"Gamification" for Teaching Collaborative Urban Design and Citizen Participation

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Abstract. We present the initial results of the research project MINECO-BIA2016-77464-C2 coordinated by the Barcelona School of Architecture (ETSAB-UPC) and the Architecture Department at La Salle (ARQ-La Salle-URL). The project consists of cross-cutting research at the intersection between computer sciences, the teaching of future architects and multimedia engineers, and urban development policies in cities, in which citizen participation is fundamental. To study the working hypothesis, we identified four areas of action: 1. Focused on training and interaction with architecture students, specifically urbanism students, for the design of urban public spaces. 2. Centred on the training of multimedia engineers who will design and implement gamified processes on information and communication technology (ICT). 3. Focused on students', professionals' and citizens' motivation and degree of satisfaction with the use of ICT. 4. Centred on studying and increasing citizen participation in this type of projects and proposals. The general objective is to promote the use of digital technologies and to assess the inclusion of serious game strategies and virtual reality in formal and informal learning environments on collaborative urban design, in order to improve, accelerate and increase its positive social impact.

Keywords: Gamification · Teaching urban design and multimedia · Educational research · Citizen participation · e-Learning usability

1 Introduction

Some examples of gamification and citizen participation can be found in planning processes, but there are none in urban design. Neither are there any examples in the formal and informal processes of teaching future architects. No example has such a high level of realism in the definition of the virtual scenario, nor such a high level of visual immersion. None of them scientifically assessed the motivation and satisfaction of users, nor the efficacy and efficiency in an academic simulation of integrated and collaborative processes of urban design.

The main hypothesis of this project is based on proving the statement: the implementation of "gamified" strategies in the area of urban design will improve citizen

participation as gamification creates more dynamic, real, flexible collaborative environments through augmented and immersive visual technologies. Some examples of the use of gamification in urban planning processes are associated with citizen participation. One of these is Blockholm: a Minecraft-based planning game on Stockholm. A total of 100,000 users, urban design technicians and experts, and citizens were invited to participate in Blockholm (Fig. 1).
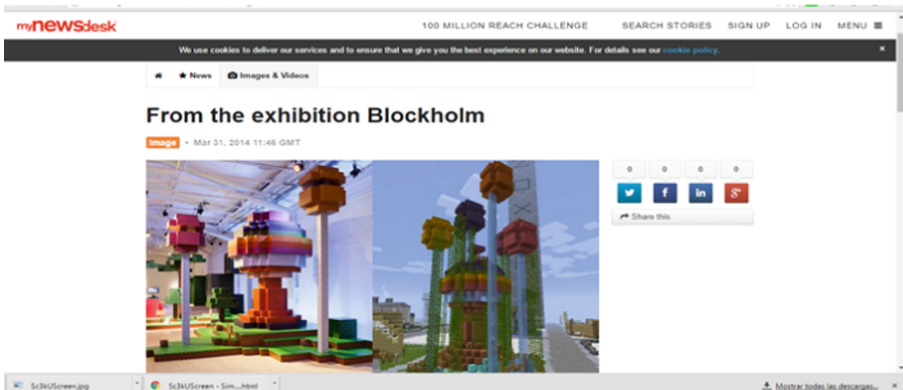

Fig. 1. "Blockholm", Source: Swedish Center for Architecture and Design 2014

Other examples are Play the City, from the Play the City Foundation, implemented throughout 2012 in various cities in Holland, Belgium, Turkey and South Africa and based on a game like World of Warcraft, or the use of the game SimCity in its various versions in urban planning workshops, notably in Cape Town in 2013 (Fig. 2).

Fig. 2. "Play the City", Source: Play the City Foundation 2012

Finally, we can mention the experience of gamification of the urban planning process in the game PLANIT, developed in 2013 in Detroit. This is an internet-based game designed to increase the attractiveness of citizen participation, by making

planning fun. However, ultimately the game is an organiser of mind maps of how users understand the city. The aim is to involve elderly people and challenge them to give their opinions of urban planning and bring new residents into the process. In this regard, the experience is closer to our approach, given that challenges have been defined for users to resolve, which generate complementary information prior to creating the design, which can be interpreted as support or rejection of a proposal (Fig. 3).

Fig. 3. "PlanIt", Source: Community PlanIT 2013

2 Short Discussion and Current Development of the Project

As numerous recent studies show, mobile devices, wearable technologies, virtual reality, augmented reality, remote and collaborative working and "gamified" strategies are becoming more common in society. Their expansion is due to their ease of use and efficacy in training phases and subsequently in professional and social environments [1–3].

