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CLASSIFICATION OF EDUCATIONAL GAMES ACCORDING TO THEIR COMPLEXITY AND THE PLAYER'S SKILLS

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Abstract

In the modern world, where the role of information and communication technologies is constantly increasing, research of the educational potential of games is a urgent problem. The study of more than 1000 different educational games allowed the authors to find out that the ratio of the educational and entertaining components in the game will depend first of all on two factors: the level of complexity of the educational task and the level of knowledge/skills required of the learner to start the game. The authors offer to divide the level of complexity of the game into three levels. The simplest tasks (which form routine skills) are accompanied today with the maximum entertainment content (the level "learning without noticing"). With the increase in the complexity of the task, the entertainment component decreases, since an increasing amount of game space is required to explain the tasks. At the same time, as more entertaining content there will be in the game, the less the trainees will be prepared for the task (the level "learning by playing"). If the educational material studied in the game is very complex, extensive, directly connected with the real world, then in the absence of the requirement of basic skills, the game serves only to get acquainted with the information. In this case, where the game requires a certain level of knowledge and skills to enter, it appears to be like a simulation, so the amount of the entertaining component is small (the level "reality as a game").

Keywords: Classification, education, game, serious game, game-based learning, learning game.

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1. Introduction

Information and communication technologies are changing society. Today, researchers note "the forecasts of the transformation of the entire world into a common computerized information community were in line with one of the main issues for social and humanitarian analytics" (Aladyshkin, Kulik, Michurin, & Anosova, 2017, p.24). Dynamic development of information and communicative networks in the form of cyberspace acquires "the topical character of self-organized virtual communities as a new class of sociocultural communities" (Kolomeyzev & Shipunova, 2017, p. 1238). The general trend of informatization concerns all areas of life, including education (Evseeva, Obukhova, & Tanova, 2017, p.57 – 58). It is noted that integration and "the digital revolution have an impact on the changes in public and individual consciousness, generating new images of reality" (Evseeva, Bashkarev, Pozdeeva, & Tarakanova, 2017, p.354). Spihunova, Rabosh, Soldatov, & Deniskov (2017) prove, that we live in a society where the solution to any professional task turns into a dialogue between human and computer. The concept of “technology” itself in the Russian language has always preserved a strong connection with humanistic dimension (Nikiforova, 2015).

The game, which made an important contribution to the acquisition of vital skills in the history of mankind, is gaining an increasingly important role in the modern information society. Moreover, Timermanis, Ivanov, Zamorev, & Smaragdina (2017) point out that modern mankind assumed his own life to be a certain role-playing game, in which participation does not require any responsibility and shall deliver only pleasure.

Stenros (2016) based on the analysis of more than 60 definitions identifies a number of key characteristics of the game: Rules, Purpose and Function, Artifact or Activity, Separate yet Connected, The Role of the Player, (Un)productive, Competition and Conflict, Goals and End Conditions. Of which the following can be recognized: prohibitive rules, goals, opposition, and representation, allowing to determine if something is a game. Studying computer games, researchers focus on three elements of the interactive rule governing play: conflict to drive play, a win scenario/condition, and for educational game, additional qualities to encourage learning (Warren & Jones, 2017, p.3-4).

In European and American literature there is a paradoxical term "serious games", demonstrating great opportunities of playing in achieving important goals. Çiftci (2018) examined more than 12 thousand publications devoted to serious games since 2007 and discovered the studies in fields such as psychology, health care sciences, environmental sciences, ecology, public environmental occupational health, rehabilitation, business economics and psychiatry and other disciplines. In terms of game technology, it also expands their presence every year thanks to mobile technologies, online games, virtual worlds and ARGs. The most similar educational technology to games is simulation. Warren, Jones, Dolliver, & Stein (2012) note that a number of authors refer to games as one of the types of stimulation, while others distinguish between them using differences which are usually drawn along disciplinary lines. Wiselia, Tanusetiawana, & Purnomoa (2017) suggest a new term "simulation game", even more bringing together two concepts.

At the same time, it is impossible not to note the general trend gamification of education. Taking the definition gamification is the use of game design elements in non-game contexts, it must be emphasized

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that gamification is concerned specifically with design elements, and not with core, technologies or practices.

Zheng & Gardner (2017), refuse to give the definition of educational computer game, and at the same time, they indicate that computer can serve as a motivational device, as feedback mechanism and as a developer of proficient skills. Nevertheless, the issue of the effectiveness of using games in education remains open. The broadest study on the effectiveness of games diagnoses that the most frequently occurring outcomes were knowledge acquisition/content understanding and affective and motivational outcomes (Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012).

