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Abstract	This paper describes early stages of an educational project focused on using gamification in architecture education. The state of the art of gamification technologies applied to education, architecture and urban design, is introduced, as well as main objectives of the project. It is based on the use of virtual reality systems on urban spaces to asses motivational, social, and spatial competences in an educational context. Finally, assessment methodology and previous design concepts are discussed.

Keywords (separated by '-')	Gamification - Education - Architecture - Multimedia - Visual representation - Urban space

Urban Gamification in Architecture Education

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1 Introduction

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Videogames are increasingly part of our life; while in the past playing videogames was
considered an activity restricted to the young male demographic segment, the average
age of a "gamer" is currently 35 years old and the gender distribution is remarkably
balanced [1]. Moreover, the use of mobile devices for leisure activities have widened
the game-playing population spectrum while introducing new genres labeled as "social
gaming" and "casual gaming" [2]. Videogames have also been used in sports training,
where a virtual partner increases the motivation of the subject while doing exercise in
a virtual environment [3], and is beginning to find its place in the educational programs
of Universities [4]. At the same time, the way games themselves are played is also
evolving; the rise of livestreaming is influencing how games are designed and played
[5], and game-playing is becoming a spectator sport.

The project presented in this article involves computing science, architectural and
multimedia engineers' education, and public urban policy for future cities [6, 7]. One
of the innovative aspects of this project is to incorporate gaming strategies in an urban
collaborative environment to enhance an initial design proposal. This approach aims to
incorporate actively architecture students (as urban designers), multimedia engineering

and informatics students (as multi-platform programmers), and final users. Citizens will play with virtual models and they will generate points of view that were not considered in the original proposal. This could be useful for project improvement since informal and casual perception would be incorporated to the project design. This fact would feed back into student's education, primarily oriented towards formal content so far.

2   Literature Review

2.1   Gamification in Education

Games are created by designers/teams of developers, and consumed by players [8]. They are purchased, used and eventually cast away like most other consumable goods [9]. The difference between games and other entertainment products (such as books, music, movies and plays) is that their consumption is relatively unpredictable. The string of events that occur during gameplay and the outcome of those events are unknown at the time the product is finished [10]. We can formalize the consumption of games by breaking them into distinct components [11, 12], i.e., Rules => System => Fun, and establishing their design counterparts: Mechanics describes the components of the game, at the level of data representation and algorithms; Dynamics refers to the run-time behavior of the mechanics acting on player inputs and outputs; and Aesthetics pertains to the desirable emotional responses of game interaction evoked in the player.

The gamification in classes helps improve the connection between the material and the student. It offers the opportunity to reflect on a topic in depth and allows positive changes in behavior [13]. In this approach, learning through gamming is achieved by aligning the game mechanics with Bloom's taxonomy of learning [14], allowing learning to be classified into three domains [15]:

- Cognitive, which is taught in traditional education and implies understanding and synthesis of knowledge.
- Affective (involving emotions), which reflects the attitude toward a situation.
- Psychomotor (the physical), which is activated by requiring a union of mental and physical activity.

To encourage the use of games in learning beyond simulations and puzzles, it is essential to develop a better understanding of the tasks, activities, skills and operations that different game types can offer and examine how these might correspond to the desired learning outcomes [16].

Previous studies in learning gamification were assessed in terms of increased motivation and engagement in the learning tasks, as well as enjoyment derived from partaking in them [17]. However, these studies revealed some negative outcomes that need to be addressed, such as the effects of increased competition, task evaluation difficulties, and design features [18]. Product designers are leveraging this alignment in business contexts to "make the consumers come in, bring friends and keep coming back". The reward is often not directly related to the goal achieved, but rather serves as a notification to the player and others that a level of competence has been achieved.

Progress tracking is often enabled and guided by reward systems. Similarly, progress towards an overall objective is mapped out by a sequence of intermediate goals.

2.2 3D Architecture/Urban Models Visualization

Historically, in civil and building engineering education, visualization and understanding of 3D space was typically accomplished via the classical view (physical models and drawings), in front of 3D models and using virtual specifications. This approach is changing due to a generational change and the continuous improvement and development of technology. The new systems based on VR/AR (Virtual and Augmented Reality), Geo-Referencing, and learning gamification, will gradually reduce the control imposed on the designed tasks and scheduled presentations.

Due to the potential of virtual systems, we can strengthen the spatial skills and abilities of students while also using the essential interactive and collaborative features of these processes. Students can work with peers and teachers and participate in multi-tasking/multi-user collaborative and instant tracking [19]. The simplicity of completing the most basic models with the creation of new objects, light treatment, materials, textures, and shadows allows a dynamic workflow that is much faster to complete than physical scale models [20].