We can apply these technologies to defined urban proposals and test various action strategies interactively. In this way, we can evaluate public spaces collaboratively, with the participation of all the stakeholders described previously: students, professionals and final users [4]. The technologies help us to define what are known as 3.0 Projects in which final users, citizens and students are no longer passive stakeholders, but participate in the project design process. The new methodology establishes a project-based learning (PBL) strategy. In this strategy, students act with a specific role that enables them to obtain and improve spatial and social skills optimally (a strategy known as a scenario-centred curriculum; SSC), both formally with contents to develop in class and informally with the opinions of the final users. This improves not only the project, but also the training.

If we take a critical approach, the first question we could ask is: what do serious games contribute to these processes? There are several answers. First, game strategies

have been found to be interesting, useful tools for learning or decision-making that can be applied in various areas of knowledge (such as marketing, business, formal education and informal education). Experimentation with the use of serious games in citizen participation processes should promote greater understanding of the city-neighbourhood-public space; a specific physical space as a place for communication in which all kinds of initiatives are produced. The gamification of a real space produces a virtual space and a simulated urban environment in which dynamic participation and generation dynamic experiments can be undertaken.

Other answers to the question of serious games' utility can be found in observations of greater motivation in the monitoring of "gamified" contents. Gamified contents increase participation and, of course, have inherent dynamism. These answers are the conclusions of numerous previous studies on all types of environments, but particularly educational and professional settings (see the references below).

In our case, the strategies that would be implemented follow the logical design rules of any "gamified" system and must be capable of including specific tools and options for the interaction of architectural and urban projects, based on the comments and experiences of students and final users. Therefore, this proposal, which is clearly in line with the definition of the "Smart City" concept, expands the approach horizontally, with cities and citizens who aspire to get involved.

2.1   Initial Hypothesis, General Objectives and Adaptation

Project activity is basically limited to the university environment. It was implemented in the Barcelona School of Architecture (ETSAB-UPC) within the bachelor's and qualifying master's degree studies in Architecture, the master's degrees in advanced studies in Architecture-Barcelona MBArch and Landscape-Barcelona MBLandArch, and the advanced studies in Design-Barcelona, MBDesign. In La Salle-URL, the project was implemented at the level of the bachelor's degree in Architecture and Multimedia Engineering, both in the general branch and in the Video Games major.

The main hypothesis is based on proving the statement: the implementation of "gamified" virtual strategies in the area of urban design will increase citizen participation as the collaborative environment will be more dynamic, real and flexible due to augmented and immersive visual technologies. In turn, we define the secondary hypothesis based on the statement: "gamified" strategies for understanding three-dimensional space improve the spatial skills of non-expert users (citizens) and expert users (students and professionals) and increase motivation in their use and satisfaction.

To study the working hypothesis, we identified four main areas of action in the project, as mentioned above. The two first areas are focused on training and interaction with students in fields with a strong visual component and social impact. The fields are architecture, specifically urbanism and landscape for the design of urban public spaces, and multimedia engineering, in which "gamified" processes will be designed and implemented using ICTs. The third area is focused on the emotional component of project users. Motivation and degree of satisfaction in the use of ICTs and the proposals of students, professionals and citizens are key factors that are included in the targets and challenges of the European Community (EC) in the framework of Horizon 2020 and are therefore one of the main areas of this proposal. Finally, the fourth area is

studying and increasing citizen participation in these types of proposals. This aspect has been identified in the targets and challenges of current national and international calls for funding. Combined, it can be delimited firstly in the challenge defined in the call "Changes and social innovations" and secondly in the challenge "Economy and digital society".

The general objective of the project is to make urban analysis methodologies known through practice in the field. In the area of architecture and society, the aim is to guide, facilitate and promote personal initiative in the urban design and transformation process by developing new critical reasoning to communicate ideas and arguments on urbanism in cities. Thus, interest in urban phenomena at the frontiers of knowledge is introduced inductively. To achieve this general objective, we propose using ICTs and gaming strategies, a cross-cutting aspect that has a special impact in the field of multimedia engineering. These proposals facilitate and streamline design and citizen participation processes, currently in the university environment only. The research by design that this involves is a required direction for contemporary thought and action in cities, although it is still not widely recognised in many scientific and university contexts.

2.2 Clarification of the Initial Hypothesis

Current urban design projects are incorporating participatory processes, but frequently these are not interactive enough or flexible, and are lacking in formal and visual aspects. The questions tend to be restrictive and do not manage to motivate many people, while the processes are not part of the formal teaching of future architects and multimedia engineers. Consequently, the aim is to demonstrate that:

1. Traditional methodologies for training in urban projects at the ETSAB-UPC and at the ETSALS-URL can be improved by incorporating project-based learning, collaborative methodologies and informal data.
2. The new ICTs, such as virtual reality with glasses and mobile devices, and the gamification of urban scenarios provide new perspectives that promote more effective design and more motivating teaching, which are vital factors in the training of future architects.
3. The ICT tools can be adapted to online participatory processes quickly and effectively.
4. Future multimedia engineers must be capable of adapting with a high degree of realism the representation of three-dimensional models. This would improve their current training, which is focused on the creation of video games in which visual formalism is less present than in the field of architecture and urbanism.
5. Due to interaction with architecture students and urban environments, multimedia engineers will be able to improve their design criteria and understanding of the structure of three-dimensional space and improve their command of collaborative interaction. This aspect is associated with the improvements that informal teaching generates in current formal flows.
6. The creation of serious games dedicated to designer-user interaction as a method of citizen participation and/or as an informal educational method on urban design for

other students will improve citizen participation processes, as it will motivate more people, and train students professionally in this area of work.

