Educational digital games: models and implementation

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Abstract. Nowadays, social media, ICT, mobile technologies and applications are increasingly used as tools for communication, interaction, building up social skills and unique learning environments. One of the latest trends observed in education is an attempt to streamline the learning process by applying educational digital games. Despite numerous research data, that confirms the positive effects of digital games, their integration into formal educational contexts is still relatively low. The purpose of this article is to analyze, discuss and conclude what is necessary to start using games as an instructional tool in formal education. In order to achieve this aim, a complex of qualitative research methods, including semi-structured expert interviews was applied. As the result, the potential of educational digital games to give a unique and safe learning environment with a wide spectrum of build-in assistive features, be efficient in specific training contexts, help memorize studied material and incorporate different learning styles, as well as to be individually adaptable, was determined. At the same time, the need for complex approach affecting the administration, IT departments, educators, students, parents, a strong skill set and a wide spectrum of different roles and tasks a teacher carries out in a digital game-based learning class were outlined. In conclusion and as a vector for further research, the organization of Education Design Laboratory as an integral part of a contemporary educational institution was proposed.

Keywords: educational digital games, game-based learning, advantages and challenges of educational games, Education Design Laboratory model.

1 Introduction

Modern media that come in many different formats, including books, magazines, newspapers, television, movies, video games, music, cell phones, various kinds of software and Internet, can be viewed as an important form of pedagogic influence and

socialization, as they not only spread information but also form our cultural values and behavioral norms.

In recent years, when contemporary high-tech enterprises require their employees to demonstrate the good level of mathematics, sciences, engineering, be computer literate and solve complex tasks creatively, the training of a new, competitive generation depends, primarily, on innovative technologies and teaching approaches that would enhance students' potential and, at the same time, would be cost effective.

Taking into consideration that the young generation of today is growing up in networked interactive media world where high-speed information acquisition, graphic images, instant rewards and multi-tasking are omnipresent, educational landscape reacts by introducing social media, ICT and mobile technologies to reach new student audience and apply these media as an educational tool on a preschool, elementary, secondary, and higher levels. Most recently, instructional designers have been examining how best use digital games.

Literature review lets us state that on the international level the scope of scholarly works about digital games is wide. For example, the focus of queries of Katie Salen Tekinbas, Eric Zimmerman [27] and Pavel Zemliansky, Diane M. Wilcox [36] falls on game design. Mark Prensky investigates D-generation and argues for partnering pedagogy [23]. Several studies, including papers by Glenda A. Gunter, Robert F. Kenny and Erik Henry Vick [15] discuss the formal design paradigm for serious games. Pieter Wouters, Christof van Nimwegen, Herre van Oostendorp and Erik D. van der Spek [35] presents the analysis of motivational and cognitive effects of video games. The description of frameworks for design and analysis of digital games can be found in the works of Sylvester Arnab, Sara de Freitas, Francesco Bellotti, Theodore Lim, Sandy Louchart, Neil Suttie, Riccardo Berta, Alessandro De Gloria [3] and Christian Sebastian Loh, Yanyan Sheng, Dirk Ifenthaler [21]. Questions related to the game-based curriculum are analyzed in article of Björn Berg Marklund and Anna-Sofia Alklind Taylor [4].

There are a number of projects that exemplify the gamification process and digital games' application to different contexts, including educational. Among them are Beaconing – Breaking Educational Barriers with Contextualised Pervasive and Gameful Learning (Horizon 2020, EU Program); Nutriciencia – a research project to increase food and nutritional literacy of high-risk populations (the University of Porto, EEA Grants Program, Ministry of Health, Portugal); Serious Games in Higher Education: Impacts, Experiences and Potential (Research Center CIIE, the University of Porto, Portugal); KidCOG' – Prevention of Online Sexual Grooming of Children' project (the University of Skövde, the Change Attitude Foundation, Sweden).

The research results report a number of successful educational video games' and commercial off the shelf games' uses [14], and confirm that digital games have a potential to increase students' motivation, provide a more authentic learning experience, teach system thinking, facilitate collaborative problem-based learning, and influence social sphere.