2. Problem Statement

Many authors note the need for a balance between subject matter with gameplay (for example, Kuk, Rančić, Pronić-Rančić, & Ranđelović, 2016). Laamarti, Mohamad, & Saddik (2014) do represent the question of fun and the main purpose of the game as the main source of success for a serious game.

The ratio of the educational and entertainment component in the game influences the player's motivation and its success from the educational point of view.

At the same time, it seems impossible to answer the question about the ratio of educational and entertaining unambiguously, as for example, Young et al. do. Having studied more than 300 articles on the related video games and academic achievement, they assume a consistent 1: 1 ratio of gaming and learning to solve many of the underlying structural problems that may inhibit learning from educational video games (Young et al., 2012). The ratio of subject matter with gameplay depends on a number of factors. For example, Laurischkat & Viertelhausen (2017) point to the motivating function of the game associating it with the state of "Flow" when the level of a challenge is met.

The authors consider the level of complexity of the educational task and the necessary level of knowledge/skills of the learner to start the game as the most important factors determining the ratio of educational and entertaining accomplishment

3. Research Questions

To solve the task, it seems necessary:

- To consider educational computer games of varying complexity, as well as their assessment and analysis by specialists.
- To divide the games according to the level of complexity of educational assignments into three groups.
- At the second and third level of complexity, there are games that require a certain level of knowledge of the player, who has no need to reach any requirement at the initial stage of complexity.
- To assess how the ratio of educational and entertainment components in the game varies depending on the parameters in question, if possible, taking as the benchmark games that have been approved by specialists.

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4. Purpose of the Study

The aim of the research is to build a model linking the complexity of the educational task and matching the level of training of the learner with the ratio of educational and entertaining in the game.

5. Research Methods

During the study, more than a thousand computer educational games were considered. Particular attention was paid to games which received high praise from researchers, teachers, or students. Also, it is used the authors' own pedagogical experience. A qualitative and quantitative analysis of the features of games was made. The content of the games is assessed in terms of entertainment and educational elements.

6. Findings

First of all, we classify the games in question into three levels depending on their educational complexity. In doing so, we will consider whether training can take place in the game completely or if a certain level of knowledge is required to participate in it.

6.1. Learning without noticing

In simple educational tasks, the pedagogical goal is the consolidation of existing knowledge, simple skills, and memorization of concepts, symbols. The solution of mathematical examples and formation of reading and writing skills can also be referred to here.

The educational task is uninteresting for the trainee since it is too routine. The level of preparation corresponds to the task.

The game is necessary in order to make the task interesting, but not fascinating, without involving the learner's interest in the task. The main goal of the educational game is to encourage the necessary actions with the help of gamification.

Simple games for memorizing concepts, symbols, simple operations with figures, pictures, have arisen already a couple of decades ago. For example, to correctly arrange the outlines of countries on a map, or elements cells, a skeleton, a food chain, to compare chemical elements and names, formulas, to put them in the Periodic Table. Practically any subject areas allow using games like Jeopardy, quizzes, puzzles, millionaire, etc. for terminology.

Over time, the entertainment part of educational sites has significantly increased. For preschoolers / junior pupils, the learning environment can be organized as a passage through the game field from a location to another one, and in order to advance in it, it can require fulfilling tasks formulated in the form of helping game characters, and it also can be rewarded with awards, include animations, etc. Such large-scale educational games are developed in many countries, for example, ReadingEggs.com (Great Britain), Mersibo.ru (Russia), Tik Tak Hitzak (Spain). For older learners, passing levels can be organized even using a three-dimensional virtual world with elements of a social network (for example, massively multiplayer online role-playing game Tyto online).

Increasing the entertainment component of the game in the field of language learning has also advanced far enough. Special applications stimulate daily activities; they are able to track errors, to issue incentives etc. Routine repetition with the help of points, awards, rating, allows the learner to compare

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himself with others, and it offers the possibility to turn into a useful habit (for example, Memrise, Duolingo, etc.). In general, Young et al. (2012) indicate that games aimed at learning the language show the greatest efficiency in comparison with other subject areas, linking it with the most social involvement. Separately, it is necessary to note the possibility of gaming interaction with native speakers. The researchers observe that in this case, in addition to the linguistic competence, the intercultural one will be formed (Almazova, Khalyapina & Popova, 2017, Chernyavskaya, 2016) and interethnic youth projects will appear (Zakharova & Krasnoschokov, 2016).

6.2. Learning by playing

The educational task is rather complicated; it requires comprehension processing available information. The task demands an active thought process; it cannot be solved on the model.

2.1 The level of knowledge of the learner does not allow seeing interest in the task itself. It seems too complicated and additional stimulation is required in order for the learner to be motivated to solve problems.

