of serious game (inclusion of learning content, adaptation and personalization). Moreover, the requirements of collaborative learning have to be considered (group goals, positive interdependence, and individual accountability). After analyzing the theoretical part the criteria for collaborative serious games were elaborated on which analysis of popular games for entertainment was conducted with a purpose to reveal aspects that can be implemented in modern collaborative serious game. The results (adaptation of theoretical framework) are presented in the form of a table, which includes the functions to collaborative serious games, the requirements, practical examples from the entertainment games and its adaptation to collaborative serious games.</p> <p>The study is aimed to encourage teachers and educators see the potential benefit of collaborative serious games and start using them in teaching learning practice; the study provides pedagogical and technological requirements to collaborative serious games design to help game designers develop good collaborative serious games and third, it provides the new results that extend the existing requirements to collaborative serious games with elaborating the requirements to games for entertainment.</p>			
Keywords collaborative learning, collaborative serious games, computer-supported collaborative learning digital game-based collaborative learning, edutainment, e-learning, game-based learning, serious games.			

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INTRODUCTION

Importance of the study and problem

At the present stage of development of human society that is impossible to ignore the role of computer technology and the Internet. Technology is so firmly established in our lives that children, who are still immature at talking, already know how to play computer games. A place of computer technology in our lives involves the use of their unique features for educational purposes. Currently there is an active computerization of schools, more and more computer training programs are appearing. Recent developments in computer video games allow us to speak of the possibility of their inclusion in the educational process as one of the effective methods of learning.

Modern students can hardly be interested by using the traditional methods of teaching and learning process, that is why the task of the modern teacher is to find the appropriate ways of motivating students to learn the certain subject and at the same time to achieve the learning goal on a particular subject by means of using different types of television programs, movies, music, internet, computer and educational games.

Educators should meet the needs of the new generation of “digital natives” who has been familiarized with digital technology from a very young age, using digital devices frequently and expressing themselves by means of the new language- ICT (Information and Communication Technology). “Digital natives” extensively play computer games and are they usually engaged in social networks, sometimes in the form of virtual worlds (Felicia, 2009).

Collaborative learning is used in schools today in various forms such as problem solving in teams, debates, or other team activities. According to Wendel et al. (2012) the idea of using computers to support collaborative learning is being investigated for more than twenty years, however, most of the research in the field of CSCL deals with e-learning applications or how to use Medias like the Internet or email to support collaborative learning. But in recent years, game-based learning (GBL) has become an alternative to traditional learning concepts. "Serious games" allow reaching this new generation and at the same time to

use new gaming technologies for educational purposes as they combine a proper game entertaining component and a training component together. Today there is a multitude of serious games that can support learning in many fields (learning, sports & health, political education, etc.) (Michael & Chen, 2005). Most of those games are for single player use and only a limited number of serious games have been designed with multiplayer support “due to the lack of concepts for multiplayer serious games” (Wendel et al., 2012).

To develop a good collaborative serious game and thereby to satisfy students’ learning needs is a big challenge as gameplay has to fulfill requirements of traditional single player games (fun, narration, immersion, graphics, sound), challenges of multiplayer games (concurrent gaming, interaction) and serious game design (seamless inclusion of learning content, adaptation and personalization). Moreover, the requirements of collaborative learning have to be considered (group goals, positive interdependence, and individual accountability) (Wendel et al., 2012).

The current study is a theoretical overview which aim is to define collaborative serious games, identify the problems arising in using and implementation of these games in learning and education and search of ways of improvement of the collaborative process by means of providing the requirements to collaborative serious games’ design.

The main idea of the research is how collaboration, gaming and technology can be combined into a one study to improve teaching learning process (Figure 1). The connection can be made by means of including the concept “Learning” that is going through the whole theory in the current study.



Figure 1. *Collaboration, gaming and technology*

Digital game-based collaborative learning (DGBCL) is a new trend in learning and education that includes the basic ideas of several studies such as collaborative learning, computer supported collaborative learning, game-based learning and digital game-based learning (Figure 2).

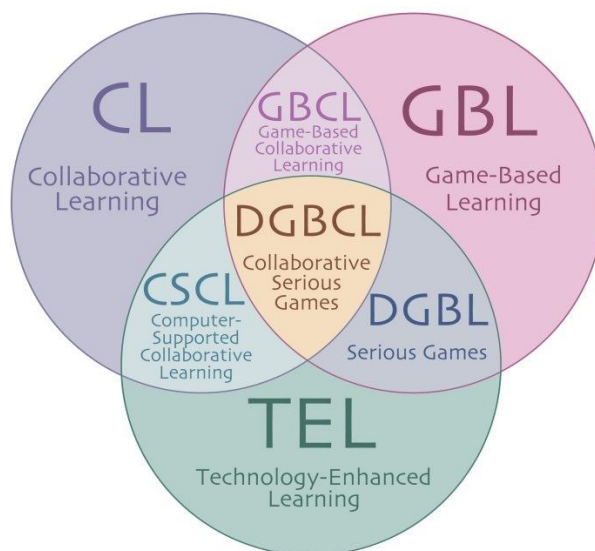


Figure 2. *DGBCL concept as triangle model*

To better understand the concept “collaborative serious games” I researched the main ideas of each of these studies that have helped to elaborate the requirements to design of collaborative serious games.

As the concept of collaborative serious games is new in educational research the study has a triangle perspective. First, it is aimed to encourage teachers and educators see the potential benefit of collaborative serious games and start using them in teaching learning practice. Due to the fact, that there are no good existing collaborative serious games the study would be an essential help to game designers as it provides pedagogical and technological requirements to collaborative serious games design. And at last the study would be interesting to researchers as it brings the light to a new approach which theoretical framework is needed to be researched deeper.

Previous studies

There is a growing amount of research on the effectiveness of online games as learning tools. Recently massive multiplayer online games (MMOGs) have become very popular. These MMOGs are graphical 3D video games allowing players, by means of self-created digital characters or 'avatars', to interact with the game world and with other players' avatars. Research on interaction and collaboration in these games is very limited. Rauterberg (2002) conducted a test about collaboration in MMOGs, Voulgari and Komis (2008) developed the design of effective collaborative problem solving tasks within MMOGs, and Zea et al. (2009) suggested design guidelines enabling incorporation of features of collaborative learning in the videogame development process.

Digital game-based learning (DGL) is a term and concept that has been under discussion and debate in recent years. Much of theoretical framework that has been written is based on the work and opinions of Marc Prensky and Paul Gee. The overview of serious games was proposed by Tarja Susi et al. (2007) where some issues concerning serious games are discussed, that is, (digital) games used for purposes other than mere entertainment. It provides the meaning of the serious games concept and discusses some possible positive (and negative) impacts of serious games. For example, serious games allow learners to experience situations that are impossible in the real life for reasons of safety, cost, time, etc., but they have positive impacts on the players' development of a number of different skills. The overview provides the connection of serious games with such concepts as digital game-based learning and Edutainment and also reflects the difference between serious games and games for entertainment. This overview has become a ground for the serious games' theo-

retical framework in the current study. Sørensen et al. (2007) reflect on the theoretical issues involved in the development of game-based prototypes for language teaching and learning and provides thermalized educational design for formal and informal contexts of learning that involve children's perceptions and activities in online game environments. Wouters (2009) reviewed 28 studies with empirical data from a learning outcome perspective in order to outline the effectiveness of serious games. According to Wouters (2009) serious games potentially improve the acquisition of knowledge and cognitive skills. Egenfeldt-Nielsen (2009) processes the quantitative studies on educational potential of computer games and underlined the role of using educational digital games in the learning process. Research shows that in most of the cases educational computer games motivate students and the higher learning results can be achieved but learning from the computer cannot replace the traditional way of teaching-learning process. Felicia (2009) proposed a handbook for teachers who are interested in using serious games in the classroom that is called "Digital games in schools". The handbook provides the necessary information about the benefits of digital games and how they can be used in teaching and learning processes.

The concept of collaborative learning, the grouping and pairing of students for the purpose of achieving an academic goal has been widely researched and advocated throughout the professional literature (Gokhale, 1995, p. 1). Roschelle and Teasley (1995) defined collaboration as "coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem" (Roschelle & Roschelle, 1995, p. 70). There are three different theoretical positions: socio-constructivist (Doise & Mugny, 1984), socio-cultural (Vygotsky, 1962, 1968; Wertsch, 1979, 1985, 1991; & Rogoff, 1990) and shared cognition (Suchman, 1987; Lave, 1988) approaches. For many years, theories of collaborative learning tended to focus on how individuals function in a group, but recently the focus has shifted to establishing parameters for effective collaboration and identifying the role they play in mediating interaction. Group itself has become the unit of analysis (Dillenbourg, 1995).

According to Dillenbourg & Fischer (2007) the evolution of research on computer-supported collaborative learning (CSCL) is divided into three ages. The first age (1990–1995) is known for the understanding the ideas that (1) "collaborative learning results from the effort necessary for co-construction of a shared understanding of the field" and

(2) “productive social interactions can be engineered by careful design of CSCL environments” (Dillenbourg et al., 2009, p. 4). The second age (1995–2005) is known with its growth of a scientific community that developed some engineering expertise for social interactions: the design of environments and activities, their analysis and utilization by the environment. The third age (since 2005) is known for disappearance of CSCL as a distinct pedagogical approach. Collaborative activities are becoming integrated within comprehensive environments (Dillenbourg et al., 2009).

There are two previous studies that provide requirements for collaborative serious games; they are an approach for a 3D collaborative multiplayer serious game for learning (Wendel et al., 2010) and characteristics that should be considered when designing a good educational game by Wang et al. (2009). But that is not a completed list of characteristics educational game should have (Wang et al., 2009) and appropriate game design is still needed.

Structure of the study

Master’s Thesis consists of three parts that provides the basic ideas of serious games, computer-supported collaborative learning and collaborative game-based learning, each of which answers the research questions of the study. The structure of the Master’s thesis is demonstrated in the following figure (Figure 3).

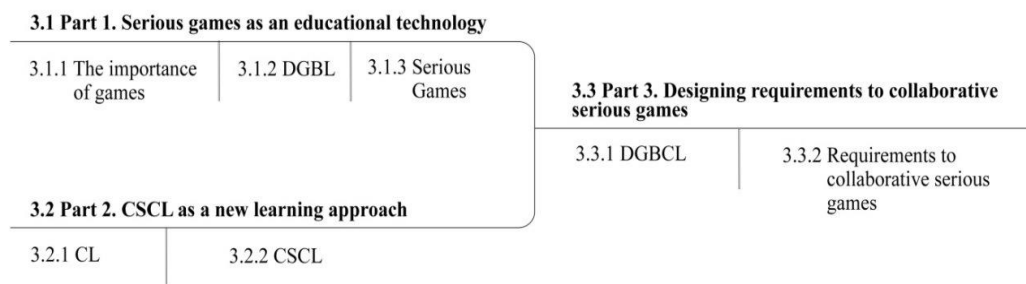


Figure 3. *Structure of the study*

Learning is going through the whole material so that each concept is researched from the learning perspective. While first two parts are the analyses of theoretical framework on serious games and collaboration, the third part is a synthesis that represents summarization

of theoretical review fulfilled with the author's both learning and game experience that inspired to elaborate practical advice to designing collaborative serious games on the basis of entertainment games.

The first part begins with the essential game theory and examination of the effectiveness of using games in teaching-learning process. It gives the explanation of digital game-based learning, characterizing the features of digital games in nowadays world. After that the basic theory of using serious games in education is presented. The theory covers such aspects as serious games' definition; the short history of using serious games in learning; the difference between entertainment games and serious games and finally after identifying of advantages and challenges of their implementation, the hints and requirements for choosing the appropriate game and organization of the game session are provided.

The second part starts with defining collaborative learning as a new learning approach that leads to deeper individual learning and understanding. Providing collaborative learning with the technological solutions is a new form of collaboration that is called computer-supported collaborative learning (CSCL). The collaborative processes of CSCL (cognitive, metacognitive and social) are learnt and presented then in order to explain the complex structure of CSCL. Providing technology is not enough for successful collaboration, students need to regulate the collective activity, while the regulation of socially shared metacognition is a key element for enhancing CSCL.

The third part of the Master's Thesis provides a definition to the concept "collaborative game-based learning", identifies the role of collaborative serious games in learning and provides the requirements and challenges of designing collaborative serious games for learning.

There is also some gap in the scientific research. In spite of the fact that the concept digital game-based collaborative learning or collaborative serious games is new and not officially established one, it summarizes the ideas and practices of the already existing studies, that is why it does not require elaborating a new theory but to the contrary the previous research on educational games and collaborative learning should be reconsidered, and the overview of the theoretical framework of collaborative serious games is needed. As the previous research shows that some video games for entertainment can enhance collabora-

tive learning of players (Zea, 2009), the experience of designing such games can be borrowed to develop a good serious game for collaboration. It requires an analysis and adaptation of the best practices of entertainment games to promote collaborative serious games.

1. METHODS

1.1 Aim and research questions

Aim of the study

The aim of the master's thesis is to define serious collaborative games, identify actual problems arising in using and implementation of these games in learning and education and search of ways of improvement of the collaborative process by means of providing the requirements to collaborative serious games design.

Research questions

Main question:

What is digital game-based collaborative learning? How can learning be enhanced by means of using collaborative serious games?

Sub questions:

1. *What are the benefits of using serious games in education and what are the “pros” and “cons” of using serious games as a technological tool?*
2. *What is collaboration in teaching-learning process and how collaboration can be supported by means of technology?*
3. *What are the main requirements and challenges in design of collaborative serious games?*

1.2 Data

To provide answers to the research questions there are two different types of data that were used in the study:

- a) The actual data is the theoretical framework for the following concepts:
 1. Digital game-based learning
 2. Serious games

3. Collaborative learning
4. Computer-supported collaborative learning
5. Collaborative serious games (digital game-based collaborative learning).

The list of the core articles is presented in the Table 1.