Despite these examples, the integration of digital games into formal education is still relatively low. This can be partially explained by the fact that many educators see video games as a leisure time activity with no pedagogic value; many are not familiar with

games' interfaces as well as the game based learning concepts and process. Even those teachers who use video games face a wide range of issues to be addressed to, which makes implementing digital games into educational context highly challenging.

In other words, what we observe today is the high popularity of video games and the increase in their production and research importance. At the same time, there is an obvious gap between theoretical claims and practical implementation of digital games into a formal educational context.

Given this, the purpose of this article is to analyze the path of educational digital games from theory to a real-life educational context and to look into what it takes to use games as an instructional tool.

2 Research methods

In order to achieve our aim, a complex of qualitative research methods, including synthesis, comparison and generalization of theoretical material was applied, which helped identify the main topics for the analysis. Theoretical analysis was in large part informed by the material related to pedagogical aspects and based on the study of such works as "Digital games in schools: A handbook for teachers" (by Patrick Felicia [10]), "Supporting Teachers in the Process of Adoption of Game Based Learning Pedagogy" (by Valérie Emin-Martinez, Muriel Ney [9]), "Learning with Digital Games: A Practical Guide to Engaging Students in Higher Education" (by Nicola Whitton [33]), "Production of Creative Game-Based Learning Scenarios: A Handbook for Teachers" (ProActive Project [24]), "Best Practices For Using Games and Simulations In The Classroom: Guidelines for K-12 Educators" (Software & Information Industry Association Education Division [34]), "Poverty is not a Game: A Handbook for Teachers" (by Caroline Kearney [19]). After the theoretical analysis was completed, the most frequently raised topics were identified:

1. game-based learning, its characteristics and distinctive features;
2. advantages of digital games as an instructional tool: cognitive, motivational and social aspects; characteristics of a good game;
3. possible ways of digital games' integration into formal educational context;
4. teacher's role(s) in a digital game-based learning class.

Our analysis is also based on interviews (within interview guide approach) with a selected group of experts from The School of Informatics, University of Skövde. Six people were interviewed, with some people interviewed twice. Each interview lasted from forty to eighty minutes. The detailed notes were taken and/or the recording was done. The group of experts was selected from the lecturers, senior lecturers and the researchers in Serious Games of the School and included the Associate Professor in Educational Game Design and Game-Based Learning and the Researcher in Game Studies; the Lecturer in Media Arts and the Researcher in Virtual Reality; the Lecturer in IT and Game Design and the Researcher in Educational Games; the Senior Lecturer in Informatics and the Researcher in Serious Gaming; the Associate Professor in Media Arts, Aesthetics and Narration, and a Serious Game Designer from ZCOOLY company.

On the later stage, theoretical claims as described in research articles, projects' accounts and web resources were compared and contrasted with the discoveries from the expert interviews, therewith a more all-round view on what digital games can offer, their strengths and weaknesses, as well as what is necessary to start using games as an instructional tool was constructed. Final conclusions were made.

3 Results and discussion

We consider it necessary to begin our analysis from defining educational digital games. Educational digital games or EduGames are also known as "video games for learning", "computer games", "applied games", "games for education", "learning games", "electronic educational game resource" (a term recently introduced by the Ukrainian scientific community) [6], "serious games", with the last term as a recent years' *mainstream* term that describes games for learning, training, healthcare and social change [28]. If video games are considered an activity that includes one or more players, has definite goals, rules, limitations, rewards and outcomes, is artificial with the element of a competition, then serious video games are those that are built on game-based learning principles, include basic elements of video games and are used not only for the entertainment.

In order to clarify the term, we asked the experts the following question, "Is Serious Video Games the best term for the phenomenon and what is your definition of it?"

When comparing two terms – "serious video games" and "educational digital games" (EduGames), all the informants pointed to the broadness of the first term, which, according to their opinion, incorporates educational games, as well as games for health and different types of simulators. In order to designate games used for educational instruction, they prefer "educational games", "game-based learning" or "game-based discussion" terms.

Therefore, further in the article, we choose to use "educational digital games" or "educational games" when speaking about educational context, "serious video games" (SVGs) when analyzing other contests as well, "digital/video games" – to describe a type of a contemporary artifact.

Now we move on to the detailed discussion of the selected themes.

Referring to the first topic, which is game-based learning, we should note that it is considered the context of educational games' application. This, in turn, leads us to a brief description of its main characteristics and distinctive features.

