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Analysis of software gamification for teaching architects in immersive virtual reality.

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Summary

The progressive tendencies of education computerization are analysed in the article. Gamification of this process accelerates the time of understanding and consolidation of educational material are proved. The author examines the prospects of using virtual reality as an effective method of teaching architectural composition course. The results provide an opportunity for students to operate with abstract concepts through the immersion virtual world where they can visualise any geometric shapes as well as to do conceptual models in real time. The future architects begin to create an architectural space based on many factors, including abstract, which usually have a graphical representation. Using a powerful database platform game software, which allows building mental models for incorporation of the virtual world of immeasurable concept. This article is devoted to the features and functionality of Unity 3D Engine and Unreal Engine for creation on this basis the gamification education of conceptual architectural modelling.

KEYWORDS: immersive virtual reality, gamification software, composition analysis, architectural education.

1. INTRODUCTION

Recently, computer modelling volumes, processes and mechanisms became the highest relevance, because it gives the user the clearest picture. Virtual reality technology further expanded the possibilities of design. The number of computer programs that enables design anything in real time are growing every day. For the success of construction industry, these technologies are gradually implemented in education. Many institutions of secondary and higher education establish computer-learning methods simulating future professional work of students. Also global approach to learning via the Internet becoming popular. All these innovations are concerning in architectural education. An example is OIKODOMOS i OIKONET: The aim of the OIKODOMOS and OIKONET virtual campus training and research projects is the development, research and

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application of new methods of study of housing and housing design, implementation of innovative education methodology in the field of architectural education (in its different forms and multidisciplinary perspectives), joint international actions addressing housing issues in contemporary Europe (in cooperation with local councils) and the creation of European educational programs compatible with the Bologna Process, which should combine physical and virtual mobility of students and teachers. In addition, these projects deal with topical issues of housing, and with innovative global dwelling solutions corresponding to social, economic and technological challenges of contemporary society. Finally, they create opportunities for active collaboration between universities and other stakeholders, such as with municipalities and social organisations, addressing complex housing problems [1].

The author believes that an essential aspect of online distance learning is Gamification of the study process. McGonigal defines four basic traits that can be found in any game: clear goals that give the player a sense of purpose, rules that define the limitations how to achieve the goal, a feedback system giving the player the promise that the goal in question is definitely reachable and, ultimately, a voluntary participation, i.e., the user accepts the goals, rules, and feedback of the system voluntarily. Everything else, such as interactivity, narrative context, graphics, or rewards are enhancements or reinforcements of these defining features [2]. All these factors transform the learning process an interesting and exciting experience.

Future architects, above all, have developed spatial imagination. In the language of psychology, they are "visual" people, who had better perceive data from visual information channel. Therefore, immersive virtual reality, based on game software, is ideal for training of this industry specialists. This research proves the possibility of creating a software platform that will combine all strengths of the above technologies.

2. METHOD

Architectural composition course has a high level of abstraction in many aspects. Classic architectural education programs offer a multifaceted analysis of existing works of art and works of the architects of the past. Methods of this analysis have inductive and deductive nature expressed through graphic language. Breakdown the shapes or flat picture on the modules, composite axis's, bundling zones of any type - this entire are required the support tools. The study provides a software environment for teaching composition, which has the following specific, purely conceptual elements. It can look like this: a student receives a task - for example, to do a compositional analysis of the Italian Renaissance palazzo. On the above software developed basis, it can:

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- to integrate 3D model of the Palazzo into the virtual gaming environment;
- to look and move in real time inside and outside the model, put VR glasses;
- by optimising facilities student will have the opportunity to see different levels of model detail.

Using a set of tools for conceptual modelling, the student performs compositional analysis models, 3D designs modular grid system used by the author of Palazzo project finds the proportioning system, notes nodes, etc. The main game point is checked compositional analysis by comparing the executed task with existing proportioning system.

In addition, the presence of such a model allows a comparative computer analysis, for example, the evolution of forms of Italian Renaissance palazzo compared with medieval buildings.

The student plays the peculiar "3D puzzles": computer provides conceptual diagrams of buildings, which must inscribe in the buildingţs model. Therefore, two scientific cognition methods - induction and deduction are realised. The virtual environment is allowed to select any view to building a holistic perception of volume and finding a right decision.

Further work with the platform of research is execution a conceptual stage of their design tasks. This can be called "virtual sketching" with having specific digital indicators, and possibilities of computer analysis. Game component implemented by comparing the set design factors with those embodied in the model of the learner.

To realise the above objectives of the study have been found needful key points relative to choice a software for application development of conceptual modelling in VR [5]:

- Usability (UI, how easy it was to learn and develop with)
- Functionality (What exactly the engine can do)
- Price Point
- Cross-platform

According to the above factors, the author was made a conclusion that Unity 3D and Unreal Engine have the greatest functionality, usability for architectural purpose and cross-platform feature. Other important features of this software are indicated in Table 1.