Table 1. *Theoretical data of the study*

Concept	Article
A. Serious games	1. Susi, T., Johannesson, M., & Backlund, P. (2007). Serious games: An overview
	2. Felicia, P. (2009). Digital games in schools: Handbook for teachers.
B. Digital game-based learning	3. Prensky, M. (2001). Digital Game-Based Learning. New York: McGraw Hill.
	4. Egenfeldt-Nielsen, S. (2007). Third generation educational use of computer games. <i>Journal of Educational Multimedia and Hypermedia</i> , 16(3), 263-281
C. Collaborative learning	5. Dillenbourg, P. (1999). <i>What do you mean by collaborative learning?. Collaborative-learning: Cognitive and computational approaches.</i> , 1-19.
	6. Gokhale, A. A. (1995). <i>Collaborative learning enhances critical thinking.</i>

	7. Johnson, R. T., and Johnson, D. W. (1994). <i>An overview of cooperative learning</i> . In Thousand, J., Villa, A. & Nevin, A. (Eds.), <i>Creativity and collaborative learning</i> (p.2). Baltimore, Maryland; USA. Brookes Publishing.
D. Computer-supported collaborative learning	8. Orvis, K. L. (2007). <i>Computer-supported collaborative learning: Best practices and principles for instructors</i> . Information Science Pub..
E. Collaborative serious games	9. Wendel, V., Gutjahr, M., Göbel, S., & Steinmetz, R. (2012). <i>Designing Collaborative Multiplayer Serious Games for Collaborative Learning</i> . <i>Proceedings of the CSEDU, 2012</i> .
	10. Wang, A. I., Øfsdahl, T., & Mørch-Storstein, O. K. (2009). <i>Collaborative Learning Through Games—Characteristics, Model, and Taxonomy</i> .

b) In the third practical part of the study data is collected from the following 8 engaging and popular games for entertainment of different styles:

1. **League of Legends (LoL)** is a multiplayer online battle arena video game that combines elements of role-playing (RPG) and strategy (RTS) genres that was developed and published by Riot Games for Microsoft Windows and Mac OS X. It is free-to-play game, supported by micro-transactions. According to Gaudiosi (2012) LoL was the most played PC game in North America and Europe in terms of the number of hours played. The plot includes two teams of powerful champions (each one has its unique design and play style), battle head-to-head across multiple battlefields and game modes. League of Legends offers endless replay ability for players of every skill level providing

the players with an ever-expanding roster of champions, frequent updates and a thriving tournament scene.

2. **Diablo series** is an action role-playing hack and slash video game series developed by Blizzard Entertainment. The series is made up of three core games: Diablo, Diablo II, and Diablo III. The series is set in the fantasy world of Sanctuary. The series focuses on the battle between the humans living on Sanctuary and the Prime Evils, demons who are led by Diablo, the series' chief antagonist. The characters in the world of Sanctuary are primarily humans, angels, and various classes of demons and monsters.

3. **World of Warcraft (WoW)** is a massively multiplayer online role-playing game (MMORPG) created in 2004 by Blizzard Entertainment. The action takes place within the Warcraft world of Azeroth. Players can control a character (avatar) within a game world in third- or first-person view, explore the landscape, fight various monsters, complete quests and interact with non-player characters (NPCs) or other players. World of Warcraft requires the player to pay for a subscription. In order to enter the game, the player need to select a server, referred to in-game as a realm. Each realm acts as an individual copy of the game world, and falls into one of four categories. Players can make new characters on all realms within the region, and it is also possible to move already established characters between realms for a fee.

4. **Assassin's Creed** is a historical fiction action-adventure open world stealth video game series that consists of seven main games and a number of supporting materials: Assassin's Creed, Assassin's Creed 2, Assassin's Creed: Brotherhood, Assassin's Creed: Revelations, Assassin's Creed III, Assassin's Creed IV: Black Flag, Assassin's Creed Unity. While playing as the Assassin characters, the games are generally presented as third-person in an open world, focusing on free-running. The games use a mission structure and make the players follow the main story and complete an assassination of public figure-heads or a covert mission.

5. **StarCraft** is a military science fiction real-time strategy video game developed and published by Blizzard Entertainment and released for Microsoft Windows. Star Craft Multiplayer has become extremely popular e-sport game. Star Craft multiplayer competitions are arranged around the world. Every year world championship is held. The game is especially popular in the USA and China. StarCraft II: Wings of Liberty is a military science fiction real-time strategy video game. The game is based on the conflict between

three races: the Terrans, the Zerg, the Protoss. Each side is presenting different strategy and tactics. In single-player mode the goal is to play through all missions on side of one of the races defeating the opponents. In multiplayer players choose the race and play against other players on special maps.

6. **Battlefield 3** is a first-person shooter video game developed by EA Digital Illusions CE. Battlefield 3 features the combined arms battles across single-player, co-operative and multiplayer modes. In Battlefield 3's campaign, players take on the personas of several military roles. The campaign takes place in various locations around the world. Multiplayer is featuring few character classes where two teams compete in completion of various objectives.

7. **Mass Effect** series are science fiction action role-playing third person shooter video games developed by the Canadian company BioWare. A trilogy of games has been released so that each one continues the previous game's story in chronological order. During the story a player needs to gather and maintain a team of interesting characters with different stories and abilities in order to protect the galaxy. Mass Effect is featuring a great storyline that is going through all the parts of the series. Gameplay is not linear and player decisions can affect the development of the story and game outcomes. Final game has seven endings.

8. **Dead Space** is a series of video games of the third-person shooter and survival horror genres. The game is set in a 26th-century science fiction universe featuring environments, weapons and characters typical of the genre. Chronology of the game is not linear as it concludes some parts of the story sections presented in the form of either prequels or sequels, and in different movies, books and comics. Dead Space 2 and 3 are featuring co-operative mode where players can walk through the game with other players supporting each other.

1.3 Data collection

Research methods:

- Analysis of theoretical and empirical research
- Study and generalization of works of foreign and domestic scientists

- Historical method
- Theoretical Analysis and Synthesis
- Objective method
- Comparison of entertainment and serious games
- Observation of most successful and popular entertainment games

In order to simplify both processes the data collection and making the results of the study more visible the theory is arranged such a way that the theoretical framework is divided into three parts. The first part of the study is a theory on game-based learning and serious games which aim is to prove the benefit of using serious games in learning and the second part is the theory of collaborative learning and computer-supported collaborative learning which introduces the basics of these pedagogical approaches and raises the challenges of their orchestration. Being a synthesis of the previous two parts the third part of the study consists of two sections. The first section is theoretical framework on collaborative serious games or digital game-based collaborative learning that brings the light to the new approach and explains how serious games can enhance collaborative learning and the next practical part provides the requirements to such games.

The empirical data was collected from 8 engaging and popular games for entertainment of different styles: League of Legends (LoL), Diablo series, World of Warcraft (WoW), Assassin's Creed Series, StarCraft, Battlefield 3, Mass Effect and Dead Space. In order to elaborate requirements to design of collaborative serious games the most successful and popular entertainment games were observed by means of both reading game reviews (www.gamespot.com) and analyzing games themselves while playing (Figure 4).



Figure 4. *Data collection*

1.4 Analyses

The theoretical data was analyzed according to the preset research questions. The theoretical framework is focused on the requirements to serious games and computer-supported collaborative learning. For this purpose the following theoretical issues were analyzed:

1. Analyzing requirements from game perspective:
 - the functions of using educational games in the classroom (Carrier, 1985);
 - the features of digital games (Prensky, 2001);
 - technical, contextual and pedagogical considerations serious game should have (Feliccia, 2009) from the requirements to the games.

2. Analyzing requirements from collaborative learning perspective:
 - the mechanisms that should be taken into account in orchestrating collaborative learning (Dillenbourg, 1999);
 - conditions which foster cooperative work in face-to-face groups (Johnson & Johnson, 1994).

3. Analyzing the requirements to collaborative serious games given by Wendel et al. (2012) and Wang et al. (2012) and my own pedagogical and gaming experience.

After analyzing theoretical part the criteria for good digital game were elaborated:

- Clear and logical controls, Clear User Interface (UI)
- Rules
- Goals and Objectives
- Strategies
- Game progression
- Learning curve
- Flexibility of gameplay/ Random events
- the Flow
- Customization/ Opportunities for creativity
- Encouragement/ Reward
- Video/Audio
- Storyline/ user driven story
- Single player mode for practicing
- Communication
- Competition
- Conflict
- Challenge
- Different character classes with different skills
- Collaborative tasks

- Outcome
- Feedback
- Help system
- Navigation

Analysis of 8 popular games for entertainment (League of Legends (LoL), Diablo series, World of Warcraft (WoW), Assassin's Creed Series, StarCraft, Battlefield 3, Mass Effect and Dead Space) was conducted on the basis of these criteria with a purpose to reveal aspects that can be implemented in modern collaborative serious game. The results (adaptation of theoretical framework) are presented in the form of a table, which includes the functions to collaborative serious games, the requirements, practical examples from the entertainment games and its adaptation to collaborative serious games.

2. RESULTS

2.1 Serious games as an educational technology

The overarching goal of this chapter is to define serious games, that are, (digital) games used for purposes other than entertainment; to detect the features of using serious games in education and to identify the “pros” and “cons” of using serious games as a technological tool. Specifically, this chapter will introduce such theoretical concepts as game-based learning, digital game-based learning and serious games.

The chapter begins with the essential game theory and examination of the effectiveness of using games in teaching-learning process. Next, it gives the explanation of digital game-based learning, characterizing the features of digital games in nowadays world. After that the basic theory of using serious games in education is presented. The theory covers such aspects as serious games’ definition; the short history of using serious games in learning; the difference between entertainment games and serious games and finally after identifying of advantages and challenges of their implementation, the hints and requirements for choosing the appropriate game and organization of the game session are provided.

2.1.1 The importance of games

Games are an integral part of human experience and they present in every culture. Most of psychologists and educators argue that game is a leading activity of children. The game is the most important part of a child's life but elements of the game are presented in a person's life at any stage of his life.

Game is usually associated with positive emotions, fun, exhilaration, but sometimes game can lead to reluctance to continue to play due to the fact it has not been structured correctly. Games include active physical or mental activities, and to the contrary they can cause the degradation and loss of imagination and even harm the health of the younger generation. In order to understand what criteria a modern and well-built game should have, first it is needed to identify the appropriate definition of the word "game". There are countless definitions of the word “game”. All of them look similar; however, just some of them define a game as a useful “tool” or “resource” for teaching.

Briefly game can be defined as having specific rules and set of players, each of one has his or her set of preferences over a set of action profiles and considers all other players' preferences before making his or her choice of action (Osborne, 2003). According to Heap and Varoufakis (2004), game theory is based on four basic assumptions about the rationality of human behaviors:

- instrumental rationality- actors in a game are rational and purposeful decision makers;
- common knowledge of rationality- actors in a game hold expectations about each other, and other actors are likely to inform what is rational for the actor to do;
- common priorities- rational individuals in a game will draw the same inferences on how a game is to be played;
- action within the rules of game- individuals know the rules of the game, all the possible actions and how these actions combine to yield particular payoffs for each player.

The essential elements of the game include the players, the strategies or preferences the players chose, the information available to them, the competition, the order to play and the outcome of the game, which in the most cases can be the enjoyment. A game has two or more players (individuals or communities) who need to possess information about the situation and other players' strategies or preferences to make their own decisions. In a game, players follow the order of play by choosing their strategies one after the other, either in sequential moves or simultaneously (Ross, 2006).

From the pedagogical perspective game can be defined as:

- An activity or sport involving skill, knowledge, or chance, in which you follow fixed rules and try to win against an opponent or to solve a puzzle. (Collins Cobuild, 1987, p. 596)
- An activity with rules, a goal and an element of fun (Hadfield, 1990, p. 5)
- A structure –that- has rules, goals and agreement of players on the surface and wonderful hidden processes underneath. (Turtledove, 1996, p. 3)
- A system with rules, conflict, and a quantifiable outcome. (Zimmerman, 2003).

Game can be widely used for educational purposes as it promotes the formation of cognitive interest, accumulation of knowledge and skills development. Role-playing and simulation games, business games and computer games have been actively used in education. To activate creative thinking, develop creative abilities and to correct mental processes educational games can be used.

An educational game is game explicitly designed for learning, in the process of which people can be taught about certain subjects, develop or improve their skills and get fun at the same time. It is a melding of educational content, learning principles, and computer games (Prensky, 2001). In other words educational game is an interactive play that teaches people goals, rules, problem solving, adaptation, interaction, collaboration, all represented as a story. Such games often require a set number of problems to solve which are followed by a short animation while learning activities are framed within the game theme.

According to Carrier (1985) games in the classroom has many advantages:

- Games give a variety of tools to facilitate the teaching-learning process;
- Games are flexible;
- Games make the lesson less monotonous;
- Games raise the students' motivation;
- Games stimulate students' participation and give them confidence;
- Games transform the teacher's role from that of formal instructor to that of an organizer or/and moderator of the class;
- Games can also serve as a testing mechanism.

By analyzing the functions of using game in a classroom we see that game positively influences on the teaching-learning process motivating students to learn and making their learning more interesting and interactive. Games are used in education in different forms as formal and informal methodology, and more kinds of games are appearing nowadays. The most popular games in education are digital games that are played on computers. They will be discussed in the next chapter.

2.1.2 Digital game-based learning

Digital game-based learning (DGBL) is the newest trend in e-learning. Much of theory is based on the work and opinions of Marc Prensky and Paul Gee. Marc Prensky does not give a certain definition to digital game-based learning but it can be defined as referring to the use of computer games in education, and aiming to develop learning outcomes of the players.

DGBL is, (Prensky, 2001) based on two key premises:

1. The thinking patterns of learners today have changed, that is, today's students are 'native speakers' in the language of digital media.
2. This generation has experienced a radically new form of computer and video game play, and "this new form of entertainment has shaped their preferences and abilities and offers an enormous potential for their learning, both as children and as adults".

According to Prensky (2001a, 2001b), educational digital game should have the following features:

- It should have rules;
- There are clear goals and objectives;
- There should be outcomes and feedback;
- There should be an element of conflict/competition/challenge/opposition;
- Some elements of interaction;
- It should have a storyline.

Prensky (2001) believes that to make the game engaging there should be a very careful balance between visual appeal (graphics) and 'gameplay' (the controls and events of the game) itself. From the definition of digital games, we see that it is not an easy task to design and develop an educational digital game to satisfy the learning needs of students.

To underline the role of using educational digital games in the learning process, the results of the quantitative studies on educational potential of computer games processed by Simon Egenfeldt-Nielsen (2009) are provided below (Table 1).

Table 2. *An Overview of the Studies into the effectiveness of educational use of computer Games (Egenfeldt-Nielsen, 2009, pp.4-6)*

Author(s)	Year	Genre	N	Subject	Results
Levin	(1981)	Action	-	Math	Computer games are motivating, engaging and ultimately successful in teaching children the planned math concepts. Computer games may be especially suitable for teaching different ways of approaching math that caters for individual differences.
Dowey	(1987)	Puzzle	203	Dental health	Children learn best from a combination of teaching and computer games but although they learn about dental hygiene this does not transfer into change of everyday practice.
McMullen	(1987)	-	37	Science	The drill-and-practice computer game was not found to have any effect on the learning, neither short-term nor long-term. However the students playing the computer game indicated that they thought they had learned more.
Jolicoeur & Berger	(1998a; 1998b)			Fractions Spelling	You learn from computer games, but educational software is more effective.
Wiebe & Martin	(1994)	Adventure	109	Geography	They find that there is no difference in learning geography facts and attitudes between computer games and teaching activities not on a computer.
Sedighian and Sedighian	(1996)	Strategy	200	Math	The learning outcome is critically affected by teachers' integration of computer games and traditional teaching, but computer games prove highly effective.
Betz	(1995)	Strategy	24	Engineer	Finds that computer games increase motivation and learning
Thomas et al.	(1997)	Adventure	211	Sex education	Students learn from playing the computer game both on specific knowledge items and in self-efficacy.
Brown et al.	(1997)	Action	59	Diabetes	The study finds that children can learn about diabetes from computer games changing everyday habits.
Klawe	(1998)	Adventure	200	Math	Computer games are effective in teaching students about math.

