GAMIFICATION AND RULE BASED DESIGN STRATEGIES IN ARCHITECTURE EDUCATION

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ABSTRACT:

This paper discusses a gamification framework for architectural education within the Design Studio. It firstly defines and explains how gamification and rule based design methodologies enables knowledge generation and deep learning in architectural design. Then the paper presents details and demonstrates how the learning objectives leading to learning outcomes by employing a gamification methodology. Hereby we draw parallels to conventional design studios and explore the students learning.

The paper presents a gamified design platform that lies in the context of urban mass housing involving multiple stake holders from developers, architects, landlords, to residents. The 'players' generate jointly design proposals in a gamified online platform. The final design is a novel design outcome that is bottom-up driven rather than current design methodologies of buildings that are exclusively designed in a top-down manner. The paper presents the findings and results of this learning methodology and how it compares to conventional students' learning.

Keywords: Gamification, Design Studio, Rule-based strategies

1. INTRODUCTION

Although the term may sound novel, gamification exists for centuries as a concept. One may argue that it is as old as Egyptian pyramids for which game elements were used in their completion. Slaves, then labor, were grouped into teams of their hometowns to compete against each other. The more effective and faster was the winner of the 'game' which was incentivized with many different goods. More recently, loyalty games established a novel form expanding their realm into other areas. Following that, gamification is describing the interactions of participants using game specific metaphors such as rules, awards, strategies, or narratives. Yet, by and large, gamification is the use of game design elements in non-game contexts.

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. Secondly, this is neither to say that they are 'serious games' which are used as training and learning environments such as in military and

education. The focus of simulations in serious games is on testing the abilities of learners and on improving their skill sets in a virtual environment similar to real conditions. Thirdly, game theory which is often mistaken as a part of gamification area is to mathematically analyze decision-making 'strategies' or individual 'choices' (Kelly 2003), whereas gamification may be helpful to improve collaboration for 'a choice' and encourage involvement in 'a strategy' (Kapp 2012). Hence gamification relates to the use of game-thinking and -mechanics in non-game contexts to engage users in problem solving tasks and to improve the perceived ease of use of information systems and databases.

For example, points, badges and leader-boards (PBLs) are irrepressibly 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. We can gamify a situation by thinking like a game designer, which is different than being a game designer. With gamification, we break down games into elements that are explained below.

1. 1. GAME ELEMENTS

The enjoyable part of games should be fundamental to anything to which gamification elements are planned to be integrated. Gamification, without fun, it is hard to gain voluntary action that the idea of gamification is targeted to catch. The largest LAN (Local Area Network) party with around 11,000 participants was recorded at DreamHack in Sweden during 2007 (Records 2007). What is intriguing about it is that the focus is on "everything you can do with computers" combining fun activities with learning and sharing, such as gaming, communication, programming, designing, music composing, etc. Admittedly, games play a major role in societies being shaped by the 21st century culture of gadgets and devices. Use of online games is constantly in increase as a business and marketing strategy to motivate people in engagement and sharing (Zichermann 2013). Huizinga's description names the boundaries of engagement in play and play environments as the Magic Circle in which once you enter, "it is sacrosanct for the time being", i.e. the game rules matter most not the real world (Huizinga 1955)

In order to invite the player into the ‘Magic Circle’, game elements should be designed properly to prompt engagement together with aesthetics that contributes to the whole experience which we look for. Game elements are analyzed differently but we use here the MDA Framework which stands for Mechanics, Dynamics and Aesthetics (Hunicke et al 2004). A good gamification is to ‘instrumentalise’ these elements most effectively but it does not necessarily require using all of them. Mechanics are the technical components that, based on the logic and algorithms, construct the game and its environment, whereas Dynamics is about the reactions and interactions of the mechanics and the player. And finally, Aesthetics describes emotional responses such as discovery, fantasy, competition or narrative (Figure 1). The designer follows M-D-A consecutively in order to construct the game which is experienced in the opposite order by the player. Implementing MDA requires investigating each element in piece as well as in interaction with one another. Yet in gamification, both

attitudes should be paid attention to apply game elements in non-game contexts in an appropriate degree of challenge.

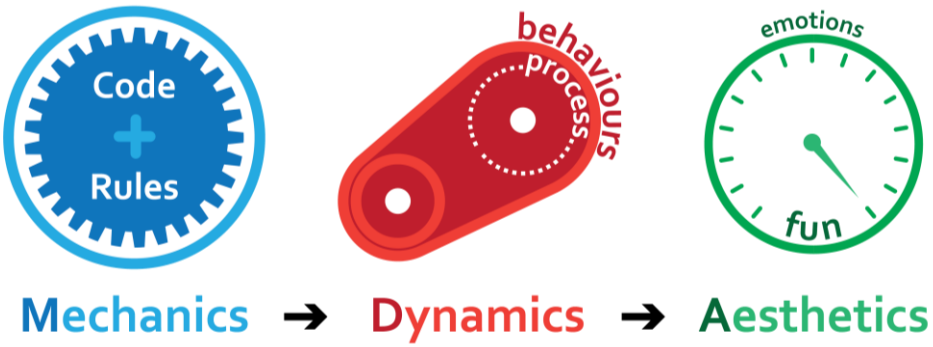

Figure 1: MDA Framework (Hunicke et al 2004).

1. 2. MASS HOUSING

In conventional design of high-rise mass housing, developers will plan based on their past experience and market analysis which architects will then visualise and realise it in a profitable and cost effective manner. As the design product might become obsolete during the process of construction, many developers target to complete and sell the building as fast as possible. This encourage both the developers and architects to adopt modular units systems to achieve the most efficient time and cost. In addition, they developed standards to ensure further efficiency and fitness of the housing products. However, this has also killed creativity and opportunity for creation (Gao et al, 2012).