Additionally, the versatility of virtual worlds and their use in social networking allows for creation and collaboration with heterogeneous groups from all over the world, who can collaborate synchronously in different virtual spaces. Virtual worlds provide a combination of simulation tools, a sense of immersion and opportunities for communication and collaboration that have great potential for their application in education [21, 22]. However, as criticized in [23], many of the existing educative experiences in virtual worlds only replicate traditional approaches, such as recreating the classrooms.

Focused in the urban data, [24] proposed a generic model to support a new way of visiting a city. In this approach, instead of understanding the city as a place for tourism, the students perceive it as a place for learning in which all necessary educational resources are available. The model has been conceived as a way to encourage learners to create their own educational tours, in which Learning Points Of Interest are set up to be discovered using two models—formal (conducted by a teacher) and informal outdoor mobile learning (no educator is related to the learning experience).

Merging gamification and 3D architectural models, we can find some references in the use of gamification applied to urban planning process with citizen participation:

- "Blockholm", a game based on Minecraft promoted by the Swedish Center for Architecture and Design. The objective of the game is based on designing an intelligent city of the future from the real cartography of the city where the topography, streets, lakes, rivers, etc. are included [25].
- "Play the City", of the Play the City Foundation implemented throughout the year 2012 in different cities in Holland, Belgium, Turkey and South Africa is based on a game similar to Word of Warcraft.
- "Planit", developed in 2013, is based on Internet that aspires to broaden the attractiveness of citizen participation, making of the planning one playful aspect, although

in the background in an organizer of the various mental maps of how the citizens understands the city [26].

These all cases were worked from basic zoning proposals of general uses to large-scale digital work. They all incorporate noteworthy aspects linked to informal teaching models: citizens generate series of opinions or suggestions, which help students to see different points of view; this information improves their formal knowledge, as cases were conduct outside an academic environment; They all are focused on the urban planning. In the current project proposal, it is important to work on both an architectonic project and urban design at the right scale that allows a larger level of detail and complexity.

3   The Project: EduGAME4CITY

The project will be carried out in campus. The goal of the main hypothesis is to demonstrate that virtual gaming implementation in architectural education will improve spatial perception and students design capabilities, thanks to the augmented and immersive visual technologies. As such, in the fields related to the architecture and society, the hypothesis will identify key elements to guide, help and encourage personal initiatives in both designing processes and urban transformation. On the other hand, in the field of the multimedia/IT education, students will be duly qualified to create applications/games through skill-based learning. They should not be only leisure related but also for social and educational purposes (serious games).

3.1   Main Objectives

We will focus our efforts in order to:

- Test and evaluate the education of the urban project incorporating collaborative design, immersive ICTs (goggles, mobile devices, etc.), gamification and citizen participation.
- Improve the competence of the multimedia engineering students through the design and creation of serious games adapted to other areas of knowledge such as the architecture and the town planning.
- Test and evaluate the usability and motivation by the students of the created gamification system.
- Test and evaluate the informal education of the project thanks to the simulations, tests and evaluations of the citizens.
- Study and link the technological profiles of the users of the gamification platform with the results, understanding the results as the achievement of the challenges defined in the games, the results of the work surveys and the personal interviews.
- Determine the correlation between motivation, satisfaction and use experience, and the improvement of the space.

- Increase the motivation, implication and satisfaction of the citizen in the process of taking urban decisions through the usage of ICTs, starting with the approach of various accessible technologies depending on the profiles of every user.

3.2 Assessment Methodology

Quantitative and qualitative approaches have historically been the main methods of scientific research. Currently, a hybrid approach to experimental methodology has emerged that takes a more holistic view of methodological problems: the mixed-methods research approach. This model is based on a pragmatic paradigm that contemplates the possibility of combining quantitative and qualitative methods to achieve complementary results [27]. The quantitative approach will be based on ISO 9241-11 [28], that will be used as in other previously educational cases [6, 8], which provides usability assessment guidelines of efficiency and user satisfaction. The qualitative approach will be post-visit interviews with a representative sample of the students involved in the project, who will share their experience with the appliance of this new technology into the visit. For this final stage, Bipolar Laddering Assessment (BLA) will be used, a technique previously validated in other educational experiments [20].

4 Conclusions

At the moment, the project is at an early developmental stage. On one hand, a location has been chosen in Barcelona to perform a study case (Sant Jaume square area and surroundings Fig. 1). Final gamification zones will be defined by the city hall of Barcelona. In that area, game dynamics and modelling specifications are being created as a previous test to be implemented in final locations. In this sense, Unreal was selected as the programming system, with the possibilities to add urban furniture. Users will reach points attending to criteria of design concepts, sustainability, accessibility and cost. In addition, public space definition will be settled on punctual uses performed by the citizens: gatherings, public markets, demonstrations, etc., in a way that the students can intervene in each place with proposals that are adapted depending on the situation.

Fig. 1. Pilot study zone, with basic 3D models and images.

Author Proof

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