GAMIFICATION FOR USER-ORIENTED HOUSING DESIGN

A Theoretical Review

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Abstract. Fluctuating economies and changing family demographics have increased the complexity in meeting the spatial needs for contemporary housing. Digital systems that allow flexibility are growing in demand but its rate of development is not catching up with the rapid changes. This paper explores how digital interventions can limit or help the process of collaborative design in high-density mass housing context. One key factor in user-oriented design system is participation. Many researchers have looked into system usability, design simplification and realistic visualisation to provide an immersive experience for users to engage the design. This paper argues how gamification acts as a form of decision support within a bigger framework model for a user-oriented digital design system. Using three levels of rules: constitutive rules, operational rules and implicit rules, the aim is for users to generate a housing design outcome not only for themselves but also collaboratively with other users through gamification.

Keywords. Gamification; user-oriented; digital intervention; decision support; mass housing.

1. Introduction

One of the most important tasks of the architect is the creation of space that reflects the desires and needs of the occupants. Despite the constant changes in the contemporary social demographics, the user groups in the housing market are experiencing an increase in its heterogeneity. These groups may have non-standardised spatial requirements that may not be best met by conventional designs. Unless the architect has the ability of mind-reading like Charles Xavier in the film X-Men, it is quite impossible for them to figure out everyone’s desires collectively and
reasonably merge these into a single architectural endeavour. Yet, the demand is real, and there is a need for such a capability to gather the ideas and design collectively and efficiently. At present, architects have built mass housing based on experiences only through a few groups or individuals. The design process alone is already of high complexity with the need to account for building performances and buildability. With users involvement which is often complicated, non-linear, uncertain and dynamic, it is no wonder that most architects and other professions try to avoid exposure to it as a way to reduce the expenditure of further time cost and ultimately profit. This paper, conversely, describes the use of gamification as an instrument for the design of mass housing. The methodology enables architects to collect informative inputs conveniently, but also allows users to communicate their desires effectively and therefore facilitating collaboration between architects and users.

2. Gamification

The use of the term ‘gamification’ dates back to the beginning of the last century. In 1912 *Cracker Jack*, a snack brand, started to give toys as a gift in their products. Although gamification in this instance focuses on the domain of marketing to encourage more ‘consumption’, it is to describe the use of game design elements in non-game context (Deterding et al. 2011). Depending on familiarity, there are varying common assumptions towards gamification, but this research is meant to be ‘collectively productive’. The following paragraph explains what gamification is and is not.

First of all, gamification is not turning everything into a game. The purpose of gamification is not to pull us out of reality but rather finding what is not boring in an activity that usually requires collaboration and engagement. This is neither to say that they are ‘serious games’ which are used as a training and learning environment such as in military and education. The focus of simulations in serious games is in testing the abilities of learners and on improving their skill sets in a virtual environment similar to real conditions. On the other hand, game theory is to mathematically analyse decision-making ‘strategies’ or individual ‘choices’ (Kelly 2003, 1), whereas gamification may be helpful to improve collaboration for ‘a choice’ and encourage involvement in ‘a strategy’ (Kapp 2012, 9). Also, points, badges and leaderboards (PBLs) are irresspressibly penetrating into every aspect of our daily lives in tandem with the growing use of social media. PBLs are one of the most common game elements. However, they are not sufficient with regards to what games and game design can provoke. The approach is to gamify a situation by thinking like a game designer, which is different than being a game designer. Instead of playing a game as a player, using a gamified system is still considered a user.

In the context of mass housing, the development towards gamification can adopt the three levels of game design rules: i) constitutive rules are the first, which are the abstract, core mathematical rules of a game. Putting it into the digital design context, this represents the essential algorithm within the system structure. They do not explicitly indicate how the users should enact these rules, but they
reflect the underlying framework of the system that informs the operational rules, the second rules. ii) The operational rules are the main ‘rules of play’ that users will have to follow when they are interacting with the design system. These rules directly influence the behaviour, input and output of the users and usually printed out as instruction or manual books. iii) Lastly, the third rules are the implicit ones, which are the ‘unwritten rules’. They are the etiquette and behaviour of the users that usually go unstated. In game culture, these are well established as a form of ‘sportsmanship’. How this can be achieved in the digital design context would be explored at the end of Section 4. Like game programs, digital tools of user-oriented design are multi-layered, complex objects. Specifying which aspects of a system belong to each type of rules are usually unclear. However, this three-part rule framework is applied to better understand the abstract formal system in achieving meaningful interaction through gamification.

