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DIGITAL GAME-BASED LEARNING OPERATIONALIZATION STRATEGIES

Abstract: The paper presents a theoretical overview of digital game-based learning operationalization strategies. As digital games gradually permeated all the pores of modern society, they clearly cannot stand a side in contemporary educational practice. Three referent strategies for the successful digital game-based learning implementation are presented in the paper, each with its advantages and shortcomings. As this approach is relatively new, there still lacks a unique recommendation for the most efficient or the most successful way to implement digital games in learning process.

Keywords: *digital game-based learning, operationalization, educational strategie.*

INTRODUCTION

The contemporary didactic methodology classroom practice is often found remarkably distant from the interests of educational community. A variety of exotic terms describing the new student "digital-oriented" generations were introduced during the last few decades. Amongst others, "digital natives" (Van Eck, 2006) were introduced as a description of students that prefer information acquiring using multimedia, immediate feedback, and concrete content rather than abstract. Even though we know that "good" educational process is more or less based on the emphasized emotional and motivational components, we are still unable to understand how exactly the mind of student works and how to initiate the spark of motivating them learning to learn. A multitude of innovation initiatives are enabled by the (information) technology development and the introduction of technology enhanced learning into practice aimed at changing the traditionally passive role of students. One of these applicable approaches with great transforming potential can be observed in digital games.

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Children, early-adolescent and adolescent population have shown an extreme increase of interest in playing digital games in the last few decades, so digital games can today be considered as the central part of youth culture (Aleksić, 2018). Digital gameplay can enhance learning by activating one's intelligence and developing willingness to collaborate in order to solve problems, while intensifying player empathy with the help of the virtual world through connecting emotions and cognition which provide a feeling of productivity and authority. Digital games can also be used to train human abilities such as cognitive flexibility (Glass et al., 2013), spatial resolution (Jigo & Carrasco, 2018) and spatial visual attention (Feng & Spence, 2018). The immersive effect of computer games (Hafner & Jansz, 2018) allows players to experience moral problems or to face ethical questions (Power & Langlois, 2010). Having in mind that information literacy is very important and even necessary in contemporary society, children should be provided access to modern technologies combined with other forms of learning and play (Arsović & Zlatić, 2017). Video games can encourage children to think and reason at higher levels. Most video games induce children to develop skills needed to win which include abstract and high-level thinking, problem solving, hand-eye coordination, planning and logistic, multitasking, etc. Some of these skills are not even developed in everyday school activities. Additionally, video gameplay indirectly introduces children to basic computer science concepts. Learning through play often achieves a greater degree of interactivity when play is guided (Ivanović & Sudzilovski, 2018). Learning through play makes a child focused, creative, practical and with positive emotions. In educational terms the largest value of play is that it is able to attract and keep child s attention to the amenities provided, as well as to motivate it to participate actively in certain activities. In brief, digital game-based learning positively influences student learning.

Arsović (2015) stated that the appropriate use of contemporary ICT tools in education depends solely on educator knowledge and expertise combined with the technology "developmental purpose". However, when observing digital game-based learning literature and research, the role of teachers and the analysis of their competences have been pretty much underrepresented (Foster et al., 2015). Most researchers still presume that game-based learning effectiveness is solely due to the game effect (Young et al., 2012).

When using modern technical devices, especially multifunctional ones (that support games and learning in a virtual environment) one has to be very careful in application to children at early age as if intensive (unregulated) can lead to serious psychiatric disorders (Vasilijević et al., 2015). Depending on the gaming immersion's stage, a player's attention is partly or even completely absorbed by the gameplay. When in total immersion, players lost their self-awareness and are completely detached from reality (Cheng et al., 2014).

The rest of the paper is organized as follows. The following section focuses on the characteristics of digital gameplay. Section after that presents the overview of operationalization strategies, following concluding remarks on the topic are given.

DIGITAL GAMEPLAY

At a social level, digital games have already become the most important and widespread global phenomena with its industry worth over 100 billion USD and more than two billion players (Games, 2016), way above the movies, TV, music or literature. Entertainment Software Association reported in 2017 that 67% of USA households owned a device to play video games (Quiroga et al., 2019). Digital gameplay releases the potential of various factors that can be used in education like interactivity, audio-visual representation, narrative, flow, psychomotor engagement etc. All of the stated introduce students to a new immersive world where the only limit is their imagination.

Conveniently, based on a simple demographic analysis one can come to a conclusion that student parents and teachers are probably already a part of a global gaming community, as their age is mostly between 35 and 45, i.e. there were born and raised in the video gaming era. This provides a solid theoretical basis when defining new learning strategies, as all essential subjects in students' life are more or less acquainted with this technology.

