DESIGN OF SERIOUS GAME "ON A LONELY ISLAND"

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Abstract: An increasing awareness about the potential of serious games for education and training at school. The pedagogical value of serious games to raise the level of knowledge, skills and competencies of students, they, like all models are limited due to the inability to recreate the pedagogical reality in its complexity and dynamism, to outline in detail the act of teaching and learning at school.

This article describes the design of serious game "On a lonely island" (Biology and health education for 9-th grade). Design of the game inspired by technologies, methods and gameplay theories.
Key words: *design, serious game, technologies*

Serious games are games that do not have only entertainment as the purpose but rather an educational, training, advertisement or other purpose that benefits from the engaging context that games provide to motivate the players. The pedagogical value of serious games to raise the level of knowledge, skills and competencies of students, they, like all models are limited due to the inability to recreate the pedagogical reality in its complexity and dynamism, to outline in detail the act of teaching and learning at school.

Key points for pedagogical effectiveness of the serious games

The important key points for pedagogical effectiveness of the serious games [3, 8, 9, 12] are following:

- The basis of the game should stay clearly defined educational goals.
- Selection of the right platform that responds to the needs of the target group, the content and the story of the game.
- The environment must be interactive, designed in a way that support the active learning, so the learner could construct himself its knowledge by interacting with the information, tools and materials and in cooperation with other learners. It should encourage the research, problem solving, to create conditions learners to experiment with their ideas, to consolidate what they have learned.
- The environment must provide timely feedback to be generated at a high level, so that students get more satisfaction for its overall progress in the strategy that they used for their overall performance instead of every specific action or decision during the training through computer game.
- The environment should provide an opportunity to study with a high level of interactivity, many different ways that the success can be achieved. The game should stimulate the curiosity of students and to ensure an appropriate level of challenge and to control the environment.
- The game should be related to the context of learning for which it is intended, the curriculum and the evaluation method, to be related to the problems of the course, to be time appropriate and convenient to the requirements and needs of students for whom it is intended.
- The environment and related activities should support and create conditions for reflection.
- The environment must allow personalization and gives equal opportunities for participation of all learners. Where possible, alternative pedagogical approaches for students should apply, which is appropriate to their individual performance.
- The game should include some mechanisms to ensure continuous process of support from the initial orientation and the basic tasks that provide quick success, with constantly increasing complexity of the tasks, accompanied by hints and help to create a sense that the virtual environment is not limited. The aim of the game experience is to develop along the students a high degree of competence.

• The game should include assessment module that allows data collection during each session. These data can be used as an evaluation tool, giving a clear picture of the performance of each student.

This article describes the design of serious game "On a lonely island" (Biology and health education for 9-th grade). Design of the game inspired by technologies, methods and gameplay theories.

The study used methods of theoretical analysis and synthesis, pedagogical modeling.

Design of serious games for student's knowledge transfer and research

For successful use of serious games in achieving the objectives of pedagogical practice, their design is crucial [8, 9]. Design and development of effective design is a complex and demanding task that requires a lot of attention and professionalism, high level of competence in both the pedagogical design and the design of digital games and software programming to achieve a good balance between the elements of learning and entertainment. The successive stages in the design of serious games for student's knowledge transfer and research are Analyze, Design, Develop, Implement Evaluate.

The main pedagogical issues that correspond to the stage "design" are presented in Figure 1.