2.3   General Objectives of the Coordinated Project

1. Test and assess the teaching of urban design by incorporating collaborative design, immersive ICTs (such as virtual reality glasses and mobile devices), gamification and citizen participation. Improve multimedia engineering students' skills through the design and creation of serious games adapted to other areas of knowledge such as architecture and urbanism. Test and assess usability and the motivation of students and users in general in relation to serious games applied to the field of teaching urban design and citizen participation. Test and assess the informal teaching of urban design through independent learning and gamification of interactive urban scenarios.
2. Simulate, test and assess citizen participation in urban designs through online gamification. Define semi-automatic systems for collecting data on users' profiles and their assessments so that they can be processed using learning analytics.
3. Generate potential patents for serious games in urban environments using mobile virtual reality multi-platforms. Define effective game mechanics for navigation and interactive participation in urban environments through augmented reality/virtual reality.
4. Study and relate the technological profiles of users of the "gamified" platform with their results. Results are defined as attainment of the challenges defined in the games, the results of work surveys and personal interviews. Determine the correlation between motivation, satisfaction and experience of use, and improvement of the space. Increase the motivation, involvement and satisfaction of all citizens in urban decision-making processes through the use of ICTs, based on bringing them into contact with accessible technologies, depending on the profiles of each user.

The research team plans to carry out between three and five full tests and experiments, including specific projects such as those of Construmat and the CCCB, which are described below. A full test or experiment involves definition of the place, design of the public space and urban design project, its virtual modelling and "gamification" and the opinions of users. Users are UPC-URL students who are not involved in the process of design-modelling and gamification, to simulate the participation of citizens in general. We could define these tests erroneously as educational research and citizen participation case studies. Strictly speaking, they are not case studies, as methodologically the study has a quasi-experimental design in which control and experimental groups are differentiated, as conceptualised in the area of educational and social research. Therefore, the report of this project focuses on describing in detail the experimental design. It indicates who was responsible for the project, and presents the subjects, content, methodology, resources and timing of its implementation, so that readers can determine how the intervention was undertaken. This is essential to guarantee the validity of the experiment, particularly as it is a quasi-experimental design in which the subjects belong to existing groups and have not been selected at random (Figs. 4 and 5).

Fig. 4. Methodological diagram. Source: Redondo, E. Giménez, Ll., Fonseca, D. Navarro, I.

Fig. 5. Interactive scenario for the first case study. Supermanzana Germanetes, Barcelona 2017. Source: Redondo, E. Giménez, Ll., Fonseca, D. Navarro, I.

In short, we can see how the proposal is in line with the aforementioned challenges and provides solutions and responses to numerous multidisciplinary issues in society that can easily be extrapolated to various fields of work and scientific research. The proposal is designed as a collaborative system involving multidisciplinary areas such as architecture, urbanism, multimedia and user experience (UX). It is intersectoral as it covers both university teaching and citizen participation in the urban field. Consequently, the aim is to improve one of the main challenges in the call and in current society: citizen participation in urban proposals through the use of ICTs that improve not only citizens' understanding but also university students' skills acquisition and training (Figs. 6 and 7).

Fig. 6. Interactive scenario for the second case study. Plaza Baró, Sta. Coloma de Gramenet, Barcelona 2017. Source: Redondo, E. Giménez, Ll., Fonseca, D. Navarro, I.

Fig. 7. Interactive scenario for the third case study. Plaza Cataluña, St. Boi de Llobregat, Barcelona 2018. Source: Redondo, E. Giménez, Ll., Fonseca, D. Navarro, I.

3   Preliminary Conclusions

Although the funded project to which this study belongs is in its final stage of development, it is clear that initially students do not seem particularly motivated by the use of digital systems that are not closely associated with requirements in design-related subjects. Preliminary quantitative conclusions of the study to date, which are explained and justified in the articles referenced at the end of this document, indicate that the most notable positive aspect of our proposal according to users is the high level of perceived realism. This opinion was shared by 65% of users. Clearly, this result is encouraging as one of the main objectives of the system is the accurate reproduction of an urban environment. The immersive nature of the experience and the controls were other positive aspects that were identified, particularly considering that users had only a relatively short time to work with the system (around 10 min per user). A total of 44% of users associated with the architectural field mentioned understanding of the space as

a positive aspect. The sense of reality, the immersion, the ease of use and the freedom of action are common aspects that were mentioned by both expert users and non-experts in architecture. There were no significant differences in any case due to the sex of users.