Table 2. Continued

Adams	(1998)	Strategy	46	Urban geography	Computer games increase motivation and teach students about the role of urban planners (affective learning)
Noble et al.	(2000)	Action	101	Drug education	Students taught by the computer games, found the experience motivating and wanted to play the computer game again.
Turnin et al.	(2000)	-	2000	Eating habits	Computer games can teach students about eating habits and lead to significant change in everyday habits.
Feng & Caleo	(2000)	-	47	Spelling and math	Children that played computer games learned better than peers not using computer games, mostly in spelling.
Becker	(2001)	Action	-	Program.	The study testifies to the increased motivation in connection with computer games. Games are found to be more effective and motivating than traditional teaching
Lieberman	(2001)	Action		Asthma, diabetes,	A review of a number of re-search projects that support that you can learn from computer games.
Rosas et al.	(2003)	Action	1274	Reading and maths	Computer games increase motivation, and there is a transfer of competence in technology from using the computer game.
McFarlane et al.	(2002)	-	-	All subjects	The study finds that teachers in general are sceptical towards the learning of content with computer games. However the learning of general skills was appreciated.
Gander	(2002)	Strategy	29	Program.	The study finds that computer games are effective for especially teaching specific knowledge.
Squire et al.	(2004)	Simulation	96	Physics	Students using the simulation game performed better compared to the control group.
Egenfeldt-Nielsen	(2005)	Strategy	72	History	Students initially learn the same in history when using video games but have better retention.
Buch & Egenfeldt-Nielsen	(2006)	RPG	72	Social studies	60% students on self-assessment found they learned more with Global Conflicts: Palestine than a traditional course. Almost 40% that it was around the same.

Most of the studies use computer games as the sole teaching style and examine whether computer games work as a viable supplement primarily during school time. It should be said that the current findings are actually more positive and promising than educational use of non-electronic games (Egenfeldt-Nielsen, 2005). Research shows that in most of the cases educational computer games motivate students and the higher learning results can be achieved but learning from the computer cannot replace the traditional way of teaching-learning process.

Unfortunately, many teachers are considering using computer games with great suspicion, and do not take them seriously, believing that they assume only entertainment. However, the use of computer-based learning and in particular educational computer games is a very important aspect, because it has a great learning potential. Educational computer games perform several functions: the game teaches, educates and develops the intellectual and creative abilities of students, makes learning more interesting and vivid, moreover it increases the motivation of committing certain actions, creates an atmosphere of joy and psychological comfort. But on the other hand, in most of the cases students have a vast gaming experience that makes them experts of this field, so that it can be difficult for teacher or educator to choose an appropriate material that satisfies students not only from the educational perspective but from the entertainment one, while the aim of using educational games is not only teach students but to motivate them to the learning process. Using of improperly selected educational games leads to the loss of motivation and students' skeptical attitude to games.

There are different approaches to the design of educational digital games. Educational game design is broad term that combines a lot of different approaches and methodologies. The one of them Edutainment- education through entertainment- was popular during the 1990s with its growing PC market (Michael & Chen, 2006).

Edutainment is a broad term that covers the combination of educational and entertainment use of a variety of media platforms and usually associated with educational video games. The primary target group was preschool- and young children, with focus on reading, mathematics, and science. Most edutainment titles are built on a simple gameplay often from classic arcade or a simple adventure game with a world player can move around in. How-

ever, edutainment software failed success since it resulted in what has been described as “boring games and drill-and-kill learning” (van Eck, 2006).

Many researchers agree that Edutainment is inspired by behaviorism and to a lesser degree cognitivist and socio-cultural theory. Focusing on simple computer games and the delivery of straightforward information to the player it does not really teach the player about the subject but gives the player the playing experience. In other words, such kind of a game make player concentrates on playing the game rather than learn from the game. Moreover, it does not need teacher or parent guidance as the students can simply learn the given content or skills from computer that does not supply the term of educational game.

There have been three generations of educational games defined by their underlying pedagogies (Bin Subaih et al., 2009). The figure below (Figure 5) illustrates the different generations view on educational use of games (Egenfeldt-Nielsen, 2009).

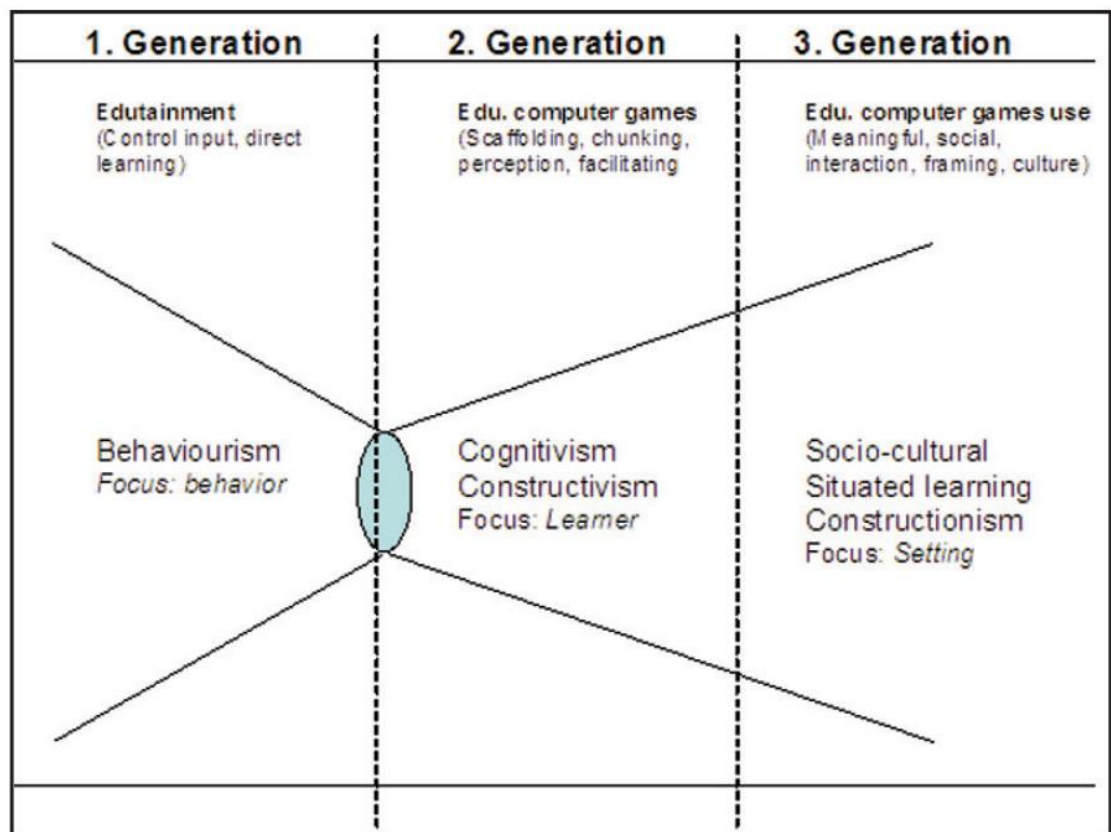


Figure 5. The model shows the different generations' characteristics, and how they emphasize different learning theories (Egenfeldt-Nielsen, 2009, p. 8)

Edutainment can be referred to the first generation view on educational games that focuses on behaviorism- learning through changing the behavior of students. Behaviorism founders Thorndike, Pavlov and Skinner believe that learning is a change in observable behavior caused by external stimuli in the environment. In other words, change in behavior demonstrates some change in learning. Researchers claims that player can learn by practicing skills and contents through reinforcements and conditioning. For example, student can learn the subject by practicing a skill enough times. Reinforcing effort is defined as an instructional strategy that “enhances students’ understanding of the relationship between effort and achievement by addressing their attitudes and beliefs about learning” (Pitler et al., 2007, p. 155).

Taking into account different ways of learning, the second generation of educational computer games is appearing. Based on cognitivist approach, it focuses on learner himself. Cognitivist approach was apparent from the mid-1980’s to the mid 1990’s and one of the most cognitive psychologist was Jean Piaget who founded his theory on the idea that “the child, at first directly assimilating the external environment to his own activity, later, in order to extend this assimilation, forms an increasing number of schemata which are both more mobile and better able to inter coordinate” (Piaget, 1955). Thereby cognitivist approach is based on intrinsic motivation and meaningful learning. The second generation provides users with supplying chunking information, building stronger scaffolding, concerning personal level of skill and developing meta-skill: problem-solving, analyzing, perceiving etc. (Simon Egenfeldt-Nielsen, 2007, pp. 263-281).

The third generation of using educational computer games is called constructionism. Seymour Papert developed a theory based on Piaget’s constructivism, the key point of which was to identify what children are interested in and able to achieve at different stages of their development. “Constructionism—the N word as opposed to the V word— shares constructivist's view of learning as “building knowledge structures” through progressive internalization of actions... It then adds the idea that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it’s a sand castle on the beach or a theory of the universe” (Papert, 1991, p. 1). Being focused on the art of learning, or “learning to learn”, Papert is interested in how learners en-

engage a conversation with their own or other people's artifacts, and how these conversations promote self-directed learning and facilitate the construction of the new knowledge. He stresses the importance of tools, media and context in human development (Edith Ackermann, 2001).

In constructionism the environment artifacts provide a platform for exploring the new material from both perspectives: individual and collaboration. This refers to socio-cultural approach, where the learning process is seen as mediated in social context and knowledge is transferred to culture, tools and communities. The role of teacher becomes central, facilitating learning process of students. The good example of the third generation is serious games that will be more deeply discussed in the following chapters.

2.1.3 Serious games

Nowadays, the term "serious games" is becoming more and more popular. Serious games are used in emergency services training, in military training, corporate education, healthcare, and in many other fields of society (Michael & Chen, 2006). Moreover, "serious games" is becoming a new form in the educational design that can be used at every level of education.

While some of the researchers define digital game-based learning as a branch of serious games, others consider serious games and digital game-based learning quite the same. According to Corti (2006), Digital Game-Based Learning/Serious games "is all about leveraging the power of computer games to captivate and engage end-users for a specific purpose, such as to develop new knowledge and skills".

Identifying games that can be used for education is complex as there are many definitions and ways of classifying educational games, serious games and their relations to virtual worlds and simulations. Some researchers see them as a continuum, as all are highly interactive virtual environments (HIVEs) with their own affordances and purposes (Aldrich, 2009), while others see them all as different categories of the same thing (Sawyer & Smith, 2008). Alke Martens and his colleagues (2008) believe that GBL (their terminology for serious games) requires a game, simulation and learning aspect in almost equal measure (Figure 6).

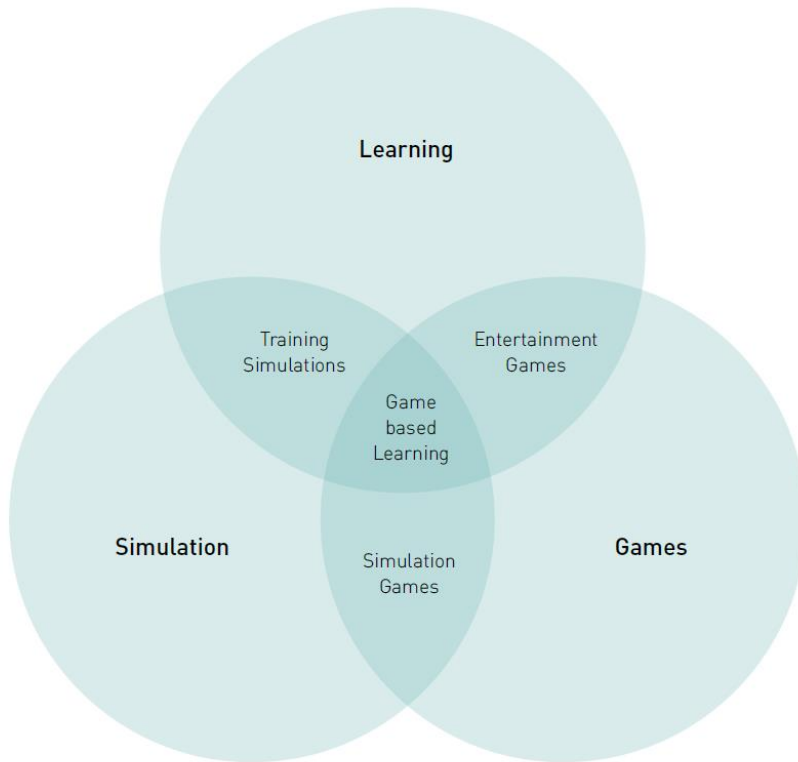


Figure 6. *Interplay of pedagogy, computer science and games* (Martens et al., 2008, p. 174)

The current model was chosen as it makes the relation between the concepts clear and visible.

Many definitions exist that describe a game but most of them define a game as goal-directed, a competitive activity (against the computer, another player, or oneself) and conducted within a framework of agreed rules (Lindley, 2004). In addition, games constantly provide feedback to enable players to monitor their progress towards the goal (Prensky, 2001).

It is appropriate to consider what the concept "serious games" itself actually means. Serious games as a term has been around for over 40 years. In 1968 Clark Abt called his book "Serious games", where he describes his work in the 1960s in which he examined war-games and simulations to train managers, students, and teachers in educational-curriculum development, school system planning, industrial management and technological planning and forecasting. He defined serious games as they: "have an explicit and carefully thought-

out educational purpose and are not intended to be played primarily for amusement. This does not mean that serious games are not, or should not be, entertaining.” (Abt, 1970, p. 9). According to Michael & Chen (2006), serious game is a computer based game with a primary purpose other than entertainment, ranging from anywhere between advertisements to military training exercises. In other words it can be said that the main purpose of serious games is not only to entertain users, but to teach them the specific subject. Zyda (2005) argues that serious games differ from computer games as they have more than just story, art and software. In addition they have pedagogy that makes games serious. The aim of serious game is “to use new gaming technologies for educational or training purposes. It investigates the educational, therapeutic and social impact of digital games built with or without learning outcomes in mind.” (Felicia 2009, p. 6). That is also important to emphasize the fact that serious games can be similar to educational games but are primarily focused on an audience outside of primary or secondary education.

Michael and Chen (2006, p. 19) described games as”...a voluntary activity, obviously separate from real life, creating an imaginary world that may or may not have any relation to real life and that absorbs the player’s full attention. Games are played out within a specific time and place, are played according to established rules, and create social groups out of their players.”