Game-based learning (GBL) – is a type of game-play with defined learning outcomes [29]. The origin of game-based learning (also known as educational gaming) can be traced back as early as the 1980's to the works of Alan Amory [2], Detlev Leutner [20], Thomas W. Malone [22] that described new technology of computers and their unique possibilities for fantasy, sensory effects, individual adaptability and the potential for creating motivation and engagement.

At the beginning of the 21st century, the increased interest in the positive impacts and outcomes of games expressed by Clark Aldrich [12], James Paul Gee [11], Mark Prensky [23], led to a dramatic growth of the academic field that argues for the

application of the game-based approach in education. Therefore, the argument is no longer whether games should be used, but how they should be used, how they should be designed and how they should be integrated into the curriculum.

In the process of GBL, learners use games as a tool to study a topic or related topics. They work individually or in teams. It is expected that in this process, the use of games will enhance the learning experience through challenge, exploration, interaction, reflection and decision-making, while maintaining a balance between the content, gaming and its application to the real world.

The main features of GBL are that it is interdisciplinary and multimodal (it combines images, sounds, texts, kinesthetic manipulation). It uses such game elements as a rapid pace, a random selection, different roles, presence of rivals and rewards. GBL is supported by the following learning principles: learning by doing or experiential learning; the authenticity of the tasks; motivation; independence and autonomy; team-working and/or competition; playfulness.

It is important to point out that game-based learning is not gamification. If the former is the use of games/digital games with serious goals (i.e. educational objectives) as tools that support learning processes in a significant way, the latter takes game elements (points, badges, leaderboards, competition, achievements) and applies them to a non-game setting with the aim to turn routine tasks into more refreshing, motivating experiences [8].

To understand game-based learning processes in depth, we asked the informants the following questions: 1) how would you describe game-based learning and what learning principles is it backed up with? 2) Is it important to differentiate gamification and game-based learning (GBL)?

As a result, we got the answers that GBL is, first of all, an approach to teaching and learning based on a constructivist pedagogy (one answer). It can be used as an extension to other traditional teaching methods but cannot serve as a substitute for a teacher, because stand-alone games never provide learning (all the interviewees). It is also important to understand that just a few games offer a real picture of the world (principle of authenticity and life skills' development) (one answer). It is the educators' role to transform a game into a meaningful activity via its contextualization, thus making real learning occur (all interviewees).

According to the experts' views, it is very important to differentiate gamification from GBL, as gamification is the use of game elements and their application to non-entertaining activities and contexts with the aim to increase motivation. GBL, to the contrary, is full exploitation of a game with the aim to reach specific learning objectives (all the experts).

To further our discussion of educational digital games, we come to the second topic, which is the advantages of digital games as an instructional tool: cognitive, motivational and social aspects and the characteristics of a good game.

Nowadays, it is the established view that educational digital games create a unique learning environment in which students interact, experiment with their ideas, discover, research, analyze and reflect on the gained experience. Many agree that games affect learning by influencing cognitive processes, motivation, by shaping and advancing social component [9; 10; 14; 19; 24; 33; 34].

Video games as a change in cognitive processes.

Up to now, there is a sufficient amount of experimental work that confirms that the material studied in SVGs is stored longer in the memory of students and is more structured [35]. Memorization in the process of video gaming takes place when the tasks are repeated and rewards are given. The analysis and understanding of the studied material are achieved through direct interaction with the game elements, free experimentation and the study of the relationship between different phenomena within the problem tasks. Evaluation skills are developed when students model game objects and processes and change them in order to achieve better results [3]. Among others, not less important cognitive qualities that are formed in video gaming are movements' coordination and spatial sensation.

Video games as a change of motivation.

Beginning from the second half of the 20th-century play became the interest of scientific studies. One of the first fundamental works on the game theory and the play element in culture was the book by a Dutch historian and cultural theorist Johan Huizinga, "Homo Ludens: a study of the play-element in culture" published in 1938. According to his views, the play is not just a pastime. It is the primary category of life and the structural component of culture, as culture is born as a play and never leaves it. The scientist puts emphasis on the indispensable ability of a person to play and speaks about "Homo Ludens" [17].