3. The Participants

In every game, although the ideal players will be everybody, specific categories of players will still be the initial focus. Similarly, a gamified design structure will have its targeted audience. In housing supply/demand process, the major influential parties are architects and clients. (Friedman 2011). Zeisei (1981), separate the clients into two types; the Paying Client and the Using Client. The Paying Client refers to the builders or in the present known as the developers and contractors whose decision will determine if the housings get built. The Using Client refers to the users or occupants who will be living in the built housing which is also the primary intention of this research to adopt gamification at first. The Using Client is usually left out at the time of conceptualization, and they have very little say in the kind of housing that is built, yet home purchase involves the greatest single lifetime expenditure of their financial assets. This indicates that housing will not be just an economic dimension to the Using Client as compared to the Paying Client. The ability of the dwelling in satisfying needs and its characteristics such as location play a major role in determining the day-to-day quality of life the Using Client will have. Through the integration of gamification into housing design system, Using Client could directly be involved in the design process. The decision support that gamification provides could reduce the uncertainty and conflicts that usually exist in such participatory design process which would be further analysed in the next chapter.

Although the Using Client is the main consumer, the architect is still the primary role in the whole design process. They serve as a conduit to the technical aspect of building. There is currently an apparent gap between the Using Client and the architect (Friedman 2011). Most of the information exchanges and programmatic decisions are between the Paying Client and the architect directly. It is also usually the Paying Client who evaluates the design solutions and, if necessary, adjusts the requirements to fit their objectives. At this conceptualization stage, both the architect and Paying Client assume the role of the Paying Client and produce what they believe is the optimised living space. This exclusion of the Using Client may be derived from either objective reasons such as Paying Client
decides to initiate construction before selling the units or subjective reasons such as insufficient time and resources to incorporate the process (Friedman 2011). Here is where gamification could intervene to facilitate these problems.

4. The Model

Centuries of research and development towards social studies has always included housing as one of its key elements. Although supplying this need can be achieved through technologies such as prefabrication, it is still a challenge to provide the desired quality of living to every individual. This paper proposes a model that instead of architects producing one design and try to diverge towards each individual needs, the Using Client can take the baton of responsibility and design their own living space with the help of an open gamified design system. However, this does not mean that the architect has no involvement in the process. They have a bigger task to perform to accomplish - giving Using Client the ability to dream of alternatives. Architects are visionaries, they are able to realise and build dreams but this paper is seeking their capability to assist not one but a collective of such Using Client to build their dream collaboratively. This sounds almost impossible, and for this reason, part of the model for this gamified design system is inspired by John Wood’s (2011) metadesign in achieving micro-utopia.

One major element in the metadesign as presented by Wood is a four-fold system visualised as a tetrahedral form (figure 1). The qualities of such a system help architects to think in a self-reflexive and dynamic way. Instead of a typical two-dimensional system, this unique form is three-dimensional, providing a manageable set of relations. The metadesign is being used in the here presented research context of a collaborative design system, providing a convenient method to get an overview of the complex problem. The components of the system are adjusted as follow:

![Figure 1. Tetrahedron depicting minimum grammar of relations (Wood 2007).](image)

- A: Agent - the agent is the professional individual or anybody contextualised by nodes B to D. In this case A is the architect.
- B: Significant action or proposition in question - the gamified design system
that is proposed by this research.
- C: Recipient - Using Client who is the main target beneficiary.
- D: Full local and global context of A to C - the housing design task which this system is design for.

With the relations of the model properly laid out, the next step will be to zoom into details of how gamification serves the other components in the system. Strategising design parameters, information gathering and decision making are the key processes that have to be taken into consideration. This part of the model makes close reference of Avi Friedman’s decision-making model for flexibility (2011). Figure 2 presents the adopted model with gamification being introduced to mediate housing design process as a decision support. This model breaks down the process into two scopes of exchange, the architect with the Paying Client setting the objectives and parameter with respect to the site context and regulation standards (A-D node) and architect with Using Client to determine the outcome of their desired living space (A-C node). Within the scopes of exchange, the model provides the connections of all twelve relations between the nodes including how gamification, being the key element in this research, could assist the architect in setting objectives (B-A node), provides for Using Client as a tool to generate alternative designs (B-C node) and bringing the generated design into the context for the architects to re-coordinate the overall design (B-D node).