Describing the features of serious games I meet a contradictory issue. Not all of the researchers consider “fun” an important element of the serious games. Stoll (1999, p. 13) is critical to “the obsession of turning the classroom into a funhouse”, and argues that computers, or “teaching machines”:

”...direct students away from reading, away from writing, away from scholarship. They dull questioning minds with graphical games where quick answers take the place of understanding, and the trivial is promoted as educational. They substitute quick answers and fast action for reflection and critical thinking [...] Turning learning into fun denigrates the most important things we can do in life: to learn and to teach. It cheapens both process and product: Dedicated teachers try to entertain, students expect to learn without working, and scholarship becomes a computer game” (pp. 13-14).

Still others see fun the core element in games and education. According to Prensky (2001), games should be fun first and then should encourage learning. Similarly, Michael and Chen (2006) argue that the main point of serious games is to get players to learn something, and, if possible, have fun doing it.

Now it is appropriate to compare serious games and entertainment games with the purpose to detect the differences in their design and focus (Table 2).

Table 2. *Differences between entertainment games and serious games* (Susi , 2007, p. 6)

	Serious games	Entertainment games
Task vs. rich experience	Problem solving in focus	Rich experiences preferred
Focus	Important elements of learning,	To have fun
Simulations	Assumptions necessary for workable simulations	Simplified simulation processes
Communication	Should reflect natural (i.e., non-perfect) communication	Communication is often perfect

According to Michael and Chen (2006), contrary to many markets for entertainment games the serious games market is more likely to possess a wide variety of hardware and operating systems. Moreover this market includes not only experienced gamers, but also first-time players that is why the games must be even more accessible. While entertainment games generally require the rich gaming experience from their gamers, serious games provide the model or simulation that can be used to solve a problem. It is essential for serious games that the most important elements of learning are in focus and the assumptions necessary for making a simulation workable should be correct to teach a skill needed. The entertainment games focus on the fun elements and use a number of techniques such as random numbers, time compression, etc. to make the simulation processes simpler. The communication that is often perfect in entertainment games (without delays and misunderstandings), usually have a lot of challenges in serious games (Susi, 2007).

Nowadays, commercial entertainment games (CEnG) significantly surpass purpose-built educational games as they are completely focused on the needs of the modern user and can provide a visually compelling experience for the player. In order the educational game serves its main purpose to teach something, first it should interest the student and support his or her motivation during the whole gaming process, and I agree that the game should not only be educational, but interesting also. Serious games need to be engaging and not necessarily fun. That means serious game should be planned not only from its pedagogical perspective, but the technical performance is also important. In other words, the design should immerse the learners in the game play.

To summarize, a lot of terms referring to what is called here “serious games” exist. The concept is defined from the different perspectives and interests. Most of the definitions share the same idea that serious game is a game or gaming technology for purposes other than entertainment. The element of fun usually draws the line between serious and other games.

Squire (2003) describes the various forms and genres of games already being used in education, especially in classroom so far:

- **'Drill-and-practice' games**, which are mostly utilized for learning by enriching factual recall exercises in a playful way;
- **Simulation games** that can be used to simplify complex systems, i.e. laws of physics, ecosystems (Sim Earth), or politics. On the other hand, high fidelity simulations can be used for realistic training scenarios as often used by military or e.g. flight simulators.
- **Strategy games**

The focus of educational games in the last decade was mainly on simple simulation games (TechForce) or learning adventures (Geographicus, Winterfest) .Those games were created as a playful alternative to learning facts by heart or to provide a playful environment learning through trial and error (e.g. physics games) (Wendel et al., 2012).

In the modern critical literature a lot of opinions can be found regarding the benefits of the use of serious games in learning, and to the contrary. It is a proved fact that a game is supposed to provide physical and mental activity, as well as commuter games bring pleasure,

motivate and capture students, help consolidate the new knowledge, as well as develop critical thinking and social skills.

Serious games not only allow learners to experience situations that are impossible in the real world for reasons of safety, cost, time, etc. (Corti, 2006), but they provide a platform for active learning as they can be customized to the learner, they provide immediate feedback, allow active discovery and develop new kinds of comprehension. There is also evidence of a higher level of retention of material (www.futurelab.org.uk/projects/games-in-education).

In playing serious games, young people can have a go at working in a number of different fields, and can practice and hone their skills again and again in an environment where making mistakes does not equal failure. Indeed, within a game, mistakes are an intrinsic part of the mechanics, in that a player only learns how to proceed through a level by trying different strategies and selecting the most successful. Furthermore, the “just-in-time” feedback that games provide could go some way to allowing disengaged young people to recognize their own personal progress, which in itself is a motivating factor to continue playing the game. (Ulicsak & Wright, 2010, p. 51)

There is an increasing willingness to use serious games in the classroom among the modern teachers as they believe serious games potentially improve the acquisition of knowledge and cognitive skills of students. But first teachers should overcome some of the challenges: cost of games and hardware, time to learn the game to ensure that it is used appropriately.

On the other hand, there is a point of view that the frequent use of computer games can exacerbate the negative psycho-social trends (for example, it can lead to social isolation, aggression and violence), and also that the game is addictive and it negatively affects health. “Later studies have shown that while digital games, played beyond a reasonable length of time, may have negative effects like any other excess, if good gaming habits are followed (eg. appropriate time, environment, moderation of online games, etc.) they can be considered a safe and fulfilling activity” (Felicia, 2009, p. 6).

In other case, using serious games does not always lead to achievement of the expected results. As pointed out by Mayer and Bekebrede (2006): “we often falsely assume that the game itself will be powerful enough to cause change or learning that the outcomes will be used automatically for decision making” (p. 150).

The learning outcome is dependent upon an appropriate pedagogy and the underlying game mechanism and how the content is integrated into the game so the learning is intrinsic to play. As Gunter and colleagues (2008) argue, placing educational content inside a game does not guarantee that it will succeed in achieving a fun, motivating experience; meet educational goals; or be a commercial success. He also believes that games are educationally sound as they require the player to recall rules, game mechanics and processes from previous levels. The role of the teacher is essential as game is the part of the learning process.

In order to determine if the game will make the learning process more successful the teacher needs to assess whether the game will enhance their students’ learning. This process usually requires time to learn and comprehend the game. Teacher should read instructional material and play-test the game in order to check if the content is appropriate for the students and suitable for the current topic (Felicia, 2009). According to Felicia (2009), the following points should be considered before start using serious games:

Technical considerations:

- User interface (UI):

Game enjoyment depends on clearness and usability of user interface. Common task performance like controls and navigation should be logical and clear. UI provides the basic user experience and if it fails most of the students lose gaming motivation at the beginning of the game.

- Saving and loading the game

Playing the same level all over again every time is not enjoyable that is why saving or even auto saving feature is expected to be provided in the game.

- Audio

High-quality sound might provide the deeper player integration within the game. However, in some cases using the audio is not acceptable that is why the game might have features to limit some audio or to mute it completely.

- Customization

The player's characteristics are usually different. In most of the cases it is impossible to create a game completely suitable for every individual. The ability to change the difficulty, customize the characters or some layouts may provide a needed level of differentiation to make a game more enjoyable for the wider audience of users.

Contextual considerations:

- Age group

The teacher should determine if the content of the game is suitable for the students in terms of age and content. It can be easily done by means of using the existing rating standards. One of them PEGI (Pan European Game information) is a European digital game rating system that helps to ensure that the content of the game is suitable for the target audience. It is voluntary used in 32 European countries, but is only enforced in two (Finland and Norway). PEGI (http://www.pegi.info/en/index/global_id/505/) consists of two levels of information to guide the consumer:

1. Logo represents the minimum recommended age. The age categories are: 3, 7, 12, 16 and 18 (Figure 7).



Figure 7. PEGI icons indicating age categories (<http://www.pegi.info/en/index/id/33/>)

2. A series of game content descriptors, designed as icons that are displayed on the back of the game box and indicate the nature of the content where it is required. There are 8 icons, depending on the type of content (Figure 8).



Figure 8. PEGI icons indicating game content (<http://www.pegi.info/en/index/id/33/>)

- Language

The level of the language in the game should be adequate for the age group.

- Time

Teacher should estimate time required for students to finish the game levels and to get the expected knowledge from playing the game. Time of completing the game varies across games: online mini-games are usually designed to be completed for the short period of time, while adventure games or RPGs (Role Playing Games) might require several hours or days. That is a good practice to plan the playing game session over a week or even more in order students learn the mechanics of the game. Games can be used after school as homework.

- Taking account of people with disabilities

The next step is to check if the serious game accommodates people with disabilities.

- Network games

If the game involves interaction between participant, the teacher should provide care to prevent bullying and be ensure that students feel safety while playing digital games.

Pedagogical considerations :

- Learning curve

The game should use an easy learning curve that allows players to make mistakes at the star and learn how to avoid them in the future.

- Educational content

First of all the game content should illustrate the topic taught to enhance learning. Goal achievement and objectives should be logical and clear in order student know exactly what they are required to do.

- Clear progression

Teacher should be sure that students know how to progress in the game. The game is expected to provide information about the each student's progression in the form of a score or progression bar. Controlling their level of progression not only raise the students' motivation, but provide to students responsibility for their activities.

- Feedback

Feedback provided to students should be regular and gentle. Verbal guidance can help students to focus.

- Opportunities for collaboration and group work

That is a good practice of using serious games that provide group activities or in other words collaboration between students. That is a proved fact that collaborative learning positively effect on the individual progress.

- Assessment and follow-up

Some of the games allow the teacher to follow the students' progress and identify areas where more attention and work is required.

- Opportunities for creativity

Game should encourage students' creativity. For example, it can include the opportunity to make and share the objects.

- Help

Help section should be available and comprehensive in a game (Felicia, 2009).

After choosing the appropriate serious game teacher need to consider how the game can be best integrated into lessons given the context and how learning can be assessed (Ulicsak & Wright, 2010, p. 7).

In this chapter I considered the main features of serious games and defined the “pros” and “cons” of using serious games as a learning technology. In spite of the fact that they are supposed to be a strong teaching tool, the use of serious games in education is still in the early stages of their development. Many experts are studying their roles and capabilities in learning, as well as working to develop a pedagogical model of games application. More teachers appreciate the educational potential of games in the system of modern education and the use of serious games in the learning process has been significantly increased.

Companies that develop games allocate the budget to create games and in consequence, they count on profits. Actual problem of serious games is that the government, educational system or group of schools should be interested in creating high-quality product to provide financing needed and quality control that means they should be sure in practicability and usefulness of serious games. It would be a good practice to attract professionals in the gaming industry. Use of serious games for learning requires serious reorganization of educational process in public schools while private schools could be a good base for implementing such experience.

Games can be customized to suit individual user needs, provide opportunities for self-discovery and help to consolidate new knowledge. Moreover playing serious games enhances student's engagement and motivation. Games are an important part of the learning process, but serious games themselves do not produce learning outcomes. If this learning method is chosen, it is important to develop a strategy and methodology of estimating the

desired results. To achieve the high learning result a lot of considerations should be taken into account. Teachers are expected to ensure their students achieve certain mastery and give the appropriate feedback to students, while students themselves should recognize how to use the received knowledge and how to progress in their learning. The game should include a dynamic gameplay with a strong pedagogy inside and be applied across the curriculum in conjunction with other teaching methods. From my point of view as a researcher I would advise not to forget the successful practice of the previous years and not to use serious games as a substitute to traditional pedagogical methods but integrate them into already known and time-proves educational process.

2.2 Computer-supported collaborative learning as teaching-learning approach

A central theme of this chapter is the following: to better understand the role of collaboration in education and to better conceptualize CSCL. Toward this goal this chapter will examine social, cognitive and metacognitive interactions in collaborative learning.

The chapter starts with defining collaborative learning as a new learning approach that leads to deeper individual learning and understanding. Providing collaborative learning with the technological solutions is a new form of collaboration that is called computer-supported collaborative learning. The collaborative processes of CSCL (cognitive, metacognitive and social) are learnt and presented then in order to explain the complex structure of CSCL. Providing technology is not enough for successful collaboration, students need to regulate the collective activity, while the regulation of socially shared metacognition is a key element for enhancing CSCL.

2.2.1 Collaborative learning

Science and technology are developing and the world has become more complex that one person is not able to cover all its aspects. Complex world requires complex ideas, combining a plurality of knowledge and skills from different areas. Only a team of individuals who effectively complement each other and master different areas of knowledge can establish and implement such ideas.

The researchers are coming up with the idea that the traditional method of teaching does not provide students with the opportunity to learn how to build argumentation and express their opinion on a high-educational level that is the essential criteria to master the learning area (Weinberger, 2011). The lack of argumentation skills and ability to share and defend individuals' point of view have led educators to the idea of reconsidering the traditional way of teaching and looking for a new teaching method.

“The concept of collaborative learning, the grouping and pairing of students for the purpose of achieving an academic goal has been widely researched and advocated throughout the professional literature” (Gokhale, 1995, p. 1).

There are a lot of definitions of “collaborative learning” concept and all of them sound quite similar. The most popular and satisfied definition was given by Roschelle and Teasley (1995) who define collaboration as “coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem” (Roschelle & Roschelle, 1995, p. 70). The other definition is by Gokhale (1995), who defines collaborative learning as “an instruction method in which students at various performance levels work together in small groups toward a common goal”.

This type of learning when students need to work together toward a common goal has been called by various names such as cooperative learning, collaborative learning, collective learning, learning communities, peer teaching, peer learning, or team learning (Dooly, 2008). However, collaboration is more than co-operation and they should be understood as two different approaches that is why the difference between the theoretical concepts should be considered.

“Cooperative learning is a process meant to facilitate the accomplishment of a specific end product or goal through people working together in groups” (Dooly, 2008, p. 22). In other words students share their responsibilities within a group and each student perform his or her part of the task. At the last stage students combine their results that makes a completed product. Collaboration presumes students to work together during the whole learning process. In collaborative learning “students are responsible for one another's learning as well as their own and that reaching the goal implies that students have helped each other to understand and learn” (Dooly, 2008, p. 22). The basis of both collaborative and cooperative learning is constructivism that means knowledge is constructed, and transformed by students.

Theories of collaborative learning usually focus on how individual's function in a group, where the individuals can be viewed as “two relatively independent cognitive systems which exchange messages” but more recently the focus shifted so that the group itself has become the unit of analysis that is “a single cognitive system with its own properties” (Dillenbourg, Baker, et al., 1995, p. 3). Between the "individual" and the "group" there are three different theoretical approaches: socio-constructivist, socio-cultural and shared cognition one.

In the previous chapter I have already mentioned the socio-constructivist approach, but now I see it essential to present its idea more deeply. Being inspired of Piaget's theory focused mainly on individual aspects in cognitive development, the group of psychologists "Genevan school" undertook a systematic empirical investigation of how social interaction affects individual cognitive development. The socio-constructivist approach includes such major concepts as conflict and coordination of points of view - centrations. Being focused on the role of interactions, the socio-constructivist approach assumes individual cognitive development as the result of a spiral of causality: a given level of individual development allows participation in certain social interactions which produce new individual states that make possible more sophisticated social interactions. The mediating process while working in pairs or groups that facilitate individual performance is called "socio-cognitive conflict" (Dillenbourg & Baker, 1995). For example, it can be the conflict between the different answers based on different centrations, when the participants have the different points of view and defend their own vision and try to get a shared understanding of the problem as a result that leads to deeper knowledge of the topic and argumentation skills enhancing individual development of the students.