Creating game-based learning operationalization strategies based purely on these facts should be taken with the grain of salt, as researchers also noticed that early adolescent males play digital games about twice as much than females do (Aleksić & Ivanović, 2017; Greenberg et al., 2008; Rideout et al., 2010). Typical gamer in the US plays between one and two hours a day (McGonigal, 2011). However, average daily digital gameplay time in China is over three hours, just little a more than in Germany, France or UK. Interestingly, average daily gameplay time in underdeveloped non-EU countries (e.g. Serbia) is similar to the stated above. In its extensive research on 1262 early adolescent Serbian students Aleksić (2018) reported that the average daily gameplay time was 148,5 minutes – a shy under two and a half hours per day. The research also identified about 12% of the students as addicted to digital games. There were no statistically significant differences by the type of living environment in relation to the digital games addiction, but the statistically significant differences were identified when gender was related to digital games addiction. Specifically, the addiction was identified in about 15% male students, opposite to the 10% female population, so the previously mentioned risks and dangers of technology misuse were clearly confirmed.

So, if digital games are so attractive, why are they not already used in the classrooms? For start, practice show that it is extremely difficult to find a digital game that matches educational goals in rigid time-constraint framework of existing curriculums. Second, school ICT infrastructure is not intended for gaming nor its hardware can support many of the digital games and virtual environments (Green & McNeese, 2011). Third, there is a limited empirical evidence of digital games classroom effectiveness, as digital games are not supported by the formal school

system nor informally by the parents (Klopfer et al., 2009). It should be noted that the developments in the field of digital games and ICT are gradually fading the influence and importance of the factors stated above.

OPERATIONALIZATION STRATEGIES

Throughout this section, several strategies for the effective use of digital games will be proposed in order to build a framework for game-based learning operationalization. The successful implementation of each of the strategies relies heavy on the teacher competence for game-based learning as a concept comprising adequate cognitive, skill-based and affective components. This means that teachers should have adequate theoretical background knowledge of each educational topic, digital skills to apply the knowledge effectively and a certainattitude and stance (i.e. openness, responsiveness, persistence) (Binkley et al., 2011). Regarding digital game-based learning, teachers should fulfill four specific roles (Hanghøj, 2013): instructor (planning and communication); playmaker (communicating tasks, roles, goals, dynamics); guide (support) and evaluator (respond).

Serious games

The term serious games is generally used to define games that have been specifically designed and developed with a purpose of various trainings (Michael & Chen, 2005). This nomenclature is usual for the games dedicated specifically to learning, health training, professional training, marketing and many others. Manyauthors consider ICT in general and serious games in particular, as useful methods to support the teaching-learning process and as adequate resources for skills development (FitóBertran et al., 2014). In the case of complex, expensive or even dangerous learning contents, serious games and simulations present effective and safe learning environments (Oberdörfer & Latoschik, 2019). A number of researchers identified positive learning outcomes and experiences in various fields such as mathematics (Shin et al., 2011), literacy (Ronimus & Lyytinen, 2015), science (Corredor et al., 2013), collaboration (Hämäläinen & Oksanen, 2013), etc.

The serious games applied to education represent an interesting option with a series of challenges to solve. On one side, a series of advantages are inherent in its own definition. Being not originally designed as educational, serious games usually include very advantageous characteristics for its use in the classroom such as: non-goal orientation, inclusion of personal follow-up mechanisms of the activity and evaluation tools, documentation and resources for teachers who can be used for designing activities, positive feedback oriented to learning. On the other hand, serious games have their focus put in the acquiring competences not in the design of games, so they may lack the resources adequate to keep students motivated and in a

state of flow (the zone or mental state where we are completely immersed and involved in what we are doing (Csikszentmihalyi & Csikszentmihalyi, 1992)). Traditionally, there have been digital games with this problem: they are not fun or visually attractive so they lose the characteristics of intrinsic motivation inherent in digital games. To address this matter, serious games are currently progressing rapidly because the development teams included game designers and specialist artists, who complement the work of teachers and psychologists. However, even though serious games are often brought into class to enhance learners' motivation, their motivational effects usually do not last beyond initial novelty (Ronimus et al., 2014).

Serious games tend to be developed tailored, for either companies (as part of their corporate formation) or publishers (usually to supplement resources). Being owners' product, serious games development is done ad-hoc and this has repercussions at very high costs, which is usually reflected in the quality of the final product which is very distant from commercial digital games.

Commercial-off-the-shelf digital games

The use of commercial (i.e. leisure) digital games is becoming one of the most popular approaches when it comes to introducing the game-based learning (i.e. GBL) in the classrooms. This approach has a series of advantages that makes it an excellent first option to start designing didactic activities based on digital games.