Alan M. Rubin [25], Jay G. Blumler [18], Thomas E. Ruggiero [26], Bradley S. Greenberg [13], John L. Sherry [30], Michael Gurevitch [18] is another group of researchers who traced connections between video games and motivation. What makes people play video games? The scientists underline seven main motifs: 1) control – over the game character and the game context; 2) challenge – desire to attain a higher level of skill; 3) competition – to win or surpass others; 4) fantasy – to engage in a variety of acts that will be difficult to perform in our everyday lives; 5) interest – to explore the game and gather information about it; 6) distraction – to take minds off usual concerns by doing something completely different; 7) social interaction – to play with each other and against each other [32].

In addition, the ability of video games to offer participants the choice of icons or the names of the players transforms it into a personally significant, increases the pleasure of participation, creates a space for self-realization, leads to the increase in motivation.

Video games as a participatory culture builder.

Except building up cognitive skills and the increase in motivation, the game-play lets participants share their knowledge with other players who, very often, have various sociocultural origin. This allows the creation of player communities. The key features, describing such game communities, are: a) open participation for any player; b) common game environment that is shared by novices as well as mature players; c) participants have the right to form and transform the game environment; d) knowledge and expertise are divided between the players; e) there are different ways to achieve the goals of the game, different ways to participate in the game and get a new status. Such communities generate their own practices, social and cultural norms, values and goals, as well as identities of their members [11].

To clarify the above-presented points, we asked the informants the following questions, "What is the advantage of video games as an educational tool?" "Do you agree that video games influence cognitive processes, motivation and social sphere of players?" "What do you think motivates people to play a video game?" "Would you agree that unique game communities are born around a game?" "What is a good educational game for you?"

Related to the first question, the most significant characteristics outlined by the informants were the cost-effectiveness, efficiency and safety of games in military, firefighters and pilots' training (in four answers). Next, video games are good at helping learners remember and grind studied material (in all the answers). Video games stimulate active participation, reflection, and discussion (in five answers). They present complex systems, and let learners experiment, make mistakes without negative consequences (in five answers). They are a visual tool with many build-in features, such as checking the answers, logging, scenario replaying (in two answers).

The second question was, "Do you agree that video games influence cognitive processes, motivation and social sphere of players?"

The informants pointed out that firstly, games per se do not teach or influence anything. They should be contextualized, i.e. tied in with target learning group, curriculum and learning environment (all the experts). Secondly, there are studies that say about players' good results in remembering the content of the game. Games are good at "drilling" the material in many fun activities (four answers). Thirdly, the social aspect of games is important and can be used and elaborated on more than it is done today (three answers).

The next question, "What do you think motivates people to play a video game?" brought the following results – to play is a basic human nature activity (one answer). Among other motifs are the feeling of "empowerment" – that a player is becoming better in the course of gameplay (one answer), a challenge, wish to create, identity-making (four answers).

The important aspect that came up in the interviews was the necessity to differentiate formal and informal contexts where motifs to play are significantly different (in one expert's comments).

There is a unanimous agreement of the informants as to the question, "Would you agree that unique game communities are born around a game?" The examples given included Dota 2, Minecraft, Counter-Strike, EVE, World of Warcraft.

As for "What is a good educational game for you?" question – a good game should be adaptable, short and focused on one main theme (one answer). Its mechanics should follow the learning experience (one answer). Concerning the "fun" component in games, we got two opposite views. The first is that the "fun" part and learning should not be separated. Another one is that "stealthy" approach to learning (when learning is disguised as a fun game-play) never leads to learning outcomes. The "flow" state of a player has to be broken and the educational component should be brought in.

The importance to understand ways of digital games' integration into formal educational context, leads us to the third topic of our discussion.

As an educational instrument, educational digital games require a complex approach in order to be integrated into the teaching/learning process. Recent projects, related to

the studies of favorable environments' creation to integrate educational digital games into a particular educational setting, state that the main "stakeholders" in this process are administration, IT departments, educators, students, their parents and the community [34].

To persuade all stakeholders to support game-based learning requires much more time and energy than to develop traditional educational and methodologic materials, as the course of establishing and carrying out game-based learning is accompanied by a lot of preliminary work, such as surveying educational organization and preparing it for implementing educational games. Preliminary analysis of the organization may comprise questions, connected with organizational culture, teachers' attitude, parents' attitude, students' experiences with game-playing, teachers' computer and technology literacy, teachers' gaming literacy, availability of devices (PCs, tablets, etc.), information storage and access, classroom size, number of students, schedule and curriculum, management and support, etc.