An example of such a game may be Lure of the Labyrinth, where monsters are more than mathematical problems. Another example is the Chinese game aimed at understanding the effects of force "Carrot Land", in which an elaborated response is developed (feedback provides the reasons or rationales for why the correct answer is the best answer for a given question, and why other answers are not correct) (Law & Chen, 2016).

2.2 The level of the student corresponds to the task, therefore the task results interesting.

The conditions of the task are set in the game form, but the game elements that are not connected with the essence of the task are not added (or added minimally). For illustration, let's cite a few games, implying the inclusion of the player in the process:

- - find spouses for children and nieces of Emperor Peter I, guided by the interests of the empire,
- - substitute emoji for words that are missed in masterpieces of world poetry,
- - arrange the living creatures of another planet in accordance with the peculiarities of their habitat in the corresponding natural zones

6.3. Reality as a game

The educational material under consideration is very complex, extensive, and directly connected to the real world requiring reflection.

3.1 Gamers have only general ideas about the problem.

In this case, the game serves to get acquainted with the information, assimilation, and understanding of the ongoing processes.

For instance, this can be role-playing computer games, implying familiarity with phenomena, situations, or relationships. The tasks to be solved during the game can be routine or purely gaming. For example, you can bring a lot of a fairly large amount of more or less reliable historical games (take at least a series of Total War or Civilization). In general, games of humanitarian content are more often attributed to this type because of the specifics of humanitarian knowledge (Grinëv, 2017).

However, this type of games can be used in different scientific fields, such as the game Immune Attack. It allows you to travel through blood vessels, and connective tissue helps you to learn how to control

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immune cells to fight the bacterial and viral infections. And the game Universe Sandbox allows you to manage the objects of the universe real-time gravity, climate, collision, and material interactions. More complex effects can be seen in the game A Slower Speed of Light. It is assumed that the player moves at a speed close to the speed of light, which allows demonstrating such effects as the Doppler Effect, light aberration, relativistic time dilation, and Lorentz transformations.

3.2 The game requires a certain level of knowledge and skills to be entered which must be improved during the course of the game. Or it might require players who do not have these skills, but an additional motivation for mastering complex information.

The task is complex; therefore it requires the processing of information and the formation and implementation of complex skills. It is at this level where it might be difficult to distinguish the game from the simulation. We can take Cell lab as an example, where a cell laboratory is developed to create different cells and test them under different conditions. In Foldit, you can deal with problems of protein folding using real world data included in real scientific research. EcoMUVE proposes to investigate causal structures in ecosystems. On the contrary, small entertainment elements can turn ordinary learning into work in programs for modeling, programming, etc. in an educational game. Shenzhen I / O - the microcontroller programming simulator falls into the category of logic games and is quite popular at the time when more than a thousand players played it simultaneously. Whitebox Learning, for example, offers computer-aided design modeling to provide a simplified version of a realistic development process, such as building a bridge. Simulations involving the inclusion of some game elements can also be used to learn and train medical procedures and operations (Cowan, Sabri, & Kapralos, 2010).

In general, complex simulations/games for specialists require a minimum amount of entertainment since the task itself, connected with real-world problems, is of interest to the learner. Consider, by a way of illustration, a few examples from a huge number of games that teach programming. The simplest level of learning ("learning without noticing") consists in understanding the very application of the principle of sequential control with the help of pictogram commands, the use of cycles, and so on. Consecutive complication of tasks of this type is necessary for the most unprepared users. For example, the game Kodable is positioned for the youngest children from 2-4 years. The meaning of the game is to move through the various labyrinths of the ball with the eyes.

The next level of complication "learn by playing" implies the first acquaintance with any programming language. The amount of entertainment content can be different; however, in any case it is large, and it is never less than the conditional half of the game. For example, CodeMonkey allows you to control a funny monkey, but not with icons (like at the previous level), but with commands. CodeCombat offers advancement in the game field with more complex entertainment content, capturing lands and defeating enemies (as in RPG). To advance the field, you must master one of the selected programming languages: Python, JavaScript and experimental versions of JavaScript.

At the third stage of complexity ("reality as a game"), the material is not very suitable for the game, represented as a sequence of solving learning tasks of moving through levels. One of the options for building a learning model at a sufficiently high level is to create an environment for more or less free programming with game elements. In it, tasks cannot be formulated at all, or at least the tasks can be chosen independently. This is, for example, Scratch for schoolchildren, where there are no assignments, but there

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are numerous examples and a variety of tools for solving various problems (creating cartoons, presentations, games, applications, etc.). To the advantages of the program it is possible to add the simple interface which allows spending not so much time for adaptation to the environment; as well as an attractive colorful design.