From this perspective, our research explores how the three rules of gamification (Salen & Zimmerman 2003) will formulate these relations and inform how it supports such a housing design model. Various games provide a better picture in comparing and analysing the elements. To begin with, it is to examine the constitutive rules or the underlying structure that would inform the operational rules.
Looking at games such as *SimCity* and *Minecraft* which are two computer games frequently utilised in relation to architectural tasks (Sanchez 2015), although they are designed as open-world games where the players are required to design everything from ‘tabula rasa’, the players are confined and limited by rules and logics such as working in a grid environment and using building elements provided by the system. In comparison, the context of the system in this research is a high-density mass housing. There could be an open site context with surrounding buildings, streets and environment to explore but the main interaction will only be within the designated building. In other words, the design process is bounded within the confined housing design.

In another type of games, Role-Playing (computer) Games (RPG) such as *Mass Effect* and *Until Dawn*, which follow a particular storyline, require players to make decisions that change the course of the story resulting in individual and unique endings for each player. The players simply need to make choices. They are not required to keep score or follow complex rules. The story, however, will be adjusted according to the choices made by the players resulting in different story endings. Such a decision-making method could also assist greatly in a user-oriented housing design. The architects could prepare a framework mapping out every decision towards the number of outcomes they would want (figure 3).

![Figure 3. An example mapping of decision-making framework (Taniguchi 2012).](image)

The role of the architect and the Using Client also affect the constitutive rules greatly. The Using Client is simply a single individual, a couple or a family settling to live in an apartment. Their objective is simply to design a desirable outcome. Therefore, they have more limitations compared to the architect who is the creator of the whole context. Another example to better illustrate this point is *Super Mario Maker*, a game which does not only allow players to play but also design and build their own game stage. This breaks the traditional form of playing where players will only try to beat the levels designed by the game designer. In the maker-game, the player is opened to more constitutive rules allowing them to create more random stages for other players to play. Yet, the player is still restricted to a certain structure compared to the game designer. After close examination, it can be anticipated that the relationship between the game designers and players is very similar to that of architects and Using Client. This can be further observed within the
influence of the different gamification rules.

In the realm of operational rules or the rules that most directly influence the Using Client, the gamified design system is both wide open and relatively closed off. The Using Client is given more freedom and availability in the choices such as layout arrangement, building materials or dimension. They are provided with an incredibly detailed view of the site context and building structure laid out in front of them. They can move about freely to explore the site, build their living space in whatever manner they prefer. The process is simplified to be manipulated easily; they only need to generate the spatial layout map through the digital system and the plans will be generated automatically (figure 4) for further adjustments. They can also communicate and design together with other users. On the other hand, however, the design is still restricted to the grid designed by the architect. The ‘freedom’ of choices is also restricted to the range of choices decided by the architect. The purpose of such constraint is because more choices do not mean more freedom or welfare (Schwartz 2004). This is also to ensure a certain order within the design system so the outcome will not be chaotic. That is the reason for which this paper stated that the architect has a bigger responsibility with such a system; they have to assess the process and outcome assisting the Using Client in making the suitable choices. If the Using Client is still not satisfied and provided a sound argument and alternative design, the architect will have to make the final decision which would affect the process and outcome. Although this may sound tedious, the increase in the anticipation of Using Client would also greatly build up their sense of ownership which bring about greater sustainability of the building (Israel 2012). In any case, the operational rules are the most accessible and understandable for the Using Client to follow during the whole process.

There is one main feature in games that is not adopted altogether in this gamified system - the objective. In games, that serves as a guide to players which keeps them on track with the game, be it the main quest to advance through the story or a side quest to enhance the attributes of the game character. This feature sits in-
between the constitutive and operational rules. In the proposed gamified design system, there is neither storyline nor character. Such a feature, therefore, serves no purpose, yet an objective is necessary and in fact, exist in every Using Client. Additionally, this ‘objective’ is very different from every Using Client. Thus, instead of the architect setting a set of objectives for every Using Client to follow, the gamified system will tailor a unique set of objectives for every Using Client based on their needs and preferences. The user will have to fill up a set of questionnaires before accessing the system. Such a feature is part of the constitutive rules of the gamified system, but they also serve as operational rules as the users will then have to comply and try to achieve their own objectives.