It is highly important to develop teachers' understanding of educational games as an innovative tool. This can be done through the initiatives that facilitate a few teachers in developing their competencies with educational games, rather than having a universal training for the entire staff. Top-down initiatives, where new techniques and tools are "pushed onto" teachers, ran the risk of being expensive and alienate teachers by limiting their involvement in decision-making [5, p. 112].

Another important factor in applying video games is the knowledge of possible integration scenarios into the educational context. We maintain that the most comprehensive analysis was made by Nicola Whitton, Professor of Education at the University of Manchester, Faculty of Pedagogy, who suggested six possible models.

Model one – application of one game per session, which involves using a game in one lesson to achieve a specific goal. Model two – one game per several session that can be used as a direct replacement for two or more lessons. Model three – use of a separate element of a game as an additional task, which involves the application of some game element as an auxiliary tool. In this case, a game does not replace a lesson. Model four – integration of a complete game into the curriculum when a digital game is used as an alternative means of presenting the material, which, in turn, leads to the reorganization of teaching, learning and evaluation process, i.e. to the redevelopment of the course. Model five – use of online games as a part of blended learning or online course. In this case, students do not necessarily meet each other, because the game runs online – synchronously, or asynchronously. Model six – implementation of a game as a "mixed reality" type [31] – the use of the elements of online environment and personal interaction, often involving mobile technologies, such as mobile phones or other portable devices [33, pp. 85–88].

The questions we asked the informants to support this discussion were: 1) should educators take a game and try to tie it in with the curriculum or should they follow the curriculum trying to pick up the right game? 2) Are there two different approaches to implement Educational Games and Commercial Games (COTS) into educational context? 3) What are possible scenarios to integrate video games into a classroom? 4) Do you think it is a viable idea to teach teachers to design their own games for their specific purposes?

The interview data related to the first question tell that this choice may depend on the level of schooling. For example, if it is an elementary school – it is easier to find a ready-made game and to use it in class, building up a lesson with specific learning outcomes around it. At the same time, this approach may not work in higher education, where teachers have to follow the curriculum to let students master a particular subject. Games take many hours to play, which may not comply with the time frame of the course (one informant).

There is, though, another opinion, stating that teachers know the curriculum and have enough traditional material to achieve its goals. However, sometimes there may be parts of it that are not quite successfully presented by a traditional material. In such cases, teachers may opt for finding a game that would explain or help master this part. It is the example when a teacher follows the curriculum and chooses a game that may enhance a particular element (three answers).

As for the second question, many answers underlined that entertainment games are time-consuming, unlike educational games that are usually small, replayable and are directed at a specific learning objective (all the interviewees). When COTS are used, most probably a teacher has to design his/her lesson plan around it. With EduGames that are not easily re-interpreted, a teacher has to adapt the working process to the game (one answer). Another difference between COTS and EduGames is the time one learns how to play them. With EduGames it is shorter, which makes the process of a game's integration into educational context faster. At the same time, with both COTS and EduGames there are the same issues of finding the right game, understanding how it can be used for a specific subject, issues of licensing and technical support (three answers).

As for the third question about possible scenarios to integrate educational digital games into a classroom, there is no one universal way to do it. The right way is the one that works best for the educator (all the answers).

Because of the time issue, many educators may prefer to use a mini-game as a complementary means to enhance learning. To the contrary, as the time that takes to find, contextualize and start playing a game is relatively long, it may be sensible to use the same game for a longer period. Whatever choice is, a game should be an integral part of a bigger educational process.

As for the idea to teach teachers to design their own games for their specific purposes (question four), all informants agreed that it is a good one. To start from analog games and move on to digital tools with the aim to help teachers understand how games work. It is also reasonable to provide teachers with courses in programming to get such experience. For example, simple programming languages, like SCRATCH or online courses on game design. At the same time, it is rather challenging to teach an educator to think like a game designer.

Now, we come to the discussion of the last topic on the teacher's role(s) in a digital game-based learning class.