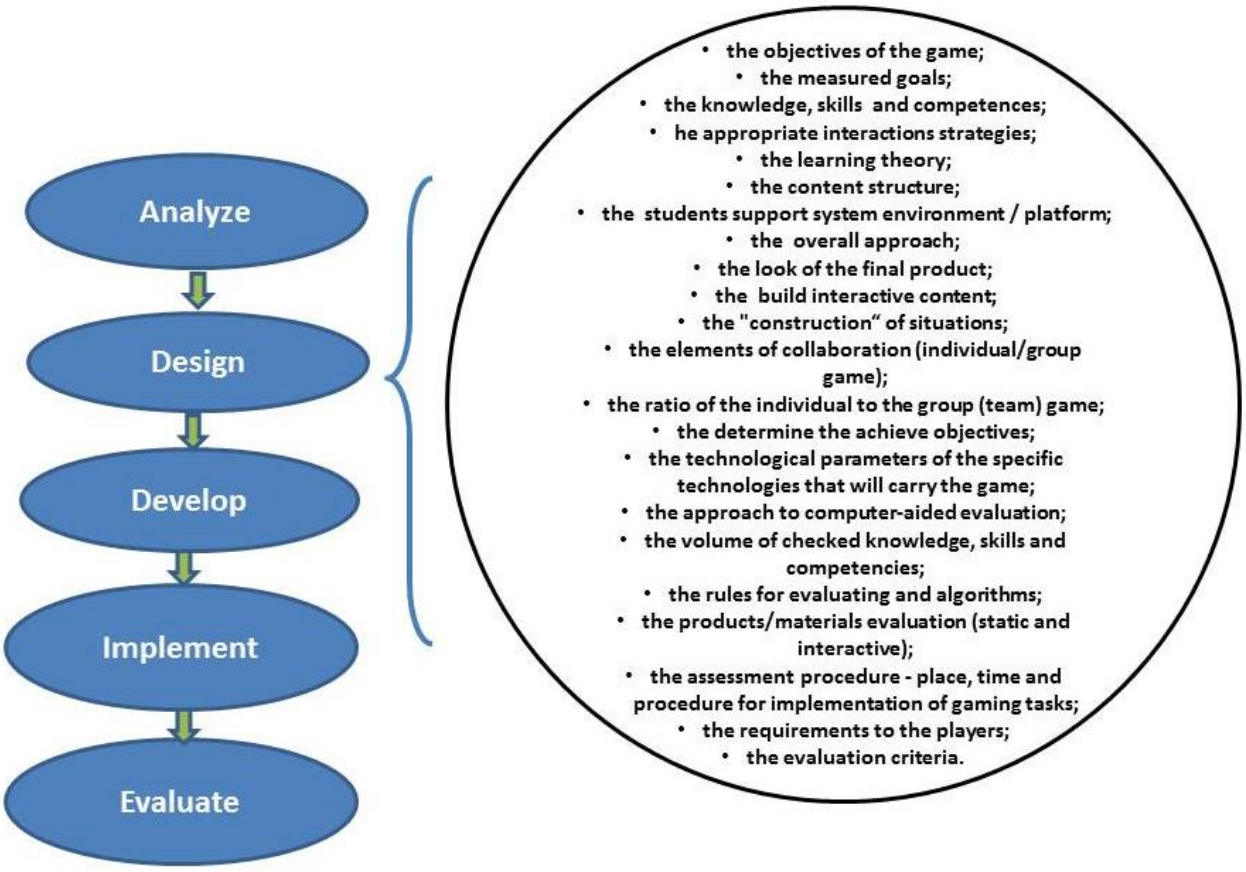

Figure 1. The main pedagogical issues that correspond to the stage "design"

Many training models suggest that the most effective learning environments are those that are problem-based and involve students in four distinct phases of learning, which M. Merrill defines as the first principles of training:

1) activation of prior experience;

2) demonstrations of skills;
3) application of skills;
4) integration of these skills into real-world activities [5].

The game "On a lonely island" is focused on the third and fourth phase of this cycle of learning.

The serious game is based on the following principles in the context of the defined goals and specifics of the pedagogical design:

• players are involved in solving real problems related to apply the knowledge of educational content on the subject "Biology and Health Education";
• existing knowledge is activated as a basis for upgrading and acquiring new knowledge in making strategic decisions in the context of the game;
• new knowledge is applied by the student in a virtual environment;
• integrate of new knowledge in the cognitive aspect of the learner through active interaction in a virtual learning environment;
• learners are engaged in real problems solving of life.

Methodology of virtual game "On a lonely island"

The game is based on constructivist educational paradigm that is based on the idea that students build their knowledge in the context of their own experiences [6]. Developed game is based on the idea of active participation of players in game situations in which the knowledge is not passed, and construct individually or through social interaction of students with the world around them.