The research proves collaborative learning is more effective in achieving high learning results than individuals working alone (Järvelä, Hurme & Järvenoja, 2011). To make collaborative learning more productive than competitive or individualistic one, there are several mechanisms to be taken into account. These are according to Dillenbourg (1999):

- Setup of initial conditions: (group size, gender, same viewpoint vs. opposing viewpoint);
- Role-based scenario: problems which cannot be solved with one type of knowledge
- Interaction rules: free communication vs. predefined communication patterns
- Monitoring and regulation of interactions: need for specific tools for the teacher

Johnson and Johnson (1994) identified five conditions which foster cooperative work in face-to-face groups:

- Clearly perceived positive interdependence: knowing to be linked with other players in such a way that one cannot be succeed unless they do;
- Considerable promotive interaction: promoting each other's success by means of helping, encouraging and praising;

- Clearly perceived individual accountability and personal responsibility to achieve the group's goals;
- Frequent use of the relevant interpersonal and small-group skills;
- Frequent and regular group processing of current functioning to improve the group's future effectiveness.

There are a number of benefits that are associated with the concept of collaborative learning (Laal & Ghodsi, 2012, p. 486). Laal and Ghodsi (2012) summarized the benefits of collaborative learning put them into four major categories of social, psychological, academic and assessment one.

Social benefits:

- CL helps to develop a social support system for learners;
- CL leads to build diversity understanding among students and staff;
- CL establishes a positive atmosphere for modeling and practicing cooperation;
- CL develops learning communities.

Psychological benefits:

- Student-centered instruction increases students' self-esteem;
- Cooperation reduces anxiety;
- CL develops positive attitudes towards teachers.

Academic benefits:

- CL Promotes critical thinking skills;
- Involves students actively in the learning process;
- Classroom results are improved;
- Models appropriate student problem solving techniques;
- Large lectures can be personalized;
- CL is especially helpful in motivating students in specific curriculum.

Alternate student and teacher assessment techniques:

- Collaborative teaching techniques utilize a variety of assessments.

In spite of the fact that collaborative learning has become an important instructional intervention that is expected to lead to positive results, to achieve successful collaboration is still a big challenge.

Speaking of requirements of collaboration, I mean high-level collaborative processes. The term high-level collaborative processes mean the co-construction of meaningful knowledge and understanding in which the members of a group not only share information but are also engaged in representing each other's mental activities used to process content knowledge (Volet, Summers, & Thurman, 2009). In order to be successful, learners must participate in the construction of joint cognitive products that require shared understanding. The importance of the quality of the interaction and collaboration has been highlighted by many researchers. The quality of social interactions refer to the cognitive content of the discussions, but also to features of the interactions that are metacognitive in nature, such as met communicative rules of the interaction, monitoring of the social level cognitive processes, regulative processes related to the use of external representations of the tasks, and the regulation of collective memory (Iiskala, 2004).

Collaboration is seen as a challenging process that requires not only responsibility and creativity but cognitive, metacognitive, motivational and socio-emotional skills. These elements are referred with the term of self-regulated learning, that is an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features in the environment (Pintrich, 2000). While self-regulated learning requires students to regulate the cognitive and metacognitive processes in their learning, activation of both is not enough for successful collaborative learning. As the core element of collaboration is getting shared understanding that could be reached by means of active and focused social interactions, it requires socially shared cognition and metacognition.

Cognition include mental processes as thinking and memorizing, metacognition means "thinking about thinking", "cognition about cognition" and it takes control over cognitive

learning processes. Currently there is no unique accepted definition of socially shared metacognition and even this title is not used by all researchers, but some exploratory findings and suggestions have been made by means of adapting the ideas of individual metacognition theory into the social context. According to Volet, Vauras and Salonen (2009), socially shared metacognition could be considered as the most inner mode of regulation since it refers to the individual metacognitive process functioning as a social entity, aimed at an objective that is the shared goal of the group in the given task. In other words, socially shared metacognition will take place when students regulate their metacognitive processes in the group level and make this regulation visible to other group members. Socially shared metacognition is a key factor for successful group problem-solving but to achieve socially shared metacognition and moreover to make it visible without mastering self-regulative, collaborative and problem-solving skills, without getting the appropriate guidance, regulation of motivation and constant control is a big challenge (Järvelä, Hurme & Järvenoja, 2011).

As we see, collaboration itself cannot be neither efficient or inefficient. According to Dillenbourg and Baker (1995) collaboration works under some conditions: the composition of group, the features of the task, the context of collaboration and the medium available for communication. Besides the essential requirements to the task the role of the difficulty level should be underlined. Collaboration never takes place when all of the group members know how to solve a problem themselves. To provoke active interactions task should make students not only use their own knowledge and skills but identify a problem and chose a right strategy how to solve it working together with the whole group. Research provides the evidence that collaborative learning is more effective in more complex learning environments (Dillenbourg, Järvelä & Fisher, 2009).

The individual prerequisites should be taken into account as “collaboration does not benefit an individual if he or she is below a certain developmental level” (Dillenbourg & Baker, 1995, p. 10). The perception of difficulty usually depends on students background knowledge and ability how to use this knowledge, how to find new information, how to control motivation and emotions or in other words it depends on person’s self-regulation skills.

Speaking about collaborative learning it is necessary to mention the role of teachers. A successful collaboration is not complete without certain planning or education. Teachers have to do more than establishing groups and telling them to study together. To provide collaborative learning and expecting students to achieve socially shared metacognition in problem-solving teachers need to take the following roles: educational, social, administrative and technical roles. In other words the main role of the teacher is to provide appropriate scaffolding paying attention to the students who face difficulties while working in a group.

In spite of the fact that collaborative learning is seen as a challenging approach it is still possible to achieve. In this section collaborative learning as a new learning approach that leads to deeper individual learning and understanding was presented. Providing collaborative learning with the technological solutions is a new form of collaboration that is called computer-supported collaborative learning (CSCL).

2.2.2 Computer-supported collaborative learning

There is a new practice besides collaborative learning in education that assumes using computer technology for fostering interactions between learners. While collaborative learning traditionally trains students to discuss and defend their ideas, engage the learning activities, take multiple perspectives without direct teacher involvement (Roschelle & Teasley, 1995), computer-supported collaborative learning (CSCL) provides new forms of collaborative learning and opportunities for active participation in knowledge construction by means of using computer-mediated environments. It is generally defined as collaborative learning, which is supported by a range of technological devices, platforms or tools (Kumar, Gress, Hadwin & Winne, 2010).

Computer-supported collaborative learning allows collaborative learning take place in computer-mediated environments where collaborative learners can interact with each other, share the information and coordinate their actions (Orvis, 2007). In other words the computer gives students the opportunity of exchanging ideas and information, working collaboratively, discovering alternatives in learning and developing their own learning styles and at the same time it takes role of the mediator of cognitive and metacognitive

processes that take place in students' individual and group learning. CSCL has problem-solving as the core element of its interaction design. Working in groups, students identify what they have already known, what kind of knowledge they need to know, and how and where to access new information that may lead to solving of the problem.

According to Weinberger (2011) CSCL can be orchestrated in different scenarios:

- co-located scenarios where students take place in the same learning environment and the technology is a cognitive tool that gives a shared focus and facilitates learning;
- computer-mediated scenarios where students can be far from each other, but they work collaboratively by means of using educational technology.

Using computer technology can facilitate learning as it gives students an equal opportunity to participate in argumentative discourse and students have time to elaborate their transactive arguments (Weinberger, 2011) but sometimes, to the contrary, make it challenging. While face-to-face meetings give students the opportunity to communicate with each other in the real life and know the emotions and preferences of the group members, it can be challenging to work collaboratively in the computer-mediated environment that is why it requires a deeper approach to emotion and motivation regulation. To support emotion and motivation regulation in CSCL situations the following requirements should be taken into account (Järvelä, Hurme & Järvenoja, 2011):

- Educators should motivate students by means of explaining goals and actuality of the given task, its connection with the studied material; regulate the relations within the group and provide appropriate guidance and feedback; make learning process interesting and create safe and cozy learning environment.
- Students are expected to use motivational strategies, learn to self-regulate their cognitive and meta-cognitive processes, be interested to work collaboratively, discuss and solve problems that take place in the group work, regulate the relations within the group and ask expert's advice when it is needed.

- Technology can be a perfect tool to support students' emotions and motivation when it provides possibilities to regulate learning. Using technology demands appropriate technological skills of students. To regulate the emotions and motivations of the whole group technology should provide participants with the opportunity to communicate and understand each other (e.g. video, voice, chat, personal information page) and work in the shared document simultaneously.
- Task should illustrate the topic taught. To enhance learning and activate individual thinking it should be interesting and challenging. Before doing the task students must be aware with the task instructions and requirements.

Some other problems that may occur in CSCL are little participation, little argumentative competence, cultural differences and preferences, different level of motivation and knowledge divergence (Kreijns, Kirschner & Jochems, 2003). It is important to remember that technology itself does not make learning interactive and engaging (Dillenbourg, Järvelä & Fisher, 2009). To activate students' cognition and provide an appropriate environment for collaboration strong pedagogical approach and adequate instructions are needed.

To promote productive interactions in computer-supported collaborative learning the collaboration script approach was developed. CSCL script can be defined as a method of CSCL design that helps to engage learners in collaborative activities by means of providing them with a specific socio-cognitive structure and distributing roles between learners (Weinberger, 2011). Collaboration scripts can provide educational design to online learning without direct teacher intervention, and provide a scaffold for learners at the same time.

According to Weinberger (2011) there are different types of CSCL scripts but all of them can be categorized into two main groups:

- Macro scripts are scripts that arrange learning activities by grouping and regrouping learners, distributing resources, accessing rights and sequencing different learning arrangements. Macro scripts solve such problems as connecting formal and informal education, loss of coordination in groups.

- Micro scripts are scripts that are responsible for arranging activities within a group: specifying and distributing roles and activities within group of learners. Micro scripts can be realized by means of structuring the communication interface.

After defining CSCL scripts, the functions of computer-supported collaborative learning scripts should be considered. Scripts can facilitate learning by building the following instructional principles (Weinberger, 2011):

1. Regulating learning activities

Guiding students in regulation of their learning activities: how to identify the core problem, how to choose a right strategy and how to apply theoretical knowledge to solve the problem.

2. Providing complementary procedural knowledge

Scripts can represent procedural knowledge giving student the opportunity to understand and internalize the script procedure.

3. Providing process-oriented instruction

Scripts provide instructions to student how to behave in working collaboratively that allows facilitating equal participation within a group.

4. Alleviating coordination

Scripts coordinate online learning activities, grouping of learners, distributing tasks among of learners and getting the shared-understanding between learners.

5. Fostering awareness

Scripts are expected to raise learners' awareness of many factors: background knowledge of others, activities of others and their presence and workplace, etc.

But to facilitate successful CSCL, providing students with scripts is not enough. All the instructions should be given before doing the task. In spite of the fact, CSCL requires little

teacher participation, teacher should provide guidance to students how to use certain scripts and be sure students can understand task instructions.

In spite of the fact that using collaboration scripts has a lot of advantages such as facilitating discourse qualities, improving online group functioning and enhancing individual achievement of learners, the researchers meet some matter of argument. CSCL script is a method that supposes collaboration to be structured by the educators. Such collaboration cannot be natural as it is forced by a lot of special factors that dictate interactions between students. The problem can be solved the following way: students who have less internal knowledge about how to collaborate should be provided with more detailed external scripts, while learners with high internal scripts should develop their existing knowledge (Weinberger, 2011). I agree with the researchers that the assessment of both factors should be conducted: the existing level of learners' internal scripts and how it is developed during the CSCL session. In this case, scripts take the role of scaffolding needed for students to learn how to construct their activities to succeed in collaboration.

Much research has been conducted to code and analyze students' interaction and participation using written messages during CSCL that has helped to understand the processes and outcomes of collaborative learning in computer-mediated environment. The messages of students were divided into a lot of categories but all of them can mainly refer to the following three groups (Hurme, Merenluoto & Järvelä, 2009):

1. Social messages are messages or comments that are not related to the problem (agreement, disagreement without visible argumentation)
2. Cognitive messages are messages related to problem-solving without any expectations.
3. Metacognitive regulation messages are messages that are related to the ongoing discussion and usually provide reasoning and argumentation to motivate other members of the group to solve a problem.

While social and cognitive interactions usually can take place matter-of-course, metacognitive interaction cannot always occur when students solve the problem together. Understanding the role of metacognitive processes is essential for designing the CSCL and supporting the groups' problem solving. Metacognition should be regulated on both levels: individual and group.

In classrooms, the teaching-learning process is a complex social situation involving multiple participants, each with their own intentions and interpretations that can influence one another's knowledge, opinions and values (Iiskala, 2004). Technology gives students the opportunity of exchanging ideas and information, collaborating, discovering alternatives in learning and developing their own learning styles but it also gives the opportunity for teachers to assess students' knowledge and skills. While students need to regulate their learning processes, cognitive, metacognitive and social processes on the individual and group level teachers need to provide students with the appropriate scaffolding.

2.3 Designing requirements to collaborative serious games

The main idea of this chapter is to summarize the findings of the previous two chapters with a purpose to define the concept of digital game-based collaborative learning or in other words collaborative serious games. After providing a definition to this concept, the role of collaborative serious games in learning will be investigated by means of researching the results and findings of the academic literature on the current topic that is a basis of identifying the requirements and challenges of designing collaborative serious games for learning. The chapter is going to represent a practical part of the Master's Thesis and answer the following research question: "What are the main requirements and challenges in design of collaborative serious games?"

The key point of the chapter is to provide requirements to design of collaborative serious game that improves the collaborative process of students and enhanced their learning results.

2.3.1 Digital game-based collaborative learning

In the previous two chapters such theoretical concepts as digital game-based learning, collaborative learning and computer-supported collaborative learning were researched. The combination of game-based learning concepts and collaborative learning may enable new application areas of CSCL that is called collaborative game-based learning.

Collaborative learning is used in schools today in various forms such as problem solving in teams, debates, or other team activities. According to Wendel et al. (2012) the idea of using computers to support collaborative learning is being investigated for more than twenty years, however, most of the research in the field of CSCL deals with e-learning applications or how to use Medias like the Internet or email to support collaborative learning. But in recent years, game based learning has become an alternative to traditional learning concepts. Today there is a multitude of Serious Games that can support learning in many fields (learning, sports & health, political education, etc.) Most of those games are for single player use and only a limited number of Serious Games have been designed with multiplayer support "due to the lack of concepts for multiplayer Serious Games" (Wendel et al., 2012).

