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INVOLVEMENT IN VIRTUAL REALITY BASED GAME LEARNING

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Abstract

The conducted studies have shown that when using educational games, the involvement and motivation of students primarily affects the effectiveness of learning, therefore, the function of playing learning is to enhance the participation of students in the learning process. Virtual reality technologies allow for strong immersion and interaction, which cannot be achieved in traditional game learning, and increases the level of interest and involvement of students. At the same time, at the moment, no specific recommendations have been developed for the development of educational games regarding ensuring student involvement. This article provides a literary analysis of studies on the study of involvement in educational games. A model for ensuring involvement in educational games with the use of virtual reality is proposed, based on three main elements: immersion, usability and playability.

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1. Introduction

The study of student involvement is a relatively new scientific field that appeared in the second half of the 20th century. Involvement in learning as a scientific problem is only gaining interest among researchers, and so far, the involvement of students in the context of gaming education has been poorly considered.

Game learning uses an integrated complex consisting of video images, missions and emotions, on the basis of which knowledge and skills are transferred. Such an approach is able to effectively increase the involvement and interactivity in the learning process, enrich the diversity of teaching methods. The emergence and spread of virtual reality technologies has aroused great interest in the possibility of their use in education. Providing a high level of immersion, visibility and interactivity, VR technologies provide an immersive experience that is very difficult to achieve in classic game learning. Such technologies provide students with a virtual, close to reality learning environment that can deeply affect the reception (Anzorova & Platov, 2019). The use of virtual reality stimulates students' interest and enthusiasm for learning, the effectiveness of learning is growing. The introduction of VR technology into the learning process by itself is not able to maintain long-term interest among students. Only in combination with a game approach these technologies can motivate students to learn and deeply involve them in this process.

2. Problem Statement

An educational game consists of many components, which can be roughly divided into three groups. First, these are the playability components, i.e. supporting motivation and interest in the game (Gonzalez, 2009).

Secondly, these are components that simulate the game world, i.e. content components. Thirdly, this is the technical implementation of the game, i.e. components providing sound, graphics, design, interface.

There are no unified approaches to identifying the components of educational games. These components can be determined based on the structure of traditional games, gameplay, ready-made software products. In our opinion, the following aspects of the game are the most significant: motivational, substantive, procedural, effective, regulatory. Technical implementation is also expected. Based on this, we define the following components of an educational game using VR technologies:

The motivational component (playability) includes the leading idea, the meaning and purpose of the game, the game and educational task, the assessment system, the reward system, the level of difficulty.

The content component includes a set of roles, a game scenario, a game environment, and a game map.

The procedural component is determined by game actions, events, stages of the game, conditions for its end, current state, system of role functions, and modeled relationships.

The regulatory component consists of the rules of the game, instructions, a help system, and player registration.

The technical component includes a graphics engine, sound engine, game look, user interface, control of additional features.

Involvement provides an individual with the ability to concentrate on the game. Participating in the game, the user gets an exciting experience, getting deeper into the gameplay.

Procci et al. (2018) distinguish four states of players: immersion, involvement, presence and flow. This model has been tested experimentally; during the experiment, the authors varied the level of graphics quality. The experiment showed that the level of user involvement in the game is determined primarily by the degree of immersion and the convenience of using the system.. Certain characteristics of the individual, such as fantasy, also had an impact.

Hassenzahl et al. (2010) divided the factors that influence involvement, quality and user experience. The former is related to utility and usability, the latter relates to motivational aspects. Febretti and Garzotto (2009) report that playability factors were found to be the most important for the level of user involvement during educational play and were the main driving forces to keep playing. At the same time, the authors report that the usability factor had a weak and inconsistent effect on long-term student involvement.

3. Research Questions

The use of virtual reality in game learning can significantly enhance immersion and interaction effects that are difficult to achieve in traditional game learning and ensure high student involvement. At the same time, there are currently no systematic, scientifically substantiated recommendations on the game design of educational games regarding student involvement. In this study, a literary analysis of the work related to involvement in educational games.

Key research questions are:

What elements of game design contribute to the formation of the deep involvement of students in the educational game?

What is the mechanism of the influence of these elements on the formation of educational involvement?