The students are engaged in "problem" not only with the level of action or operation in the "On a lonely island" game. Players solve problems of increasing difficulty. Problems are authentic, real-life and personal. Within the game, the students recalled, connect, describe or apply knowledge from relevant past experience, which is used as a basis for acquiring new knowledge. An important experience that can be used as a basis for new knowledge on the players provides. From the perspective of constructivism the learning is based on active involvement of students in critical thinking, problem solving, searching for meaning and understanding and metacognition [4, 7].

In this respect, the main features of constructive learning formulated by P. Simons [10] are:

Active – the students are participate in activities that encourage them to process information, to learn in a meaningful way important concepts and ideas. Problem solving allows students to be active learners by identifying important problems for them and create relevant solutions;

Creative – problem-solving offer environments in which students can solve increasingly complex problems using old and new knowledge in new ways. They develop their skills in creative thinking by generating a variety of ideas and selecting the most appropriate concept;

Cumulative - learning is builds on existing knowledge of students as new knowledge accumulates them. Problem solving allows students to use and connect their existing knowledge with new ideas by applying various methods such as analysis, synthesis and evaluation. When students work with specific problems they develop the ability to determine how and when to use existing knowledge;

Goals oriented – the goals of training should be known from the students. Solving problems is a process that is oriented towards the goal. Students define the problem clearly identify the desired end state (goal), analyzed alone or with the help of their teachers and classmates how to reach him. They are required to actively search and generate alternatives, deciding what action to be taken;

Diagnostic – the students observe themselves and themselves as determine what omission and training needs;

Reflexive – the students assess what they know and what they need to learn. Solving problems is related to "look back" of the actions taken to the problem solve.

The problem-based learning is a good example of constructive learning environment [1, 2, 4, 11]. It is a strategy of training that promotes active learning.

In the ”On a lonely island” game every problem situation solving includes the following steps:

1) Understanding the situation;
2) Definition of the problem;
3) Analysis and brainstorming;
4) Systematic analysis of the problem;
5) Determine what type of information and what learning objectives are necessary;
6) Task study and receiving information;
7) Result evaluation and application information.

The players' evaluation is based on achieving defined goals. Learners self-assessment and / or obtain adequate feedback.

Pedagogical scenario of the game “On a lonely island”

The educational goals of the game "On a lonely island" are based on expected outcomes in the curriculum of Biology and health education, 9th grade (in Bulgarian schools) and build certain knowledge, skills and competencies. Educational goals within the pedagogical scenario of the game are as follows:

• to assess the impact of man on the nature and how dependent on it and the reasons for the disruption of the ecological balance;
• to make conclusions about the relationship between the characteristics of the environment and to the people employment;
• to accept and demonstrate themselves as part of nature and its friend;
• to discuss the effects of harmful to human health and substance impacts and major environmental pollutants;
• to explain the state of the environment through natural environmental laws and through the influence of man;
• to do findings and conclusions about the complex nature of the conservation and restoration work of natural resources;
• to do findings and conclusions about the scarcity of natural resources and the need for rational use;
• to assess the importance of the concept of sustainable development to the global environmental problems solving;
• to recognize and analyze the value reason and moral consequences of human behavior in different social spheres;
• to evaluate depends production on natural resources and knows the ecosystem capabilities for reproduction;
• to aware of the civil society responsibility to protect the ecological system;
• to aware of the threats to the existence of mankind and the importance of its sustainable development;
• to aware of the importance of the global problems of humanity and discuss possible solutions.

Of the players success criteria have a certain number of "credits" at every game level. To participate in the educational game requires a basic level of students’ digital competence.

The following situations are the base of the "On a lonely island" game design:

• the game players have come to an lonely island in the ocean with certain geographical parameters;
• water is provided by natural circulation;

• source of the food - plants and animals;
• there are selected flora and fauna species;
• basin for fish;
• compartment for biological purification of waste water;
• solar panels for securing the power supply etc.

The concept of the educational game "on an island" is presented in Table 1.