Traditionally players of computer games were playing alone or with very limited number of players connected to the same computer while nowadays the focus has shifted from the isolated games to multiplayer ones allowing 64 or more users play against each other at the same time (Wang et al., 2009). All home-based gaming hardware is using the same standards for communication between each other like Wi-Fi and Bluetooth. Development of communication technology have led to the use and research of Collaborative Virtual Environments (CVE) the main aim of which is to bridge geographical gaps between people. There is a lot of research on collaborative gaming or Computer-Supported Collaborative play (CSCP). According to Wang et al. (2012) “the third place” is a metaphor for online gaming where players meet on the neutral ground that allows them to display their personality, individuality and sociability using nicknames (pseudonyms). The main activity of “the third place” is conversation that can occur by means of using voice or text chat with increasingly realistic 3D graphics.

Recently Virtual Worlds like Second Life or private virtual worlds like IBM Virtual Collaboration for Lotus Sametime are researched as collaborative learning environments (Nelson and Ketelhut, 2008). Massively Multiplayer Online Games (MMOG) have been used also as environments for collaborative learning scenarios as they are popular and often freely available. Moreover the design of such games is very complex as gameplay has to fulfill requirements of traditional single player games (fun, narration, immersion, graphics, sound), challenges of multiplayer games (concurrent gaming, interaction) and Serious Game design (seamless inclusion of learning content, adaptation and personalization). Furthermore, the requirements of collaborative learning have to be considered (group goals, positive interdependence, and individual accountability) (Wendel et al., 2012).

That is important to clarify that collaboration does not mean competition between players but otherwise collaboration set its goal to create a conflict in the form of interaction within the game. The team has to cooperate to reach a common goal, but the players always meet a conflict because of the differences in their preferences, strategies and motivation. Unfortunately, the lack of proper means of communication and interaction has made it difficult to support collaboration in computer games, that is why there are just few actual true collaboration games on the market (Wang et al., 2009).

Wendel et al. (2012) have conducted the literature review and developed the requirements for collaborative serious games based on elements of cooperative working (Johnson and Johnson, 1994): Positive interdependence, Individual Accountability, Face-to-Face Promotive interactions, Social Skills, and Group Processing) and the design guidelines stated in Zea et al. (2009) (Table 3). Based on these considerations, Wendel et al. (2012) developed an approach for a collaborative 3d multiplayer game fostering collaborative behavior as a foundation for collaborative learning. Escape from Wilson Island (EFWI) (Figure 9) was created using the Unity3 game engine. The game can be classified as a 3rd person role-play game (RPG) with limited roleplaying aspects which focus is the collaborative game-play that includes such social skills as teamwork, coordination or communication. As a narrative background, a well-known scenario 'Robinson Crusoe' was chosen.

The players stranded on a deserted island and have to escape from there. They have to reach a neighbored island with a high mountain to ignite a signal fire there. The starting island contains such resources as trees for wood, bushes with berries for food, or NPC herons running around randomly.



Figure 9. Four players steering the raft together (Wendel et al, 2012)

In order to clearly demonstrate how the following requirements were applied in the game, I created a table that includes the idea concepts, requirements and implementation (Table 3). As we see players have a common goal that is to reach the other island. In order to do that players need to collaborate as they need each other's help and skills for example to build a raft for which they need wood and other items. As the island is a dangerous place the players need to build a hut to sleep and get food that makes the gameplay realistic and promotes interactions among the players.

Table 3. Multiplayer 3D game design by Wendel et al (2012)

Concept ideas	Requirements	Implementation
1. Common Goal/Success	The goal of the game should be designed in such a way that success means success for all players.	Players can only escape together, not one player alone.
2. Heterogeneous resources	Each player should have one unique tool or ability enabling him/her to perform unique tasks in the game which other players cannot perform.	Each player has one unique tool (axe, map, whistle, hunter's badge) so that only the player with the axe can fell palms in order to get wood for building the hut, the raft or for fire.
3. Refillable personal resources	There should be certain refillable resources in a game which slowly deplete automatically or when players act dangerously and they should be influence able in a way such that players can help each other.	Need for food, health, and fitness.
4. Collectable and tradable resources	In order to create space for decisions to negotiate or collaborate there should be tradable resources in the game world necessary for the players to win the game.	A player can gather berries from a bush or the players can hunt a heron, which will give them some pieces of meat that can be cooked. Wood can be gathered from palms if they are chopped

5. Collaborative tasks	There should be tasks which are solvable only if players act together.	Carrying palms, hunting herons can only be performed in team (dependent of the size, this requires 2-3 players). The raft can be steered if all players are participating.
6. Communication	The game should provide a way for players to communicate (e.g. chat system, voice communication)	Players are able to communicate with each other via an integrated chat where a player can select the listeners. The chat window is always visible in the lower left corner.
7. Ingame help system	The game should provide help to the players when they are stuck. The help system should be triggerable by the players or help can be included in the game itself, e.g. by using ingame characters (NPCs) providing help when needed.	The game has a Non-Player Character (NPC) who tells the goals and gives hints how to achieve these goals. The NPC communicates with the players via a predefined structured chat system
8. Scoreboard	The scoreboard should show both individual efforts and team efforts at the end of the game that helps players judge the overall success.	At the end of the game, each player will have an individual score that is visible to the whole group. The score depends on the number of actions performed during the game like gathering berries, carrying wood, building the raft, helping to catch a heron, etc.
9. Trading	Players should be able to trade	Every player has a personal in-

system	items among each other that create space for decisions for or against collaboration.	ventory where he/she can place items gathered throughout the game. Those items can be given to other players by placing them in a community box accessible by every player.
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I have chosen the prototype of collaborative serious game created by Wendel et al. (2012) as it is not only a good example of collaborative game-based learning but a good tool for researching and identifying the requirements and challenges of developing and using such kind of game in teaching-learning practice. The study was made with 23 participants who after a short introduction (10 minutes) played in groups of 4 players per game. Gaming session lasted 30 minutes, and then the participants were asked to answer a questionnaire concerning user experience (UI) and game design. The participants found the game interesting, involving and motivating. During the game the players were solving tasks collaborating with each other and using such social skills as communication skills, teamwork and etc. The results of a user-centered study have shown that “collaborative multiplayer games can be promising alternative to traditional CSCL” (Wendel et al., 2012).

Another interesting finding is that groups with a team leader performed better than teams without a leader who did not collaborate at all. From my point of view collaboration is impossible if there is no leader in a group. That is a misconception to expect collaborative learning occurs if there is equality in a group, self-regulation and minimal teacher intervention. The good example is that in working experience when people collaborate there is always a person who controls quality of the work, regulate time and distribute roles between workers. In our case these are the tasks of the teacher or educator who need to regulate the group work.

In addition to the questionnaire participants gave their critical feedback, reflecting problems of the current game that are:

- Improvement of character control
- Need for a minimap

- More camera views
- Improvement of graphics
- More interaction with game world / more tasks
- More ways to differentiate the own avatar from others

The other set of requirements to GBCL was suggested by Wang et al. (2012) who has identified eight characteristics that should be considered when designing a good educational game:

1. Variable instructional control

The level of difficulty depends on the skills of the player or the player can choose complexity. In multiplayer games the players' skills should be used to match player of similar skills.

2. Presence of instructional support

If the player cannot solve a task, some hints or supplementary background information is available to the player. In multiplayer games the players can learn from each other by means of support for chat or forums.

3. Necessary external support

Personal follow up and available guidance are necessary for players to have a positive game experience.

4. Inviting screen design

Playful and inviting screen design might motivate players to game and learning process. In multiplayer games the players need to have an opportunity to customize avatar to differentiate between different players.

5. Practice strategy

Players should have an opportunity to practice their skills without affecting other players' results. In multiplayer games, a single player practice mode should be provided.

6. Sound instructional principles

Motivating abstractions of theoretical syllabus, collaborative learning or use of recognized cognitive psychological principles such as repetition and incremental learning are essential principals in a game.

7. Concept credibility

The theory or skills need to be abstracted in a way that maintains the integrity of the instruction. When abstractions become too conceptual or the game becomes too focused on abstractions instead of instruction, players find the game silly and lose interest.

8. Inspiring game concept The game concept should inspire the player to invest time into the game. While playing a game the players lose track of time, experience curiosity, have an enjoyable experience and want to continue playing until they need to stop.

Wang et al. (2012) mentions that these eight characteristics are not a completed list of characteristics educational game should have.

2.3.2 Requirements to collaborative serious games

As the key point of this chapter is to provide the requirements to collaborative serious games' design, I analyzed the functions of using educational games in the classroom (Carrier, 1985), the features of digital games (Prensky, 2001), technical, contextual and pedagogical considerations serious game should have (Felicia, 2009) from the requirements to the games and then the mechanisms that should be taken into account in orchestrating collaborative learning (Dillenbourg, 1999) and conditions which foster cooperative work in face-to-face groups (Johnson & Johnson, 1994) from the collaborative learning perspective and finally the requirements to collaborative serious games given by Wendel et al. (2012) and Wang et al. (2012) and my own pedagogical and technological (gaming) experience. The results (adaptation of theoretical framework) are presented in the following table (Table 4), which includes the functions to collaborative serious games, the requirements, practical examples from the entertainment games and its adaptation to collaborative serious games.

Table 4. Requirements to collaborative serious games' design

Requirements to game design	Practical implementation in entertainment games	Adaptation to collaborative serious game
Basic interaction with a game world essential function of any game		
<p>Clear and logical controls</p> <p>All game actions are controlled via input devices. Game should have simplified versions of the controls to take into account people with disabilities.</p>	<p>All in-game manipulations are made using specific, customizable controls. In most strategy and RPG games such as League of Legends or Diablo main character skills are mapped to a few keyboard keys, and mouse is responsible for main actions, like attack and move. Also each skill and action is available as an icon on the interface and can be activated by clicking on it.</p>	<p>In all popular games controls are made as simple as possible to end user so that player can concentrate on game process itself. Customization of key binding is important for players to make controls as easy to use as possible. For easy access most features could be accessible not only by keyboard but also via main menu or other interface elements like icons.</p>
<p>Clear User Interface (UI)</p> <p>should be clear and easy to navigate. All the necessary functions must be easily accessible to the players.</p>	<p>In action games where speed of players' reaction is vital interface is clear and provide as much information as possible. In Battlefield 3 only ammo count, health and map that is providing main tactical info, are displayed. Other information, like more detailed map, statistics and game options can be accessed via game menu and hot keys. In Diablo 3</p>	<p>Main game UI should display all needed information and statistics, but not to be fussy. It is important that game configuration is clear and statistics are straightforward. The player can browse skillset and inventory items of his or her group members that is important for collaborative game. If gameplay is not intense, it's ok for player to spend some</p>

	main game interface is more complex. UI displays selected skill set, skills' cooldowns, mana and health. Also player can quickly access inventory, map, check other players' statistics and compare items.	time interacting with interface, but if player needs to react fast, all important interface elements should be clear and easily accessible.
<p>Rules</p> <p>There should be clear basic rules describing what player can or cannot do in a game</p>	<p>RPG games like League of Legends or Diablo has clear rules describing how player may interact with a game world, how player progression is monitored and what it takes to level up a character. Most of the rules are described in a help section, and sometimes game characters are helping the players. For example in Diablo main character is telling the player "I cannot do that" if he or she tries to use health potion too often.</p>	<p>Games without rules are not only messy but also not fun. Rules could define game progression and learning curve and also help player to understand what actions are available in a game and what consequence an action might have. Help information could be integrated into the game process and be provided by NPCs. But also should be readable in specific section or in the Internet.</p>
<p>Task interpretation and planning</p> <p>promotes better task interpretation and teaches students to plan their cognitive and meta-cognitive learning processes</p>		
<p>Goals and objectives</p> <p>should be clear. They should be individual and collaborative. In the end completing the primal objective requires actions of all players.</p>	<p>In online co-op shooter Battlefield 3 there are two teams of players where characters have different skills. Each team has a clear objective (e.g. to defend or</p>	<p>The success of Battlefield game is based on the advanced and well-balanced cooperative system (winning the match is almost impossible when players act sepa-</p>

	<p>to capture different points). And team members should collaborate and use their own skills to achieve the goal. Objectives are clearly indicated on the map, shown in the game world and the completion of a single objective has obvious consequences in the gameplay (e.g. capturing an objective gives a team tactical advantage and let their players spawn closer to the next objective or enemy base).</p>	<p>rately), as well as engaging a system of personal achievements. This result also could not be achieved in collaborative serious games without each member knows and perceives team goals. That is why objectives should be clear indicated, visible and they should be explained by e.g. “objectives” part of menu and by the “voice of commander” that is telling what is done and how to proceed.</p>
<p>Strategies might be developed while player proceed during a game. Mistakes during the game should encourage the player to elaborate new strategies and new way of collaboration with other players.</p>	<p>In Battlefield 3 winning and losing the match strongly depends on the selected strategy of the team. Usually the team plays many matches in a row and before the next match starts team members can discuss why previous game was won or lost and how the strategy and game tactics could be improved. Even the game is lost each player is provided with personal statistics and if the player performed well it encourages him or her to go on or to improve own scores in the next game if</p>	<p>In a game there should be various ways of improving strategy and developing own skills of the players like playing few similar rounds or while proceeding further in a game. Even in a failure there should be an encouragement for player to improve and continue the game. Also in collaborative serious games an opportunity to discuss the future strategy and current tactics is an important part of collaborative gameplay.</p>

	the last one went not as desired.	
Monitoring and Control		
helps students to self-regulate their learning process by means of continuous monitoring and control of learning activities.		
Game progression Saving and loading mode should depend on the goals and duration of gaming session. Giving feedback on players' progress from time to time.	Many modern online games are featuring different kinds of auto-save feature. Diablo 3 is tracking player progress all the time and every action like changing a gear set or skill is immediately saved to the game server. But player cannot continue to play from the middle of the level and every time game is opened current quest must be started over. Multiplayer games like Battlefield or League of Legends have short game sessions and only general player preferences are saved. However game progress could be browsed any time during the game as for example Diablo 3 features extensive player statistics which are enjoyable to follow and compare with other players.	Game can combine auto saving feature with ability to save game progress by player. Progression statistics could be available during the game so that player can see what needs to be improved and after the end of a game, when overall performance is displayed and compared.
Learning curve The more player progresses	Even inside one difficulty level game difficulty is	For educational purpose it is important that player never