4. Purpose of the Study

The purpose of this work is to develop a conceptual model for ensuring educational involvement in game based learning using virtual reality.

5. Research Methods

The research methods that contribute to solving the tasks are the following:

- theoretical methods-operations: analysis, generalization and comparison of international experience in the use of educational games based on virtual reality, modeling of game learning processes, their formalization;
- theoretical methods of action: the dialectical method of cognition of the gamification of education, the identification and resolution of its problems;

- empirical methods-operations: the study of psychological and pedagogical literature, educational programs, teaching aids, dissertation research, pedagogical observation;
- empirical methods-actions: experimental work and processing of its results.

6. Findings

In the presented article, we propose a model for ensuring educational involvement in game learning based on virtual reality, which includes three main elements: immersion, usability, and playability.

Usability is a feature that requires the closest attention when developing educational games. The usability of the game is subjective, the user himself determines how easy it is for him to play and learn. Users often note a lack of intuitiveness in the user interface of educational games. This creates problems with the control of user actions and their interaction with game objects. The compatibility of the pedagogical content and the storyline of the game is also very significant, since the storyline is the connecting element between the missions. Playability is a characteristic of the game process that determines the degree of pleasure and satisfaction of the player during the game. Educational games attract students more than traditional educational software, bringing elements of gamification to the educational process.

Immersion is a dualistic phenomenon. Immersion is interpreted as a certain property of the virtual environment that determines the level of technology. At the same time, immersion is a psychological state when the subject ceases to be aware of his real physical state while interacting with the virtual environment. Thus, user immersion is largely determined by usability and playability.

This article proposes a model for ensuring the involvement of students in game learning using VR technologies. Based on it, developers will be able to provide a higher level of involvement.

6.1. Immersion

Immersion is a state of consciousness, often artificial, in which the subject's self-awareness of his physical state decreases or is completely lost (Nechvatal, 2010). This mental state is often accompanied by a feeling of infinity of space, over-concentration, a distorted sense of time, as well as ease of action. The term is widely used to describe immersion in virtual reality and video games.

The feeling of being immersed in virtual reality can be described as the complete presence of virtual objects inside the suggested space, where everything related to this space necessarily assumes its "reality", and the subject seems completely disconnected from the external physical world.

Immersion proceeds in two stages: first, the user forms in his head an idea of the game (how it looks, sounds and feels), and then gradually begins to perceive the virtual environment as the main "coordinate system", as the place where he is and whose rules it obeys. The first minutes (or hours) of gameplay are usually spent on getting to know the controls, careful reconnaissance of the area, and only after a while the user begins to set goals justified by the context - that is, the virtual environment.

The atmosphere of the game is a key element of the immersion effect: in games, this term usually refers to a whole range of senses: sight, hearing, touch, and in VR games, also the vestibular apparatus.

The combination of graphics, sounds, music, story, gameplay and decision-making ability creates an atmosphere, and the player adapts to it, translating his thinking into the "play" plane. If the atmosphere carefully designed by the developers allows the user to experience the virtual world through the impact on all possible senses and psyche, then consciousness itself erases the border between reality and illusion.

The integrity of the gameplay itself also plays an important role in the immersion effect, transitions to new locations should be seamless.

A great contribution to the formation of the atmosphere is made by the interactivity of the environment. To make the player believe in the game world, you need to give him the opportunity to interact with it. In the newest immersive games, the player usually has a lot of control over the surrounding objects and many ways to achieve the goal, using a variety of mechanics.

To create a sense of total immersion and a sense of physical reality, all five senses must perceive the digital environment (sight, hearing, touch, smell, taste). Immersion technology should replace real sensations of the surrounding world with those suggested to the senses through: panoramic stereoscopic display (vision), surround sound (hearing), tactile sensation and strong feedback (touch), smell reproduction (smell), taste reproduction (taste).

The task of reaching deep immersion in an unfamiliar environment is impossible for most people. The ability to immerse is determined by their activities and skills, therefore the immersion experience of students will depend on whether the game developers can create the necessary prerequisites, namely usability and playability.