An evaluation of negative points shows that users did not like some aspects of the interaction. According to unsatisfactory interaction results, problems with the selection of objects from the menu and the location of these objects are two critical factors that could be improved. As occurs in virtual reality systems, another notable aspect is the dizziness experienced by users when they try to move around the scenario. This negative aspect was mentioned by 21% of users. Users associated with architecture made 100% of the negative comments relating to the details, lighting or lack of accuracy in the control of the elements. Non-experts in the field were more critical about the usability of the system.

In terms of the qualitative evaluation of the project, the main innovation in the case studies that were undertaken is the design of a practical system for recognising informal data generated by citizens and, by means of a mixed method, the opportunity to extract important data that could contribute to the education of urban design students. The results indicate that new technologies can be introduced into urbanism to facilitate the process. The use of tools such as virtual reality is suitable to achieve greater citizen motivation, precision and collaboration. In addition, the proposal serves as a method for students and professionals to present design proposals efficiently by collecting informal data.

The use of digital transformation in the educational process of urban design courses helps to improve digital skills in complex representation and enables the reassessment of urban spaces. In formal and informal education areas of collaborative urban design, this method improves the motivation, implication and satisfaction of the public in urban decision-making processes. Participants were receptive and aware of adapting to this new paradigm using advanced visualisation methods. This factor not only reflects the utility of the method, but also the potential for academic improvement and improvement in students' skills. It demonstrates that it is possible to define a new model of participation that is spatial and guided at local scale. However, one aspect to reassess is the fact that participants did not support the statement that the tool can identify potential unmet social needs or the statement that the use of interactive systems generates less stress than traditional systems. Consequently, it is important to improve the interaction with the space and the objects, the quality of the graphics and the reality of the objects. After the recent presentation and dissemination of initial partial results at Barcelona Building-Construmat 2019 and after extensive collection of surveys, the real impact of the project is being processed (Figs. 8 and 9).

Fig. 8. General presentation of the project at Barcelona-Building Construmat 2019. Source: Redondo, E. Giménez, Ll., Fonseca, D. Navarro, I.

Fig. 9. Public presentation of the initial results and general virtual reality test of the various scenarios. COAC stand. Barcelona-Building Construmat 2019. First prize for stands. Source: Redondo, E. Giménez, Ll., Fonseca, D. Navarro, I.

The scientific output of the project to date, which includes initial results assessed scientifically, can be found in the articles referenced at the end of this document [5, 6]. The project is expected to be concluded after participation in the joint exhibition of CCCB+ZKM, the Centro de Cultura Conteporánea de Barcelona+Center for Art and Media Karlsruhe (Zentrum für Kunst und Medien), called Gameplay. "Cultura del videojoc", which will run from 19 December 2019 to 3 May 2020. The project team has been invited as special guests (Fig. 10).
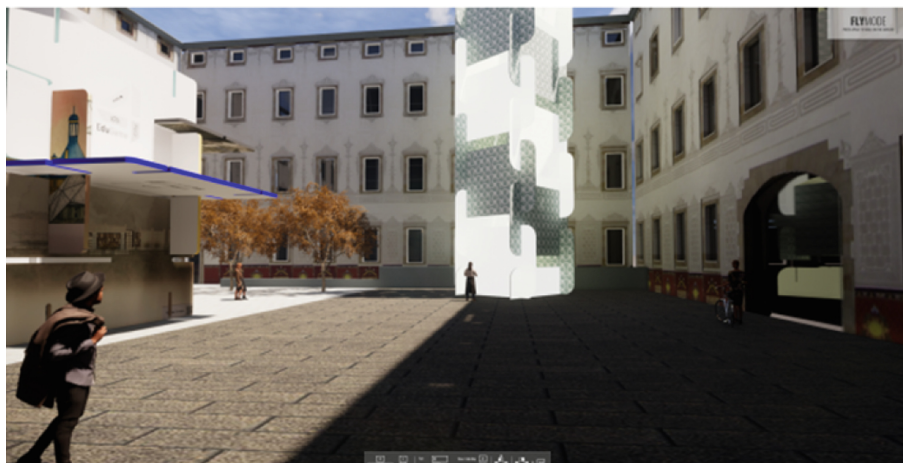
Fig. 10. Model of the virtual scenario and of an initial result of gamification of Game4City for the exhibition CCCB+ZKM. 2019-2020. Source: Redondo, E. Giménez, Ll., Fonseca, D. Navarro, I.

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