Another key feature that is adapted from gameplay is the ‘massive multiplayer online role-playing games’ (MMORPG). This is the part where this research and proposed design system greatly differs from the rest of the existing systems. Most of the available systems such as Wikihouse, iPrefab, BarCode Housing, are designed for users to design their own houses. There is a lack of communication between users and designing as a community. One main reason is that including a group of users will exponentially increase the already complex housing design. However, online communities have proven, through MMO popular culture, their potential in providing powerful problem-solving capacities through collective intelligence (Segard 2013). Games such as Clash of Clans and Mobile Strike are famous mobile application games that call for strategies among players. Players need to understand the capabilities of each teammate and communicate well to execute the best performance against common enemies. New friends and communities were formed from these games; internet forums were created to allow discussion of battle strategies, etc. The key point here is that through a process that requires strategies, people tend to communicate with each other to pick up the best strategy that suits them and through this communication, builds up communities and relationships that push them towards solving problems together. There is clearly great potential to integrate this capability into an online digital housing design system in hope to bring about a collective design that an architect would not be able to generate alone. Yet, even with gamification, the whole process is not implemented easily. There is a crucial precondition, which could be controversial; every participating Using Client can not be anonymous as compared to MMORPG.

This leads to the next implicit rules which are also the most important rule in the gamified design system. The design process depends on the participation of every Using Client, and there is no particular control over such action. Therefore, the success of this model falls heavily towards these unwritten rules. There are three key points for an accurate user-oriented collaboration to be initiated; communication, transparency, and understanding (Lo et al. 2015). Every aspect of the gamification is to bring about these points among Using Clients. Context variables such as socio-economic background, rate of mobility, life stage and living quality preferences are some necessary information to ensure this gamified design process produce the relevant result. The level of information comes in two levels; Level I are general information that influences design decisions and Level II are analysed information that responds to the needs of the Using Client. In additional
to providing truthful personal information, timely feedback is also necessary to determine criteria for their selections. These will reduce the uncertainties of such participatory process. The aim of gamification is to anticipate the users into the process and provide the information with ease and confidence.

5. The Next Stage

We carried out pilot studies, the technical aspects and functions is explained in Lo et al. (2015). This paper provides a more detailed explanation of the purpose of gamification. As gathered through the study, our gamified housing design system provides a versatile structure to enhance the participatory process between the architects and the Using Client. On the one hand, the Using Client can design their living space with ease while the architects, on the other hand, can obtain real information that assist them to provide better design solutions. This is a win-win situation as suggested by Wood’s tetrahedron model (figure 1). There are, however, still many potentials in further enhancing this gamified experience. One current disadvantage is that this participatory process still involves a keyboard and a screen. Some physical models could be added to enhance real interaction with the model data feeding into the system directly but this would mean an increase of necessary resources. With the recent growth in interest towards Virtual Environments (VE) and Augmented Reality, from multi-touch tabletop (Chen & Schnabel 2011), to VE CAVES (Frost & Warren 2000), the next step to provide a more immersive and sustainable experience could be towards this as well (figure 5).

6. Conclusion

In conclusion this paper argues that a more powerful tool might not be the only way to resolve challenges. Other methods, such as gamification, can provide an alternative, more engaging ways of operation of designing housing which in turn, enhance the outcome as being more user-orientated. Since digital intervention is inevitable and necessary in the complexity of housing design, gamification could provide a compelling bridge between the architects and the Using Client. This paper has structured the models at different levels of the engagement and integrated in such a way that the resulting model system is conclusive before the gamification rules can come into play. This is to build up the foundation of the design purpose.
which is necessary to demonstrate that there is a need for gamification to facilitate the process. Subsequently, the aim of gamification as a methodology is for users to understand one another through certain transparency in the information they provide and they can understand. With seamless communication on top of that, the research presents a particular approach to forming a desirable pre-construction housing community.

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