Table 1. The concept of the educational game „On a lonely island“

Target audience	**Students from 9th grade**
Subject	"Biology and health education" (environmental education content)
Game play The game includes 12 basic themes of ecology of educational content for 9th grade. Its starting with "situational awareness" of the island. Each topic is a separate level or mission, in which students apply specific knowledge and skills relevant to environmental issues**.**	**Each mission begins:** Introduction (related to disclosure of the purposes of game play time, feedback, the mission of the player, etc.) Introduction → Level 1 → Level n ... → Final feedback from game
Concept of the game – macro-framework	Each mission (game session) has a certain storyline and is structured in two parts as logic is repeated in each level. The first part is related to preparation for the game by the student. In this part the player chooses the necessary resources, equipment, etc., which would require depending on the mission. *For example: to select seeds, choosing the type of dwelling, microscope distiller, etc*. The second part is related to specific actions in the virtual environment depending on the topic of educational content. *For example: to planting and cultivation of a certain group of plants according to conditions on the island*. Each mission is a separate level, to pass to the next level, students must have accumulated a minimum number of "credits". Initial mission require individual work and on the seventh mission at the request of players, they can form teams and participate in group missions.

The final feedback of the game	The student receives feedback on the success of its missions. It is determined by the selection of: - adequate resources depends of goal of the level; - adequacy of individual actions of each mission. At the request of the student, the mission can be repeated each time a student starts over again and make a different choice of necessary resources.

Conclusion

The role of serious games to support active learning by engaging students and encouraging them to involve in research, experimentation and collaboration with peers. Serious games provide an effective pedagogical tool for active and problem-based learning. These games should not be used as a substitute for pedagogical training students in real classroom, they only complement and diversify the traditional teaching.

The game "On a lonely island" will contribute to increased motivation for learning, formation of research competencies, provoking emotional activity, personalization of learning, encouraging experimentation.

References:

[1] Arlegui, J., Pina, A., & Moro, M. (2013). A PBL approach using virtual and real robots (with BYOB and LEGO NXT) to teaching learning key competences and standard curricula in primary level. In Proceedings of the First International Conference on Technological Ecosystem for Enhancing Multiculturality (pp. 323-328). ACM.

[2] Brown, S. W., Lawless, K. A., & Boyer, M. A. (2015). The GlobalEd 2 Simulations: Promoting Positive Academic Dispositions in Middle School Students in a Web-Based PBL Environment. Essential Readings in Problem-Based Learning, 147.

[3] Giessen, H. W. (2015). Serious games effects: an overview. Procedia-Social and Behavioral Sciences, 174, 2240-2244.

[4] Marra, R., Jonassen, D. H., Palmer, B., & Luft, S. (2014). Why problem-based learning works: Theoretical foundations. Journal on Excellence in College Teaching, 25(3/4), 221-238.

[5] Merrill, M. D. (2002). First principles of instruction. Educational technology research and development, 50(3), 43-59.

[6] Obikwelu, C., & Read, J. C. (2012). The Serious Game Constructivist Framework for Children's Learning. *Procedia Computer Science*, *15*, 32-37.

[7] Onyon, C. (2012). Problem-based learning: a review of the educational and psychological theory. The clinical teacher, 9(1), 22-26.

[8] Peicheva-Forsyth, R., & Yovkova, B. (2011). Serious computer games in the preparation of future teachers. In: Sofia University Journal of Educational Research, No. 4, pp. 5-28.

[9] Ranchhod, A., Gurău, C., Loukis, E., & Trivedi, R. (2014). Evaluating the educational effectiveness of simulation games: A value generation model. Information Sciences, 264, 75-90.

[10] Simons, P. R. J. (1993). Constructive learning: The role of the learner. In Designing environments for constructive learning (pp. 291-313). Springer Berlin Heidelberg.

Strobel, J., Wang, J., Weber, N. R., & Dyehouse, M. (2013). The role of authenticity in design-based learning environments: The case of engineering education. Computers & Education, 64, 143-152.

[11] Yotovska, K., Asenova, A., & Slavov, V. (in press). Pedagogical design of serious games for student's knowledge transfer and research, In: XIV-th International Conference 'Challenges in Higher Education and Research in the 21st Century' , Sozopol, May 31 - June 3, 2016.