Commercial-off-the-shelf (i.e. COTS) digital games are well designed. Game art, programming and sound are made by digital game design professionals, which in turn ease its acceptance by the students. On the other hand, COTS games are highly effective in terms of economic investment and time. They represent a finished product that students can instantly use and cost just a fraction of what custom development would.

At the same time, using COTS games in education carries a series of challenges that must be taken into account when you consider their instructional design (Aleksić et al., 2016). Visually appealing high-res 3D graphics often require very powerful last generation equipment, which is difficult to provide in many educational facilities. On the other hand, the user license is usually linked to one computer, so the game-space is limited to the educational institution itself by which we lose the possibility of expanding the scope of activity to extra-curricular environment.

When it comes to games designed for a purely academic purpose (e.g. educational or serious games), its game mechanics (what the player does within the game) can be so intense that it could lead user to cognitive overload. The cognitive theory of multimedia learning (Mayer, 2005) emphasized that multimedia content helps learning, but that we also have a limited capacity to process this information.

The cognitive load represents, defined with a high level of abstraction, the ability to process information in our brain. If the basic control of the game involves a great cognitive load, there will be no capacity left for cognitive processes linked to the learning of underlying concepts.

Regarding the way to use COTS games in the classroom, a certain difficulty in aligning the game with the curriculum and with the content can be identified (Van Eck, 2006). The simplest way to overcome this difficulty is to face the asynchronicity in the same way that as with other media, such as movies. Teachers play important roles in enhancing the learning and motivational aspects and in designing game-based learning processes (Kangas et al., 2016). Teacher should pose (demonstrate) a way to play the game in order to achieve goals through one or more analysis sessions. That way learners should be attuned to what is important within the game and theirlearning beyond the immediate game design is supported (Gresalfi et al., 2011). These meta-cognitive spaces become suture where the students assimilate what they have learned and where the foundations for the transfer between what was learned in the game and the real world are laid. It is not necessary that each specific or transversal competence should be supported by the appropriate game mechanics. Many concepts can be indirectly presented through game elements that originally were not designed for. When teacher uses the demonstration strategy, typically one computer is used. In these cases, teacher should select a game genre that is abound with conditions and choices, like adventure games. Additionally, these games can be paused which allows a collective gameplay based on decision consensus of the students. Teacher plays (manages) the game and the rest of the class observes it typically through a projector. Decisions about what to do or what action should be carried out are proposed as a debate and should be argued and decided in a collaborative manner.

However, some COTS digital game features can pose a certain difficulty when designing activities based on them. First, after an adequate game is selected, teachers often cannot directly choose a part of the game that could maximize learning, as there are no shortcuts to reach certain level. This structure implies having to dedicate enough hours overcoming parts of the game that do not fit in this approach, in addition to cinematics, tutorials or other elements that will only divert the attention of students. Second, one of the biggest concerns is to be able to measure GBL performance efficiently and rigorously. For this, a certain relationship between students' behavior within the game and evaluation of subject related competences should be established. Ideally, the evaluation should be directly linked to the game metrics (points, achievements, levels etc.). Most often, this presents an impossible requirement, so an alternate design should be implemented such as teacher observations, student self-reflections, commented videos etc.

With these concerns in mind, a new category of digital games has developed in recent years – educational versions of COTS games. These games present all the necessary qualities to be used in a way that is effective and efficient in the

classroom. One of the bright examples is Minecraft Education Edition. This version of the game did not change its original gameplay but included elements such as student portfolio (based on pictures within the game and reflections that were written), multitude of documented levels and activities, game creation and management tools for the teacher, a global learning community for both teachers and students etc. (Kapp, 2012).

Constructivist approach

When the competences that are to be covered with a GBL activity are very particular, it could be really difficult to find a game, commercial or serious, that fits with the requirements. In these cases, the recommended approach is that teachers should become game designers and developers. Although, a priori, this alternative may seem accessible only to a small group of teachers with high levels of technological competence, knowledge and experience, today we have many free virtual environments for games creation and with levels of complexity more closely to professional, covering the wide range of profiles present in the teaching field.

When it comes to designing and creating a digital game, teachers should take into account the two recommendations: The simplest approach is to create mini-games focused on a specific competence, so that that the complexity of development will be minimized and Game mechanics should be simple and practice-oriented.

Most often, the game development environments are simple, 2D oriented, based on the constructing complex scenarios. The interaction is most often based on functional blocks using "drag and drop" technique. These environments usually do not require any specific programming skills. Some referent examples are Stencyl (http://www.stencyl.com/) and GameSalad (https://gamesalad.com/).