<p>in a game, the more difficulty level raises so that the player gets more knowledge and skills through gaining experience.</p>	<p>changing during player progression in the game. In latest Diablo 3 patch difficulty is based on player level. After receiving experience points character gain new levels with new more powerful abilities. However enemy level is rising accordingly, so that the player needs to practice new skills and improve old ones all the time during the game progression.</p>	<p>stop practicing and improving his or her skills. So the game is introducing new challenges and new skills required to complete the challenges. Also increasing difficulty makes sure that player stays in the flow and will not get bored.</p>
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<p>Motivation</p> <p>motivates to play a game and learn through playing</p>		
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<p>Flexibility of gameplay/ Random events</p> <p>Game environment reacts to players' actions in a game and changes accordingly.</p>	<p>In Diablo 3 terrains and mobs on each game level are generated randomly providing a player with different experience every time. It is especially important when game is designed to be replayable. Also some interesting locations or enemies are randomly accessible, so player must replay the level few times to find all of them and achieve rewards they hide.</p>	<p>Resources of game developers are usually limited. It is important to make each game level as much replayable, and each game asset as much reusable as possible. Random generators help to reuse the same game resources and motivates players not only to proceed further in the game story but also replay same parts of the game few times to find all interesting places and better rewards. Also rewards for the same objective could be random in some range, with</p>
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		<p>better rewards more rare to appear. It encourages players to complete the same quests few times to achieve better results that might be important for learning process.</p>
<p>The Flow Different players have different skills and level of difficulty should be adjustable.</p>	<p>For player to experience the flow a game should be challenging in the right way. Not too easy to bore and not too difficult to annoy. In example games already discussed the difficulty could be adjusted. Also if player feels that game is too challenging difficulty could be lowered on fly. For example Diablo 3 has 5 different difficulty levels. And the last level is divided into 6 levels. For example on lowest difficulty enemies have 100% health and damage and on hardest 8590% Health, 2540% Damage. However in Assassins Creed series there is no difficulty adjustment. The game is designed in such a way that every player can find optional objectives and play styles to match his or her skills and abilities.</p>	<p>Making the Flow is one of the most challenging parts of game design and balance. Main balance should be developed while designing the game, however letting the player select suitable difficulty level is the most effective way to let him or her experience the flow and as a result to rise a motivation to play more.</p>

<p>Customization/ Opportunities for creativity</p> <p>Characters can be customized in a game. Customization items can be received as a reward.</p>	<p>Most multiplayer games provide player with tools to customize their character. In games like Diablo 3 customization items (armor, banners) are achieved by completing challenges and progressing during the game. Achieving more powerful and rare items helps players to compete with other players. Often ability to select colors, change the look of a character (like haircut and eye color) have no practical advantage but helps player to self-express themselves.</p>	<p>Often creating the customization opportunities is a challenging process that requires significant resources. The depth of customization should be elaborated considering game style and necessity of such a system as well as available resources. In collaborative gameplay customization might help players to recognize each other and on the other hand to create an image of teammates that will provide grounding for collaboration.</p>
<p>Encouragement/ Reward</p> <p>Reward might reflect game progress or take part in competition with other players.</p>	<p>Special items and gear might be used to raise the power of character. Most powerful items could be bought for real money in a game. Even if these items are not vital to play through game, they help the players compete with each other by showing of who has built a better character. For example, Diablo 3 provides the players with RMAH (real money auction house) where items can be bought in order to upgrade a</p>	<p>Best items can be given to students not for money but as a reward for eagerly completing the task and motivate them to compete with each other and reach higher results.</p>

	character.	
<p>Video/Audio</p> <p>Graphics should match gameplay. The game can be absorbing without advanced graphics or vice versa it can be beautifully drawn but be not interesting.</p>	<p>In fantasy RPGs like Diablo and World of Warcraft graphical style is matching the gameplay and story completely. It has magical feeling and beautifully drawn cartoonish art. Battlefield however has advanced graphics with ultra-realistic style as the game is positioned as battle simulation. While both of this games has advanced graphics made but a whole division of professional artists there are also games played by huge amount of gamers with simplified video graphics or without graphical representation at all (textual and symbolic games). In such games gameplay, concept and story are so engaging that advanced graphics are just not necessary.</p>	<p>Quality requirements and style of game video and audio should be well considered and match the style and requirements of a gameplay as well as requirements for target group of players. While great engaging gameplay might be essential in a game, in serious collaborative games graphics seems to be the most neglected part of it. And for modern young players good look of a game make a first and the most important impression. So finding a balance is the main challenge in creation of such games.</p>
<p>Educational content enhances learning process</p>		
<p>Storyline/ user driven story</p> <p>Game should have interesting and exciting storyline that needs to be connected</p>	<p>Assassins Creed series is story driven game and it has really engaging story interesting to follow. Player cannot change main storyline;</p>	<p>Depending on the game style story might be its driven part or be just a background for more engaging gameplay. But it might be</p>

with the learning material.	however it is up to him to decide how to play the story. What quests to take first and how to complete them. Also player decisions during the walk through might have effect on future game and even on the game ending.	important for the player to have some kind of freedom to make decisions and to have an influence upon a flow of the plot.
Single player mode for practicing Games should have single player mode where the players can practice and master their skills.	League of Legends is featuring simple single player mode to get a taste of what it will be like in the multiplayer. Also player may try out skills that will be available only on higher level later in the game.	For some players fills uncomfortable playing with the real people. For example because real, more experienced players a new comer might be criticized. So single player mode where a gamer might learn the basics of game is important.
Collaboration promotes and fosters collaboration between the players		
Communication is basics of collaboration that should be enhanced by using chat system and/ or voice communication.	Games like Battlefield provide teammates with different features to communicate with each other. Most important is teamspeak and chat. In Diablo however there is no build-in voice communication, but it is possible to use Skype and other third party software to communicate with players in a game.	Communication features are essential for collaboration. Voice communication is the most efficient way to discuss game progress and plan a task, but alternative ways of communication like team chat should be provided as teamspeak requires additional devices and access to those could be limited.
Competition The element of competition	Competition in games can be provoked by result charts.	In collaborative serious games result charts could

<p>should present in a game motivating students to achieve higher results than other players.</p>	<p>For example in Star Craft where the main goal is to win the enemy team, in the end of the game result charts with individual and group results are provided to the players. Result charts reflect effectiveness of each player making them compete with each other.</p>	<p>provide the information about the quality and time of task performance as collected score points.</p>
<p>Conflict Conflict situations teach players argumentation and negotiation skills.</p>	<p>In multiplayer games like League of Legends game is based on a conflict of two teams. However often conflict may rise inside a team as all players are different age and level and some of them can be blamed in team failure. However after game ends other players can award teammate with “teamwork” status meaning that players’ behavior was sportsmanlike.</p>	<p>In multiplayer educational game it is important for players to be able to negotiate and solve conflict situations inside a team as single player should not be able to complete collaborative task himself.</p>
<p>Challenge Game should provide challenging situations to make students solve the problem together but it should not be very difficult as the players can lose their motivation.</p>	<p>Challenge is one of the fundamental part of the game. In multiplayer game like Battlefield opponents are making player to get better gear and skills to be able to encounter player of higher level.</p>	<p>Tasks and difficulty levels should be built in a way to provide player with continues challenge. It is even more interesting and engaging for players if they can challenge each other as it can provide higher standard and goal for students. Com-</p>

		pletion challenging tasks might be rewarded with achievements to compare with other players and be a part of competition.
<p>Different character classes with different skills</p> <p>Opportunity to select preferred skillset or playing style.</p>	<p>League of legends provides players with opportunity to select a character from a list of 116 different champions. Each of them has different abilities and play style. Diablo has 6 different heroes with different tactics. Playing co-op game with different classes involved give an opportunity to combine different skills and build an ultimate tactic that combine strong points and eliminating weaknesses of each hero.</p>	<p>Game where player is required to combine skills with other players to achieve a goal is interesting to play and requires collaboration. Different character classes gives opportunity to choose preferred skill set and player might want to try to complete same tasks few times playing different characters.</p>
<p>Collaborative tasks</p> <p>Task should be developed such a way that they can be solved only in collaboration with other players.</p>	<p>Battlefield game has four classes to choose from. Destroying some targets requires one class to mark a target for another class to be able to shoot it.</p>	<p>As each player has its unique skills or items, some tasks require collaboration to be completed as it is possible only by combining different skills.</p>
<p>Assessment</p> <p>allows the teacher to evaluate learning results of the students</p>		
<p>Outcome</p> <p>depends on individual and group actions.</p>	<p>Mass Effect series features amazing storyline and has seven different outcomes. It makes gamers play the</p>	<p>Outcome could be straightforward like win/lose, but it is more engaging if different player actions and perfor-</p>

	whole series again and again to perform right actions and find all available outcomes.	mance of the team trigger different outcome.
Feedback could be given during game progression and completion of some tasks as well as more detailed feedback should be given when the game ends and all primal goals are completed.	Diablo 3 provides player with extensive statistics on how player progresses in the game. Amount of tasks completed, elite enemies killed, special items collected, achievements, etc, could be viewed any time in the game. Battlefield 3 provides team and players with charts displaying members' performance when game match ends. It shows how player performed individually and has supported other players from team perspective.	Providing a player with game statistics during a game in progress allows the player to compare scores and outcomes with teammates or opponents and make some steps to improve it. Also feedback in a form of score charts must be provided in the end of the game where results of all players is displayed and compared to each other and to the goal. So all players can see individual performance and overall success of the team. Also such a report is useful for teachers to monitor students' progress and to give own feedback.
Scaffolding/ Instructional support scaffolds players in a game world.		
Help system Help need to be triggerable and flexible not annoy the player who does not need any help at the moment.	Dead Space series features smart help system. Help topics and notifications are triggered only if player is stuck and cannot progress further in the game or is doing something completely wrong. Also game has a	In educational games it is important to help player if needed. Some intractable items might be provided with help icon that might be clicked to view help information regarding the subject. If teacher is inspecting

	help menu and manual if further assistance is needed.	game process he might be able to help out contacting player using chat.
<p>Navigation</p> <p>Game can have an open world where players can chose objectives how to proceed in a storyline or game can have a straight progression in the world where players usually move in one direction. However, in both game types map, compass, directions can greatly improve the ability to navigate easily in the game.</p>	<p>In Battlefield 3 map is important part of the gameplay as it provides tactical information regarding enemy dislocations, objectives, important places. And also helps to navigate throw game world. In Diablo 3 map is used to quick travel throw the vast game world.</p>	<p>Map helps players to see tasks and objectives in a game world. Different markers can indicate different task types (like collaborative or not). If teacher is inspecting a game he might have an opportunity to place a point of interest with a comment on a map visible to all students.</p>

3. CONCLUSSIONS AND DISCUSSION

The current study is a theoretical overview on collaborative serious games. Collaborative serious games as a new approach in teaching-learning process was defined, the problems arising in using and implementation of these games in learning and education were researched and the requirements to collaborative serious games' design were provided with a purpose to improve the collaborative process of students and to provide a new solution to the pedagogical problems the modern teachers can face in their practice (e.g. motivation, engagement in learning, self-regulation, developing of argumentation skills and ability to work collaboratively and etc.).

The main research questions of the study were: (1) What is collaborative game-based learning? (2) How can learning be enhanced by means of using collaborative serious games? In order to provide answers to research questions of the study the theoretical framework on digital game-based learning, serious games, collaborative learning, computer-supported collaborative learning, collaborative serious games (digital game-based collaborative learning) were researched and analyzed.

The first sub question of the study was the following: *What are the benefits of using serious games in learning and education and what are the "pros" and "cons" of using serious games as a technological tool?*. First of all, the importance of games as an educational tool was identified. Game can be widely used for educational purposes as it promotes the formation of cognitive interest, accumulation of knowledge and skills development. The definition of educational game that is an interactive play that teaches people goals, rules, problem solving, adaptation, interaction, collaboration, all represented as a story shows how important using games in teaching-learning process can be (Prensky, 2001). In the process of educational game people can be taught about certain subjects, develop or improve their skills and get fun at the same time. By analyzing the functions of using game in a classroom given by Carrier (1985) we see that game positively influences on the teaching-learning process motivating students to learn and making their learning more interesting and interactive.

After identifying the role of games in teaching-learning process the appropriate definition of serious games was chosen. Serious game is a computer based game with a primary purpose other than entertainment, ranging from anywhere between advertisements to military training exercises (Michael & Chen, 2006). Serious games differ from computer games as they have more than just story, art and software; serious games have pedagogy (Zyda, 2005) so that the main purpose of serious games is not only to entertain users, but to teach them the specific subject. Serious games can be similar to educational games but they are primarily focused on an audience outside of primary or secondary education.

Among the benefits of using serious games in learning and education the following states were established. "Serious games" are often considered as one of the methods to reach the new generation of students and at the same time to use new gaming technologies for educational purposes as serious games combine a proper game entertaining component and a training component together. Serious games allow learners to experience situations that are impossible in the real world for reasons of safety, cost, time, etc. (Corti, 2006). Serious games provide a platform for active learning as they can be customized to the learner, they provide immediate feedback, allow active discovery and develop new kinds of comprehension (www.futurelab.org.uk/projects/games-in-education). Educational computer games perform several functions: the game teaches, educates and develops the intellectual and creative abilities of students, makes learning more interesting and vivid, moreover it increases the motivation of committing certain actions, creates an atmosphere of joy and psychological comfort (Ulicsak & Wright, 2010, p. 51).

In spite of the fact that serious games potentially improve the acquisition of knowledge and cognitive skills of students there are some challenges teachers need to overcome when they are going to use serious game in the teaching practice; they are: cost of games and hardware, time to learn the game to ensure that it is used appropriately. Many teachers are still considering using computer games with great suspicion, believing that they assume only entertainment. And although it can be difficult for teacher or educator to choose an appropriate material that satisfies students not only from the educational perspective but from the entertainment one.

In spite of the fact that they are supposed to be a strong teaching tool, the use of serious games in education is still in the early stages of their development. Using of improperly

selected educational games leads to the loss of motivation and students' skeptical attitude to games. (Felicia, 2009, p. 6) while frequent use of computer games can exacerbate the negative psycho-social trends (it can lead to social isolation, aggression and violence), and it negatively affects health (Felicia, 2009, p. 6).

Games are an important part of the learning process, but serious games themselves do not produce learning outcomes. If this learning method is chosen, it is important to develop a strategy and methodology of estimating the desired results. To achieve the high learning result a lot of considerations should be taken into account. Teachers are expected to ensure their students achieve certain mastery and give the appropriate feedback to students, while students themselves should recognize how to use the received knowledge and how to progress in their learning. The game should include a dynamic gameplay with a strong pedagogy inside and be applied across the curriculum in conjunction with other teaching methods.

The second sub question of the study was the following: *What is collaboration in teaching-learning process and how collaboration can be supported by means of technology?* There are a lot of definitions of "collaborative learning" concept. The most popular and satisfied definition was given by Roschelle and Teasley (1995) who define collaboration as "coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem" (Roschelle & Roschelle, 1995, p. 70). In collaborative learning "students are responsible for one another's learning as well as their own and that reaching the goal implies that students have helped each other to understand and learn" (Dooly, 2008, p. 22). The basis of collaborative learning is constructivism that means knowledge is constructed, and transformed by students. The research proves collaborative learning is more effective in achieving high learning results than individuals working alone (Järvelä, Hurme & Järvenoja, 2011) but collaboration itself cannot be neither efficient nor inefficient. According to Dillenbourg and Baker (1995) collaboration works

under some conditions: the composition of group, the features of the task, the context of collaboration and the medium available for communication.