6.2. Usability

Usability is a key characteristic of educational games, which necessitates careful study. Procci et al. (2012) believe that usability is a key factor in developing an educational game, and this has a close relationship with the overall user experience. They also noted that if the educational game had poor usability, insufficient attention was paid to its content and cognitive processes were ineffective. Usability should also be considered when developing educational games since it has an impact on the attractiveness of the game for the user (Virvou & Katsionis, 2008). The attractiveness level directly determines the levels of motivation and involvement of students, and therefore their learning success. Markopoulos and Bekker (2003) argue that game usability has become a central issue for electronic resources of all purposes. In general, when creating e-learning tools, usability development comes to the fore. From the point of view of involvement in the game, it is usability that is responsible for whether the user interface will distract the user's attention and prevent it from apprehending the content adequately. Poor usability of the game will prevent the user from immersing in the game and moving to higher levels of involvement.

The game usability score is determined by the following qualitative indicators:

1. Orientation. Orientation refers to how obvious it is for a new user to perform the simplest actions in the game.
2. Efficiency. Efficiency is how quickly users get to what they entered the game for.
3. Memorability. How quickly the user can perform actions in the game, after a long absence from it.

Before starting a game, participants should become familiar with its user interface. Understanding the user interface of a virtual reality game provides the very opportunity to participate in it. For example,

if the user does not know how to use the "inventory", "map" and "hint" UI options in the game, it will result in low involvement and immersion levels. While studying the interface of the educational game based on virtual reality VR-Engage, it was found that its simplicity and clarity makes the gameplay simpler and more pleasant (Virvou & Katsionis, 2008). Therefore, when developing a user interface, information that can be misleading or difficult to understand should be avoided. Developers should make every effort to design the workflow taking into account the traditional behavior of the users, thereby providing them with the opportunity to concentrate on the course of the game itself.

The active interaction of the user with the e-learning product is the main advantage and strategic objective of education. The level of interactivity, in other words, the level of user activity when working with an electronic educational resource is one of the most important indicators of the quality of this resource.

The development of environmental elements has a strong impact on user satisfaction. There are many aspects of the virtual environment that must be taken into account when designing effective interaction. High-quality dynamic display of user actions is only more realistic and improves the interaction between him and the objects of the virtual environment, but also increases the level of immersion in the game and contributes to the growth of internal motivation and involvement. The reliability of the interaction has a significant impact on the subjective opinions of users about immersion, involvement and usability (McMahan et al., 2012). Therefore, in the process of developing games, one should take into account not only that the virtual environment is as realistic and colorful as possible, but also the interaction between users and the game environment should also be more realistic. Thus, the learning process will take place in an exciting gaming environment, which greatly contributes to the realization of cognitive abilities.

Numerous studies have shown that the quality of the storyline determines the level of student learning motivation. An engaging storyline provides compelling content and encourages continued missions. The plot brings together individual scenes and locations in games with educational content into a single scenario. In the course of the game, a correctly built storyline clearly communicates the ultimate goals, provides various options for achieving them and encourages players to take action, while maintaining their involvement. When developing a storyline, it is necessary to integrate it with educational content as much as possible, dividing it into interrelated components and creating appropriate game moves, combining all the fragments. The plot should be clear, and the main and secondary subjects clearly differentiate. The too complicated storyline will distract the user's attention, forcing him to concentrate on the plot of the game and not on the educational content.

6.3. Playability

There is no strict definition of playability. This concept can be viewed as a set of properties for describing the player's experience when using a certain game system designed to entertain the player and bring him pleasure by convincingly meeting the player's needs (Zhu & Fang, 2015). At the same time, playability is a combination of gameplay and user interface that combines the concepts of intuition, unobtrusiveness, pleasure and game challenge.

Playability is essentially the degree to which users get what they want, which is expressed in satisfaction with the game context, which depends on the gameplay, the quality of the plot and other

components (Zea et al., 2010). The factors that determine playability also include the convenience of the interface, control of what is happening, the response of the game world, the quality of integration, the ability to customize, complexity, and strategy.

Game learning is attractive to students and aims to increase their motivation to learn. Gamification of the educational process allows students to enjoy it, therefore gamification has become an effective way to motivate and involve students (Seaborn & Fels, 2015). Common elements of gamification include points, awards, ratings, and restrictions. To increase student involvement, you can add reward elements that they can receive upon completion of certain tasks. Thus, it is possible to effectively influence the educational motivation of students. The rating shows the user his current position in the game, thus stimulating him to take action. Assessment informs students of their successes and failures, encouraging them to try again. It is advisable to use an element of limitation, for example, limiting the time of the game or part of it, since some tasks in educational games involve execution within a certain time frame. Another option may be to limit user interaction, for example, limiting the number of available functions for a certain period, or unlocking some functions only after the task is completed. Such restrictions motivate the user to respond faster and encourage him to act.