Here we have to say that knowledge acquisition is possible in many different ways, which depends on learners' characteristics, material to be studied, the situation where learning takes place. The same is true about teaching styles that differ depending on a particular educational context.

For the present discussion, we use five metaphors of learning and the accompanying teaching styles as described in ProActive: Fostering Teachers' Creativity through Game-Based Learning project. These are learning through knowledge transfer, learning though imitation, learning though experimentation, learning through participation and learning through discovery [24].

The way of knowledge transfer is the information pass from one person who possesses it (a teacher) to another one who acts as a receiver (a student). Learning is targeted at memorization of facts and concepts' acquisition and is rooted in repetition and replication. In this context, the teacher acts as an expert who conveys information. The way of imitation is when learners model behaviors or make a copy of the proposed model. Learning is targeted at improving practical skills. Here, the teacher acts as a coach. The way of experimentation takes place when teachers provide a task and let learners experience it. Here, the teacher acts as a facilitator. The way of participation is targeted at social aspects of learning. To encourage learners to be a part of the community, teachers stimulate interaction between peers, organize discussions, view-exchange and collaboration. Teacher's role is also of a facilitator. The way of discovery is aimed at establishing new relations between objects and concepts. Here the teacher acts as a facilitator who organizes guiding activities for the learners to discover and construct new meaning.

Thus, within the five metaphors, the teacher may come as a knowledge expert, a coach, a facilitator, an evaluator.

In the context of digital game-based learning, an instructor carries out all the roles listed above, guiding learners into their specific task and experimentations within the game, reflection, consolidation, and reinforcement of the gained experience (Figure 1).

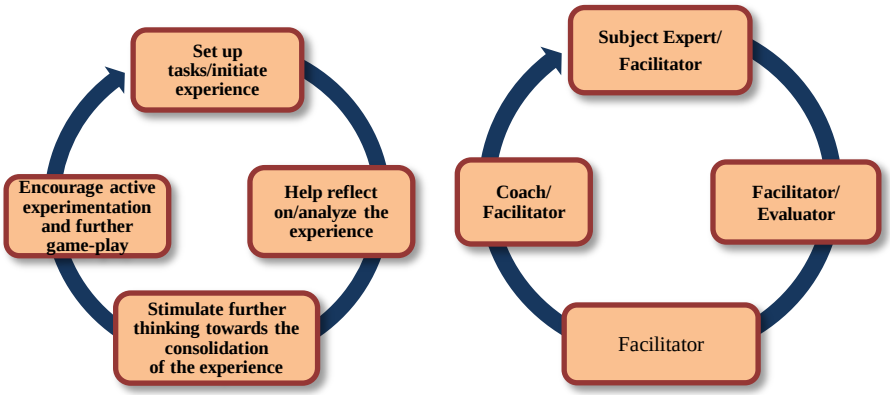

Fig. 1. Example of educators' tasks and roles in experiential learning cycle

Research carried out on game-based learning confirms that when conducting game-based classroom activities, teachers take on a wide range of roles in order to successfully and significantly integrate the educational game into their classrooms. During a typical game-based exercise, teachers act as game administrators, lecturers,

game tutors, subject matter anchors and authority figures that keep students in an educational mode of play. This, in turn, requires a diverse skill set, including technology expertise, gaming literacy, subject matter knowledge, and a strong pedagogical foundation [5, p. 206].

Another important principle outlined in many research works states that for a game to have positive educational value, briefing before the game and reflection after the game (known as a debriefing or after-action review AAR) are a must. Debriefing – is a meeting that takes place in order to get information about a particular piece of work that has been finished, for example about what was done successfully and what was not [7]. Debriefing after the game facilitates reflection and serves to check whether participants learned what was intended to learn. It also allows the participants to reflect upon the training experience and make connections between game events and real-world events [16].

Therefore, a digital game-based lesson passes three distinct stages: 1) before the game-play stage (organized as a briefing); 2) during the game-play stage (the game-play itself); 3) after the game-play stage (in a form of a debriefing or after-action review).

The model of "a coaching cycle" (Figure 2) developed by Anna-Sofia Alklind Taylor serves as a good illustration of a digital game-based session [1, p. 193].