There is another principle of building gameplay for people who have certain knowledge and want to improve them, in the game CheckiO. Here, after the player has solved the problem, he can see the solutions reached by other users. There is a rating solution for each task depending on different parameters (creativity, simplicity, speed, etc.).

7. Conclusion

The optimal ratio of educational and entertaining in the game depends on various factors, the most important of which are the level of complexity of tasks and the correspondence of the student's knowledge/skills.

The more complex the educational task is, the more there will be "serious" educational elements in the game regarding purely entertaining content. By this criterion, we divided the game into 3 levels: "learning without noticing," "learning to play," "reality as a game." On the other hand, the less the learner is ready for the task, the more attractive the game should be to him and the more the player should maintain interest. Therefore, at one level of complexity, the entertainment component will be smaller for those who have a level corresponding to the task at hand. If the task is too complicated, then the game introduces additional entertainment content (Fig.01).

Thus, it is necessary to take into account primarily the educational goals and the intended level of the audience while designing the game and the planning of the relationship between the educational and the entertaining part.

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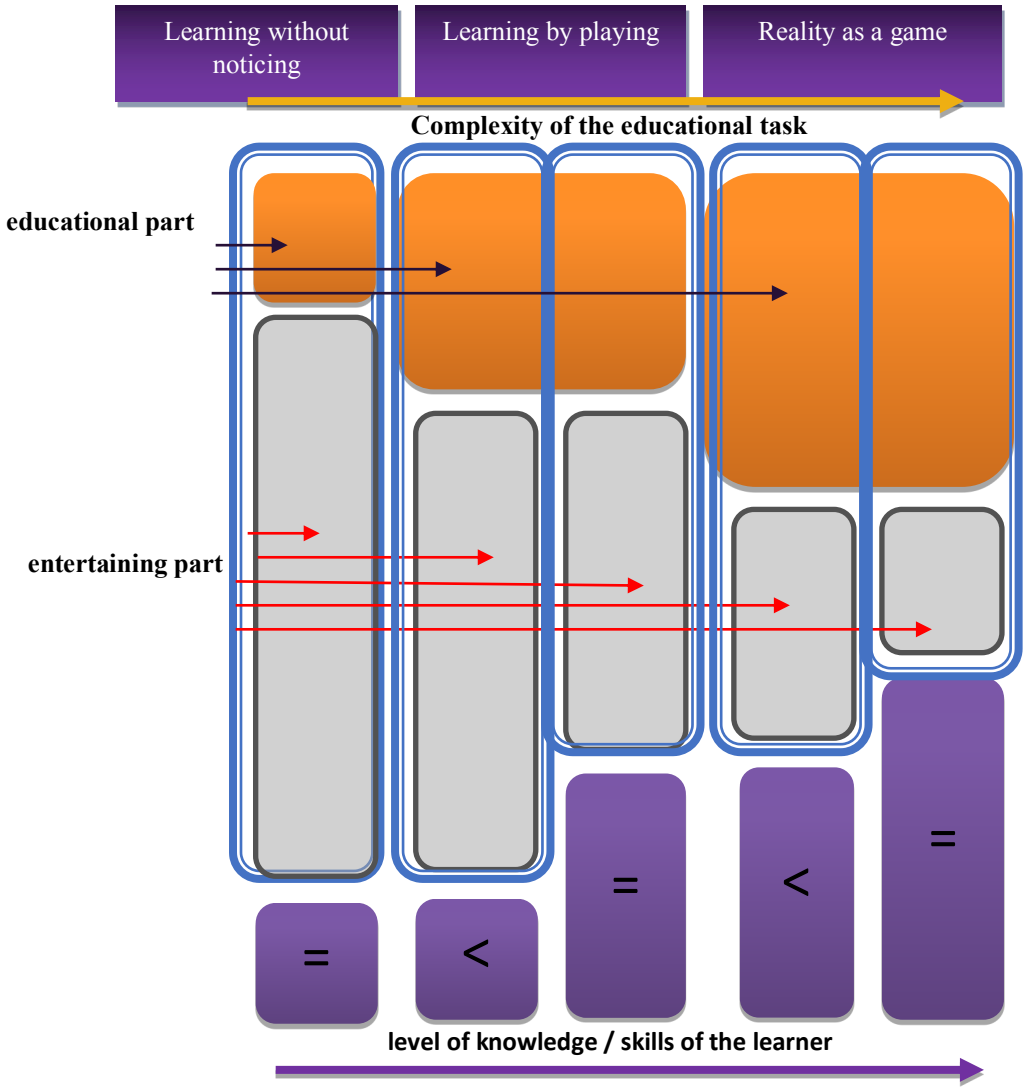

Figure 01. The change in the ratio of the entertainment and educational element in educational games

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