With a more detailed consideration of playability, its value can be determined based on the following characteristics (Gonzalez, 2009):

Satisfaction: how much the player enjoys the gameplay, which includes: "fun" as the main game goal; "Disappointment", which should not be too much or too little, since in the first case the player will give up the game, and in the second there will be insufficient challenge; "Attractiveness" as a set of attributes that enhance the enjoyment and satisfaction of the game.

Learnability: the player's ability to understand the game world and its mechanics, and then become a master in it - this includes setting a problem, a set of rules, ways of interacting with the game, etc. This includes game knowledge, skills, difficulty, speed, frustration, discovery.

Efficiency: the amount of time and resources a player needs to spend to gain gaming experience; is described through the completeness of implementation and structured elements.

Motivation: Many characteristics that motivate the player to complete the game. Encouragement, interestingness, self-improvement, diversity are important here.

Emotionality: properties of the game that give the player an impulse to chains of unconscious actions: reaction, behavior, sensitivity.

Socialization: characteristics of the game that stimulate social aspects, satisfying the players by forming relationships with other players. This includes social perception, group identity, personal fulfillment, communication, interactive interaction, cooperation and competition.

Thus, playability is a complex process, as it depends on many factors and can be considered from different points of view and architecture.

In our opinion, the degree of immersion is mainly determined by the level of complexity of the problem posed and the knowledge gained by the user. Over-complicating or simplifying a task will negatively affect the level of immersion in the game and the player's involvement. In the first case, users will be worried or frustrated because they have no control over the process. In the second case, the user will not be interested in performing boring tasks. Achieving immersion is possible only when these two

factors are balanced. To maintain immersion in the game, subject to continuous improvement of skills, students should consistently increase the level of difficulty of the game problems. Thus, maintaining a balance between task and skill at all times ensures that the student is immersed in the educational game. Game tasks should be scientific enough and at the same time reasonably difficult. The game can take the form of a personal research project for one student or virtual collaboration for learning with other partners.

7. Conclusion

When implementing the situational approach in teaching, the most appropriate method is educational game. Games based on virtual reality platforms create a virtual world for the user that can be explored at will, and blur the line between it and the real environment. While in the gaming environment, students can make changes in the virtual world, while learning and forming competencies that remain with them in real life. The use of virtual reality opens up very wide opportunities for education, thanks to interactivity, creativity and deep involvement, it can significantly motivate students to learn. Numerous studies have shown that the use of educational games based on virtual reality has a positive impact on the level of student involvement and the quality of their learning (Cao et al., 2019; Cheng et al., 2015; Lim et al., 2017). The degree of student involvement has a strong correlation with learning outcomes in a computer-based learning environment (Tempelaar et al., 2019). Thus, the goal of virtual reality-based learning games is to stimulate student involvement during training.

This article proposes a model for ensuring the involvement of students in educational games using the capabilities of virtual reality. The proposed model declares the basic principles of creating educational games that ensure user involvement in the learning process, based on three key aspects: usability, playability and immersion.

Playability determines the degree of pleasure and satisfaction with the game during its interactive interaction between the game and the student.

Immersion is determined by the level of technology and the psychological characteristics and state of the user. Well-tuned virtual reality technology, carefully crafted usability, and playability will provide a deep immersion for students.

Previously, the authors developed and tested an educational model based on the Second Life virtual reality platform (Anzorova & Platov, 2019). Its goal was to improve the educational process by taking advantage of role-playing games, collaborative and interactive learning, as well as realistic cases in a virtual environment. The principles described above were laid in the development of this model. The model has been tested in a number of Moscow universities. Testing results showed an increase in the level of student involvement in the learning process.

Nevertheless, the presented model relies heavily on literary analysis; empirical data are not enough. In addition, states of involvement include cognitive, behavioral, and emotional aspects. Therefore, the theses set forth require further empirical studies.

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