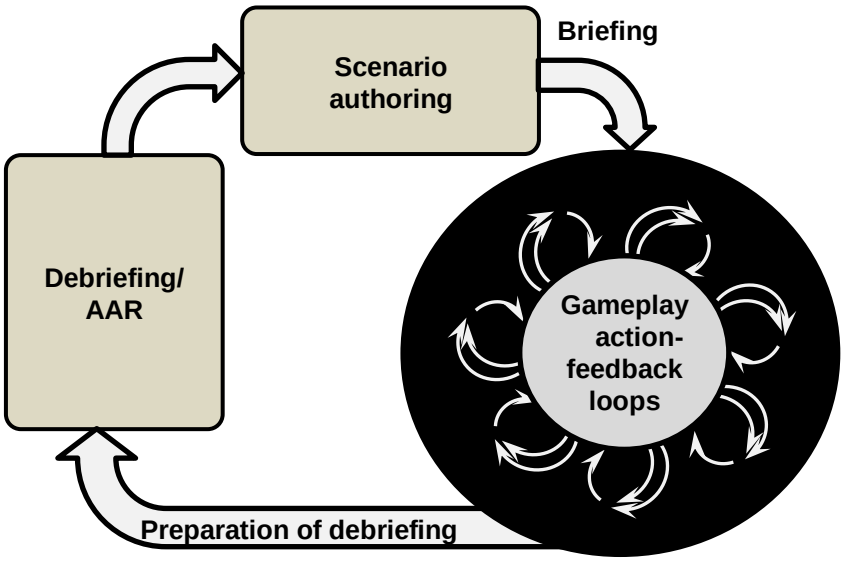

Fig. 2. Game-based session coaching cycle (used with permission)

Consequently, in preparing and conducting a digital game-based lesson, a teacher follows the path from making up a lesson plan targeted at a specific learning group and a syllabus (scenario authoring), setting up the gameplay (briefing), guiding learners in the game-play process (gameplay) and finalizing the experience afterwards (debriefing).

To reinforce the discussion, we asked the experts these questions: 1) how are the roles between a teacher and a student distributed when digital games are used in educational context? What roles does a teacher carry out? 2) What are possible ways to transfer knowledge from a game-play to real-life situations?

Answering the first question, all our informants confirmed that a teacher carries out different roles, including a facilitator, a knowledge expert, a de-briefer, etc. At the same time, and what is very important, in digital game-based learning the teacher also acts as tech support, a moderator who explains how the game works, as an IT administrator. These extra functions often distract teachers from their immediate tasks (four answers).

Situations may occur when students who often play games outside school help teachers during the game-play and become facilitators of the learning process, and this changes lesson's dynamics (one comment).

The teacher also may act as an active player involved in the game along with students. Assuming this role, a teacher can give feedback from "inside" the game by responding to students' actions (Figure 2). In this case, the game flow and the students' engagement are not broken (one comment).

The teacher may act as a game developer, which requires good experience with games (four answers).

Concerning the second question, it is a hard task to transfer knowledge gained in the game-play to real-life situations (all the experts). One way to do it is to pause the game and to highlight a specific learning point. Conversations and discussions around the game build up the knowledge and help make connections with the real world. One way to get students into conversations is to sit two of them at a computer. Another way to transfer knowledge from a game-play to real-life situations is to carry out a debriefing. Here, it is important to explain the difference between the game and the real life, reflect on practices inside the game and outside it. Reflection is the way to transfer the knowledge and the experience into real life contexts. As in a game it is hard to simulate all possible real-life scenarios, it is the teacher's role to help students make these connections and that is one more reason why games cannot replace teachers.

4 Conclusions and prospects for further research

Having conducted theoretical analysis and expert interviews and having compared and contrasted the obtained data, we may come to the following conclusions:

- although "Serious Video Games" is considered the recent years' mainstream term to describe games used not for entertainment, the experts' practical opinion states that "Educational Games" is a better term for the phenomenon;
- game-based learning (GBL) is one possible approach to teaching/learning that is supported by a constructivist experiential pedagogy. It uses educational games as a tool of instruction. GBL is an extension to other traditional methods but not a substitute for them or a teacher. In the process of GBL the game is fully used to reach specific learning objectives and the teacher is the key actor to make learning happen;
- educational digital games (EduGames) are complex systems that provide a unique and safe learning environment for experimentation. In reality, there are only a few

games that provide authentic material and real-world tasks. To get the most of learning out of games a teacher should help students make connections between the knowledge and experience from the game with real-life scenarios;