Another strategy represents the approach in which students create their own games. Game design forces students to solve problems and consider things from different viewpoints (Randolph et al., 2016). Creating games involves a great set of non-traditional competences:

1. Systemic thinking – In the complex reality that we live in, understanding our environment as a whole of elements that interact with each other is fundamental. Far East thinking paradigm aims to identify the patterns that determine how different systems behave (although seems unrelated), how they interact between them and how they influence each other. This implies acquiring and processing large amounts of data and information from various sources. The design of games implies thinking about the relationships between different aspects (narrative, economics, personal etc.) that compose it.

2. Creative problem solving – represents the culminating application of all acquired competencies as they put in motion a great number of high cognitive pro-

cesses in order to establish relationships between different areas of knowledge aimed at formulating solutions for problems that are raised. Every creative decision taken during the game design is faced with this skill, since we have to reach a certain goal (in the rules, interaction, players' progress etc.) respecting restrictions.

3. Art and aesthetics – modern society is eminently visual and any public element must be visually and aesthetically appealing. Digital games base their attractiveness largely on the visual component.

4. Programming – when creating digital games, students should be introduced to programming in applied manner. The program that should be presented is the most direct way to acquire the computational thinking skill that is fundamental in our digital reality (Serafini, 2011).

5. Narrative – Digital games have a strong narrative component and for this reason when designing and creating a game, students will resort to their writing skills to create the script, instructions etc.

There are several strategies that can be proposed for successful integration of constructivism through creating digital games: creating games based on curricular elements so that students at other educational institutions can use them, creating a game based on a thematic proposal (narrative concept, news, social issue, etc.), and creating games with absolute freedom that allows the creative work processes although it may require more time in the execution.

There are many environments that enable students to engage in creating digital games. Some referent examples are Scratch (https://scratch.mit.edu/) and Kodu (https://www.kodugamelab.com/).

CONCLUSION

The GBL approach has been showing up in the last few years as a didactic methodology with a great potential, especially well based in the motivational aspect. Its deployment in the educational field has still not lived up to expectations. One great deficiency is that teachers know their roles have changed in using new technologiesand digital games, but still lacking necessary competencies andtraining, thus they are unsure how to adopt these changes (Allsop & Jessel, 2015). However, a pedagogically competent teacher should be able to plan, implement and assess game-based learning activitiesand connect them meaningfully with the curriculum (Foster et al., 2016). While the competencies in pedagogical area are based on teachers' theoretical knowledge, technological competencies are often principally developed through hands-on activities. As teacher digital competences are becoming increasingly important, many efforts in this field are currently ongoing. For example, the European Commission has developed DigCompEdu, a reference framework for assessing educators' digital competencies (Ghomi & Redecker, 2019).

On the other side, students' positive attitude towards the use of digital games in education cannot be taken for granted. For instance, Martí-Parreñoet al. (2018) analyzed four students' characteristics (perceived relevance, confidence, media affinity and self-efficacy) that combine attitude towards the use of digital games to develop their competencies. They implied that teachers should pay attention when choosing the features ofthe digital games to be used in developing students' competencies so it will be perceived as relevant by students and not just as "a nice variation and break in the lecture" (Wang, 2015). Also, as digital games vary in difficulty not all students may have the skills to play them, so teachers should pay attention to this matter to avoid the lack of confidence becoming a factor leading to a negative student attitude towards GBL.

Several referent operationalization strategies have been presented in the paper, but there is no "one recipe" to choose a GBL approach in a universal way. The increased research interest in digital games and their educational application potential seems confident for the future of GBL. One should also rely on the students, making them part of the configuration of activities in an environment in which they feel important.

As a concluding remark, this paper was limited to purely theoretical overview of contemporary approaches in GBL that are being developed in hope that these few brush strokes about different GBL operationalization strategies may inspire some teachers to immerse themselves in this educational concept.

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ОПЕРАЦИОНАЛИЗОВАНЕ СТРАТЕГИЈЕ УЧЕЊА ЗАСНОВАНЕ НА ДИГИТАЛНИМ ИГРАМА

Резиме

У раду је представљен теоријски преглед операционализованих стратегија учења заснованих на дигиталним играма. Како су дигиталне игре постепено прожимале све поре савременог друштва, оне очигледно не могу бити пострани ни у савременој образовној пракси. Три референтне стратегије за успешну имплементацију учења заснованог на дигиталним играма представљене су у раду, свака са својим предностима и недостацима. Како је овај приступ релативно нов, још увек не постоји јединствена препорука за најефикаснији или најуспешнији начин имплементације дигиталних игара у процес учења.

Кључне речи: *учење засновано на дигиталним играма, операционализација, стратегија образовања.*