These game engines have free versions for individual work. Scripting for Unity 3D can be performed in Visual Studio, which is also free. Additionally, it should be noted that in Unreal Engine scripting is done by using visual programming language Blueprint. There are plugins for Unity 3D engine that allow programming so also (Uscript). This technology can prescribe algorithms without dipping into writing codes through text nodes - a graphic representation of software elements.

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Table 1. Comparative analysis important for this study Unity 3D and Unreal Engine

Type of software	Optimization	Scripting	Possibilities in VR	3D file formats	Cross-platform
Unity 3D	Level of Detail	C#	Unity VR lets you target virtual reality devices directly from Unity, without any external plug-ins in projects. It provides a base API and feature set with compatibility for multiple devices. It has been designed to provide forward compatibility for future devices and software [3].	.3ds, .max, .obj, .fbx, .dae, .ma, .mb, .blend	Windows, OS X, Windows Phone, Android, Apple iOS, Linux, Wii, PlayStation 3, PlayStation 4, Xbox 360, Xbox One, MotionParal-lax3D
Unreal Engine	Node count is the number of nodes on the screen or in the game space in general. The number of nodes simultaneously visible on the screen affects the performance when rendering the scene.	C++	Rendering pipeline that gets you to 90 Hz stereo frame rate or faster at high resolutions, no code changes required. Tools that scale from simple to extremely detailed scenes, environments and characters. Low friction startup and rapid iteration [4].		Microsoft Win-dows, Linux, Mac OS и Mac OS X; Xbox, Xbox 360, Xbox One, PlayStation 2, PlayStation 3, PlayStation 4, PSP, PS Vita, Wii, Dreamcast, GameCube, Apple (iPad, iPhone).

The method of transferring mathematical meanings and relationships in a visual plane is the best fit to the general hypothesis of the study, which is to present the abstract model graphically. In addition, the above-listed software runs on object-

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oriented programming, on the main provisions of which is lying model component hierarchy. Besides both platforms implemented the principle of optimisation game geometry, which is crucial in the assembly the build of the game. Moreover, the implementation of the optimisation principle, which makes image more detail when the user came closer, offers to users different levels of model details. He can manage this system through a specially designed UI. That is if the user is close to a particular piece of the model the fragment is automatically detailed. In case the user wants to see a generalised image of close, he gives the appropriate command from the menu, and vice versa. The concept of “Level of Detail” is very important for this study. Development of analysis tools and architectural compositions in virtual reality requires flexible interface, for maximum comfort and clearness for the user.

The relevance of the study is also confirmed by various developments of inexpensive equipment for training specialists. For example, the system of 3D-visualization I-Space FGUP NIIR. I-Space is a multifaceted cubic environment in which the observer is completely "immersed" in a virtual Scene. The main components of the system are projection screens, projectors, interactive feedback (tracking) system, audio system and software for creating interactive 3D visualisation [6].

3. CONCLUSIONS

Virtual space - is a boundless field to implement any ideas that have a graphical representation. Human sees in the imagination of even abstract concepts, and thinking, in fact, is the consequence of this view. Research makes the assumptions that among immersive virtual reality environment, as in the human mind, it is possible to visualise any concept, to create a concept model, and make from it a specific architectural conceptual model later. The Educational Conceptual design of architectural spaces on the first stage is performed from archetype shapes that have mutual relationships and connections. Executing of educational tasks from this "virtual designer" according to the proportions and other factors is interesting professional experience and the development of abstract and spatial imagination. The game principle of the gradual complication of tasks by increasing the number of influencing factors and increasing structural elements are training architects to design large multifunctional complexes. However, mastering the study material comes from the possibility of constant checks on the raw data in the a not stressful atmosphere. The teacher has the ability to distance observe and adjust the process in real time with the appropriate equipment.

It should be noted that the above gamification-learning platform widens the boundaries the classical concept of architectural space. Optionally, by changing the program code of physics engine, space stops to obey earthly physical laws. This

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provides an opportunity for students to create new virtual architectural measurements, experiment with algorithmic shaping in the absence of the usual gravity force and explore multidimensional mathematical spaces. One of the hypotheses of this study is understanding the virtual environment not as a simulation of a real environment, but as a new real architectural space. Architects create virtual offices for business meetings of various experts, virtual stores and 3D social networks pages interior with the same importance of representative value as an own home décor. These spaces can be radically different in structure, but open and bring unexpected compositional novelty into the real physical world. This will contribute to "go beyond" the standard of the imagination - one of the main principles of gamification, which immersive virtual reality is provided.

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APPENDIX

Gamification is the application of game-design elements and game principles in non-game contexts. Huotari, K., & Hamari, J. (2012). "Defining Gamification – A Service Marketing Perspective" (PDF). Proceedings of the 16th International Academic MindTrek Conference 2012, Tampere, Finland, October, 3–5.

VR (virtual reality); **Immersion** into virtual reality is a perception of being physically present in a non-physical world.

https://en.wikipedia.org/wiki/Immersion_(virtual_reality).

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