- content studied in game-play is stored longer and is better structured in learners' memory. There are different motifs why people play but it is important to remember that motivation to play in formal and informal contexts differ. Games stimulate active participation and create communities around them;
- there are two different views on "fun" component of games. The first is that fun and learning should not be separated. The second is that to achieve a desired learning outcome, the "flow" state of a play should be regularly broken and a reflection and discussion brought in;
- to integrate video games into educational context requires a complex approach. It includes cooperation between administration, IT department, educators, learners, community. In this process, it is highly recommended to survey and to prepare the target organization to work with EduGames, as well as to help teachers understand EduGames as an innovative tool. It is better to start from a small group of teachers, rather than to facilitate the whole staff;
- if a teacher chooses a game to use in the class, he/she should build up the entire lesson and lesson materials around it by tying it in with the curriculum. To the contrary, a teacher may follow the curriculum and try to find a game to enhance a particular part of it. Whether COTS or EduGames are used, the issues of finding the right game, understanding how it works for a specific purpose, licensing and technical issues are the same. There is no one universal scenario of how to integrate EduGames into an educational context. Some may opt for a mini-game or a bigger game for a longer period of time. It's important that the chosen game fits right into a general educational process;
- in the context of digital game-based learning, a teacher carries out the roles of a facilitator, a knowledge expert, a coach, an evaluator. The teacher also acts as tech support, IT administrator, a moderator, a de-briefer, which may distract from exercising immediate teaching tasks. The teacher may act as an active player and provide feedback from "inside" a game. In addition, a teacher may be a game developer. These roles require good experience with games;
- the positive educational effect is achieved if briefings and debriefings become a part of a game-based learning process. Properly organized debriefing is the way to transfer knowledge and experience from a game to a real-life context. As games cannot simulate all possible real-life scenarios, a teacher, as a de-briefer, cannot be replaced by games.

The implications of the study presented in this paper are that what educational digital games may give as an instructional tool is a unique and safe learning environment with a wide spectrum of build-in assistive features. They are very cost-effective and efficient in specific training contexts. Digital games are good at helping learners memorize studied material, appeal to different learning styles (visual, audio, kinesthetic) and individually adaptable. As a novel educational instrument, they increase motivation, stimulate players' interaction, active participation, discussion, and reflection.

At the same time, the path of digital games to formal educational context requires complex approach that may affect administration, IT departments, educators, students, parents, community and is accompanied by many preliminary arrangements, starting from the analysis of the target organization to the choice of the most appropriate scenario of a game's application. The key figure in the process of transforming a game into a meaningful activity is an educator. This demands a strong skillset of gaming literacy, technical skills, knowledge of the taught subject, pedagogy, psychology, etc., as in the process of digital game-based learning a teacher exercises different roles of a subject expert, a facilitator, a coach, an evaluator, a game moderator, a tech support, a de-briefer, a co-player, a co-designer. Teachers build up lesson plans, conduct the lesson and debriefing, follow the quickly changing market of digital games, play games to be able to choose the right one for the class.

If we place the results of this brief study into a broader context, we may state that digital games as a contemporary cultural artifact are here to stay with no turning point, as well as other modern digital tools, gadgets and applications. They may not revolutionize education but it is highly possible that a new generation of teachers will come that are used to playing video games and who will be ready to put their knowledge of a game-play into learning in the attempt to get to the present and future generation of learners.

Therewith, the importance of information dimension in the development of the 21st-century skills as well as the digitalization of education will stay as important elements. This will lead to the re-evaluation of the teaching process in terms of how to teach with modern digital tools, including digital games.

We conclude this article with the idea (and the prospect for further research) of building up Education Design Laboratory as an integrative part of a contemporary educational institution. This laboratory may stream its work into Contemporary Multimedia in Education Unit, Educational Game Design Unit, Teacher Training in Multimedia and EduGames Unit, Gamification Unit, etc. This, as we see it now, may help teachers gain and/or upgrade their competences and get support in implementing cutting-edge instructional tools, assist the administration in building up a contemporary technologically rich research model of an educational institution and students – to develop the 21st-century skills.

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