Laal and Ghodsi (2012) defined the academic benefits of collaborative learning that are the following:

- CL Promotes critical thinking skills;
- Involves students actively in the learning process;
- Classroom results are improved;
- Models appropriate student problem solving techniques;
- Large lectures can be personalized;
- CL is especially helpful in motivating students in specific curriculum.

A successful collaboration is not complete without certain planning or education. The main role of the teacher is to provide appropriate scaffolding paying attention to the students who face difficulties while working in a group. In spite of the fact that collaborative learning is seen as a challenging approach it is still possible to achieve.

Providing collaborative learning with the technological solutions is a new form of collaboration that is called computer-supported collaborative learning (CSCL). CSCL allows collaborative learning take place in computer-mediated environments where collaborative learners can interact with each other, share the information and coordinate their actions (Orvis, 2007).

According to Weinberger (2011) CSCL can be orchestrated in different scenarios:

- co-located scenarios where students take place in the same learning environment and the technology is a cognitive tool that gives a shared focus and facilitates learning;
- computer-mediated scenarios where students can be far from each other, but they work collaboratively by means of using educational technology.

Computer gives students the opportunity of exchanging ideas and information, working collaboratively, discovering alternatives in learning and developing their own learning styles and at the same time it takes role of the mediator of cognitive and metacognitive processes that take place in students' individual and group learning (Weinberger, 2011).

CSCL has problem-solving as the core element of its interaction design. Working in groups, students identify what they have already known, what kind of knowledge they need to know, and how and where to access new information that may lead to solving of the problem.

To promote productive interactions in computer-supported collaborative learning the collaboration scripts are used. CSCL script can be defined as a method of CSCL design that helps to engage learners in collaborative activities by means of providing them with a specific socio-cognitive structure and distributing roles between learners (Weinberger, 2011).

In spite of the fact, CSCL requires little teacher participation, teacher should provide guidance to students how to use certain scripts and be sure students can understand task instructions. Understanding the role of metacognitive processes is essential for designing the CSCL and supporting the groups' problem solving.

In classrooms, the teaching-learning process is a complex social situation that requires students to regulate their learning processes, cognitive, metacognitive and social processes on the individual and group level while teachers need to provide students with the appropriate scaffolding.

The third sub question of the study was the following: *What are the main requirements and challenges in design of collaborative serious games?* The combination of game-based learning concepts and collaborative learning may enable new application areas of CSCL that is called collaborative game-based learning. The design of such games is very complex as gameplay has to fulfill requirements of traditional single player games (fun, narration, immersion, graphics, sound), challenges of multiplayer games (concurrent gaming, interaction) and serious game design (seamless inclusion of learning content, adaptation and personalization). Furthermore, the requirements of collaborative learning have to be considered (group goals, positive interdependence, and individual accountability) (Wendel et al., 2012).

Digital game-based collaborative learning or collaborative serious games is a new and not officially established concept in the scientific research but it is considered as a promising approach that helps to motivate modern students to the learning process. According to

Wendel et al. (2012) using collaborative multiplayer games in learning can be promising alternative to traditional CSCL” (Wendel et al., 2012).

As we see from the Table 4 (p. 60) games of different styles developed for entertainment have a lot of common and similar characteristics. Developed to motivate the players to continue playing the game, such things as Flow and gameplay are considered from many perspectives and all game features are connected with each other. From the technical perspective there are basic requirements for all games: there should be clear and logical controls, clear UI and clear basic rules describing what player need to do in a game. In all popular games controls and rules are made as simple as possible so that the player can enjoy game process itself. Concerning collaborative serious games that is important to take into account that students are expected not only be motivated by playing a game. It needs to make students concentrate in order to benefit new knowledge and skills from the game process. Moreover, some students cannot be introduced with the game area and they can experience difficulties at the beginning. Goals and objectives should be clear in a game. They should be individual and collaborative. Teachers need to explain the rules and goals of the game beforehand and be sure students have a right task interpretation. Most of the games provide the players with an opportunity to elaborate and improve strategy while playing few similar rounds or proceeding further in a game. Collaborative serious game should encourage players to maintain strategies on a group level, for example by providing the students with an opportunity to discuss the future strategy and current tactics in order to succeed. Different strategies can be provided by different character classes as each class can require different playing style and approach (Figure 10).

Figure 10. *Battlefield 4. Different character classes with class specific abilities and role in a game*



Next it is important to underline the role of scaffolding or in other word support for both students and teachers. Teachers take a new role where they need not only to teach a certain subject to enhance students' learning competence and outcomes but to scaffold students if they face difficulties in game itself. First of all help needs to be triggerable in a game, but the teacher might be able to help contacting player using chat. If the game has an open world it should provide the players with different types of map, compass and directions to navigate players in the game world. Here we meet the next challenge: even teachers who have a good gaming experience can meet difficulties with using and implementation of the game. The solution can be teacher-teacher and teacher-IT expert collaboration that can be reached by contacting game technical center and discussing problems with other teachers by using official game forums. The other important aspect is Learning curve that means the more player progresses in a game, the more difficulty raises, that is why it is important that player never stops practicing his or her skills in order to improve it.

A lot of attention should be drawn to such aspects as motivation and collaboration in collaborative serious games. According to the table the following aspects could foster students' motivation to learn through playing game: Flexibility of gameplay/ Random events, the Flow, Customization/ Opportunities for creativity, Encouragement/ Reward, Video/Audio. Making the Flow is one of the most challenging parts of game design as different players have different skills that require the level of difficulty to be adjustable. Both

Customization/ Opportunities for creativity and Encouragement/ Reward should be considered and connected with each other in order to make game interesting and engaging. Characters can be customized in a game while customization items can be given to players as a reward for eagerly completing the task and motivate them to compete with each other and reach higher results (Figure 11).



Figure 11. Diablo 3. Character evolution during the game process

Communication features are essential for collaboration. Voice communication is the most efficient way to discuss game progress and plan a task, but team chat should be provided. The element of competition should present in a game motivating students to achieve higher results than other players. In collaborative serious games result charts could provide the information about the quality and time of task performance as collected score points (Figure 12).



Figure 12. League of legends. Aftermaths statistics

In collaborative serious game it is important for players to be able to negotiate and solve conflict situations inside a team that is why game should provide challenging situations to make students solve the problem together and tasks should be developed such a way that they can be solved only in collaboration with other players. Game should provide challenging situations to make students collaborate but it should not be very difficult as the players can lose their motivation. Completion challenging tasks might be rewarded with achievements to compare with other players and be a part of competition.

Video game design refers to planning, designing, and creating video games. As we see designing collaborative serious game is challenging but realistic at the same time. A lot of factors need to be considered as there are a lot of different areas of video game design. For example, to creating a complex video game one team of video game designers may be responsible for coming up with the story behind the game and the narration while another team may focus on creating characters and animation and other designers collaborate to create the settings and layout for the game. Some game designers can specialize in creating music, sound effects, or character voices in a video game. Unfortunately, in serious collaborative games graphics seems to be the most neglected part. Quality requirements and style of game, video and audio should be well considered and match the style and requirements

of a gameplay as well as requirements for target group of players. So finding a balance is the main challenge in creation of such games.

Not only implementation of using collaborative serious game requires teachers' participation as designing and development of such games requires collaboration of game developers and teachers so that the game can be considered from both perspectives technological and pedagogical and vice versa teachers and educators may face difficulties in using such games in learning that is why they may need some technical support.

Through researching the importance of pedagogical concepts as serious games and collaboration in learning and providing learning with a technological support that is called computer-supported collaborative learning has helped to identify the importance and necessity of developing and implementation of collaborative serious games in formal and informal learning.

Nowadays when technology has become an essential part of life and it is using in many different spheres a lot of research has been conducted to define on how technology can enhance learning (Marc Prensky, Paul Gee). Games are widely used in learning and education. Serious games include both fun and entertainment, as well as teaching and learning content and they make the process of acquiring knowledge and skills easy, fun, and, at the same time informative (Michael & Chen, 2006). But in spite of the fact serious games are expected to improve knowledge and skills of students they are still not much in use. Due to the fact it is challenging to develop collaborative serious game that should include strong pedagogical content, all the game features and elements of entertainment nowadays there are no many good existing collaborative serious games (Wang et al., 2009).

Taking the role of providing requirements to collaborative serious games it is hoped that the current study will help to raise students' motivation and improve learning. Have being researched a big amount of scientific literature has helped to create an understanding that learning is a complex process that has a certain structure and it requires a systematically connected methods and activities. That is why even a good designed collaborative serious game cannot be effective without a proper pedagogy and close connection with the learning material and other methods.

It can be concluded that the proper and adequate use of collaborative serious games and exclusion of violence in their content can significantly increase the effectiveness of teaching-learning process. Collaborative serious games could be a key to reach modern students while in addition to the traditional methods of learning and teaching it could help to open students' mind and lead to deeper learning. On the other hand collaborative serious games can be used as a tool to involve not active students to the learning process. First, such students might prefer technology especially games to real people and secondly, educational technology allows students to reveal communication and argumentation skills, making conversation easier.

The current study is a good addition to the earlier studies on DGBL (Egenfeldt-Nielsen, 2009; Felicia, 2009; Prensky, 2001), CL (Dillenbourg, 1999; Dillenbourg & Baker, 1995; Dooly, 2008; Gokhale, 1995; Johnson & Johnson, 1994; Järvelä, Hurme & Järvenoja, 2011; & Laal and Ghodsi, 2012) and CSCL (Kumar, Gress, Hadwin & Winne, 2010; Hurme, Merenluoto & Järvelä, 2009; Orvis, 2007; Roschelle & Teasley, 1995; & Weinberger, 2011) as it explains the relationships between the theoretical concepts and by summarizing the existing theories provides a definition to a new pedagogical concept - digital game-based collaborative learning.

Being a theoretical overview on collaborative serious games the study fills the gap in the scientific research. Moreover, it provides the new results as they extend the existing requirements to collaborative serious games (Wang et al., 2009; Wendel et al., 2012) with elaborating the requirement to games for entertainment.

As the previous research shows that some video games for entertainment can enhance collaborative learning of players (Zea, 2009), the experience of designing such games can be borrowed to develop a good serious game for collaboration. It requires an analysis and adaptation of the best practices of entertainment games to promote collaborative serious games.

While researching the features of games for entertainment and elaborating the requirements to collaborative serious game it was noticed that there is a strong connection between the requirements to game design; all factors should be taken into account in order to develop a

good collaborative serious game that is why the task of modern methodologists, psychologists and programmers is to develop reliable, high-quality and effective collaborative serious games by working in close cooperation. According to Wendel et al. (2012) using collaborative multiplayer games in learning can be promising alternative to traditional CSCL” (Wendel et al., 2012). Teachers and educators need to reconsider their attitude to computer technology, as well as they need to learn how to use a variety of technological tools to enhance students' learning and motivation to the learning process.

Implications for future research

The basic theoretical framework of collaborative serious games is provided in the Master’s Thesis. The study introduces teachers and educators with a new educational approach, revealing the features of DGBCL in order to make them be motivated in using of such games in formal and informal learning as a part of the learning plan. The study is focused on providing the requirements to collaborative serious games. It is expected to help game designers in developing of such games and teachers or educators to understand how to choose a good game that will enhance students’ learning. Recently the topic is widely being discussed but there is not much research on how to apply collaborative serious games in teaching-learning process (Wendel et al., 2012) that is why the further research on implementation of DGBCL in formal and informal learning is needed. It is hoped the current study will become a useful source for the further research.

5. EVALUATION

To better understand the concept “collaborative serious games” the main ideas of each of the following studies: game-based learning, digital game-based learning, serious games, collaborative learning, computer-supported collaborative learning that are different research areas that have similar structure and requirements were researched that is a great amount of work done. Each theory was reflected through the prism of learning and the method of Analysis and Synthesis was used. To provide more accurate results, the scientific works of domestic and foreign researchers has been chosen and analyzed. To answer research questions (1. What is digital game-based collaborative learning? 2. How can learning be enhanced by means of using collaborative serious games?) two different types of data (theoretical and empirical) were used in the study.

The study provides reliable information as sources used in the Master’s Thesis are the articles from high-quality journals and books. The conclusions and discussions are reliable due to the fact that the author has both pedagogical and technological backgrounds. Considering data collection it is essential to mention that to make data reliable games of different styles are chosen and analyzed.

The study does not have participants that is why ethical issues concern the right to use the ideas and results of the previous research. All the information used in the study has a permission of using for learning purpose. The references to the original sources are used.

Nowadays when technology has become an important part of life and it is using in many different spheres a lot of research has been conducted to define on how technology can enhance learning. Games are widely used in learning and education but in spite of the fact serious games are expected to improve knowledge and skills of students they are still not much in use (Felicia, 2009). As a researcher being interested in using technology in education especially in digital game-based learning I set the following questions:

- Why are serious games not used much in formal and informal learning as they are a popular subject of the research nowadays?
- What kind of advantage can learners and educators benefit from using serious games in learning and education?

- What are the requirements to serious game design which purpose is to satisfy students' learning needs?
- How teachers and educators can be encouraged to use serious game in teaching-learning practice?
- How serious games can be used in order to enhance learning?

Being an expert of theory and methodology of teaching foreign languages and cultures the first idea was to conduct a research on how serious games promote language learning that results and conclusions can be applied in my future practice but when I have started to research theoretical literature about digital game-based learning to master this scientific area I have known that serious games can promote students' collaboration. According to Felicia (2009) serious games could provide group activities or in other words collaboration between students and according to Wendel et al. (2012) using collaborative multiplayer games in learning can be promising alternative to traditional CSCL. That is why I decided to change the focus and to research the reciprocal relationship of serious games and collaborative learning that forms a new learning approach that can be called collaborative serious games or digital game based collaborative learning.

Being interested in playing games myself I am expressing the positive position of using games as a pedagogical tool if the content and use satisfies the choosing auditoria. Moreover to prevent a risk of psychological and physiological health disorders games need to be used under proper control of educators and parents (Felicia, 2009). Games are interesting to play but they take a lot of time, while using serious games allows to combine both learning and fun and to spend time usefully (Michael and Chen, 2006).

While playing the selected games and analyzing their functions I have learnt that using the experience of games for entertainment open new perspectives and opportunities in the field of education. In spite of the fact that such games are aimed on the wide selling, they are able to motivate players, attract their attention, make players continue playing and at the same time master new skill (Zea et al., 2009). Games for entertainment are not developed with educational purposes but at the same time they include learning aspect (games teach certain skills, emotion control, communication and some aspects of collaboration) that

means that game itself could be a solid basement while their adaptation for educational purposes would be able to reach high results in teaching- learning practice.

The Master's Thesis has a wide perspective that supposes to be used by teachers, game designers and researches in order to enhance collaborative process by means of using collaborative serious games.

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