Mass housing, as the name suggested, is for the masses. Yet, the industry is in such a top-down manner that the occupants do not have any say in the design process. They can only choose from what is predefined from them and select the one that is most suitable for them. Every family is different with different needs but the houses are usually categorised very generally into studio apartments, 3-room to 5-room apartments. Instead of design responding to family needs, it is now the other way round where family has to adapt to the units design. By adopting open-source system and open-collaborative design strategies, this re-search examines the need to develop a platform for a bottom-up design approach that allows mass-customization and maintain efficiency and cost-effectiveness in the housing industry. A design environment that employs such a platform is represented in the following.

1. 3. OPEN BUILDING

Open Building is an approach for building design that was promoted by John Habraken (1961) and was recognised internationally during the six-ties to represent a new wave in the architectural field. The idea of a bot-tom-up design approach is not new and that Habraken proposed two main domains of actions - the action of the community and that of the inhabitants. Without the individual inhabitant, the result is usually uniform and brutal, which we can see in most mass housing projects nowadays. On the other hand, the community which in this case involve the designers is necessary as well. Without the design control, the spontaneous result will be chaotic and disturbing. The coherent balance between the

individual participation and the top-down design manipulation is challenging as it involves all parties during the building process, which ideally led by the building maters - the architects. A design studio is therefore setup to test the practicality of the idea with the help of state-of-the-art architecture design tools.

2. PARTICIPATORY MASS HOUSING

Mass-housing projects are carried out for the society native to complex relationships from economical level to aesthetical. Yet, the AEC industry is globally in such a top-down manner that the occupants of the society are mostly limited to participate only in the marketing stage. They can only choose from what is predefined and select the one that is hardly suitable indeed. Instead of what a family may need, it is at the moment the other way around where families have to adapt to the units usually far away from dealing with family-specific demands. The ideology of 'having a house' has changed from planning and designing the house to fit the individual families to choosing the 'container' units like a product in a mall that the family could best adapt to. By adopting such an open-source system and open-collaborative design strategy, this research examines the need to develop a platform for a relatively bottom-up design approach that allows the participation of its inhabitants giving most of the control back to the people.

The Ökohaus (Eco-home) is a project conducted by Frei Otto and Herman Kendell in 1988 for the *Internationale Bau Ausstellung* (IBA) exhibition (www.laciudadviva.org). It is a collective housing which exercises user participation and open design. Frei Otto sees this as an opportunity to consider new ways of living in high-density urban context. Occupants are selected only if they are willing to spend the time and effort to participate in the design process. In exchange, the cost of the unit is much lower than an average house in the city.

Next21 (Kim et al. 1993), is an experimental housing project that consist of 18 individual housing units. For this project, the focus is more on the building system itself instead of the collaboration process as compared to the previous example. Specific design strategies are generated from the framework of two principal concepts, the system building and the two-stage building. In 1996, they did an experimental remodeling of one unit with the participation of its residents and it was a great success (Sasakura 2005). This provides precedence for the possibility of a participation/collaboration design method and also flexible building system for collective housing.

From the two examples, the participatory process is made possible not only by the designer but also the habitants themselves. The architect prepared the framework or infrastructure for the participation and provides incentives to attract habitants to contribute willingly. In the case of Ökohaus, Frei Otto only gave two simple rules, the design had to incorporate greenery and that every space must have enough sunlight. Next21, on the other hand, had unit elements such as facades and partitions set for the habitants to mix and match. The gamification is actually happening in a disguised form which can be improved to enhance the engagement.

3. PRELIMINARY WORK: COLLABORATIVE STUDIO

The objective of this studio is to observe the struggle between flexibility and control, the conflict of the top-down versus bottom-up approach. To limit the variables, this studio addresses only the collaborative design among different designers and users rather than the involvement of the users and the stakeholders. The aim is to investigates the potential problems faced when a group of designers and users come together to design a part of the building. This is very different with other collaboration efforts in the real world where a group of architects design a building together. In the normal circumstances, the designers will generate a common design idea and goal together. The model used is similar to the process of urban planning stage to architectural design stage, where the urban planning provides the infrastructure and land plots for independent architecture, which work together to larger urban functions. It involves bottom-up informal urbanization alongside the formal urbanization. In this design scenario, each designer will take the volumetric zones setup in a building scale for autonomous design decisions. The research value will be to monitor each meeting to find out how the collaboration works. The aim is also to understand what aspects of housing design the designers will choose to follow or compromise and the crucial part in controlling the interface between different zones and the framework for each zone in relation to the overall coherence.

The data collected in this studio session is also to prepare a next stage of collaboration. A digital platform that could outweigh all the precedent models to provide a fully effective design collaboration platform that is capable of instant feedback on various components during the design process. By going into the digital means, the aim is also to explore the possibilities of adopting various level of computation method such as rhino-python scripting to generate a much flexible yet controlled means to generate housing components such as facades and building layouts

3. 1. DESIGN SETTING

The following design studio is set-up to understand what exactly architects need in a collaborative design environment. Two groups of 8 designers each are gathered together to explore this design methodology. First, precedencies are studied to understand various possibilities of units and circulation types (Figure 2). Instead of the normal design workflow where the architects design a building from scratch, the studio is sequenced in four phases:

Figure 2: Precedent study (Justin Chan, 2013).

Phase 1 – A main architect (the author) defines an overall building form in terms of layout and structure: a typical mix-use building with commercial-use at the lower floors and residential units at the top floors. The commercial component is fixed and will be design by the main architects while the residential, the main focus of this research, will be given to the designers. The residential component is subdivided into a grid (Figure 3) which allows flexible selection and customization. This phase takes reference from the Open Building concept where the housing design is broken down into support and infill. 'Tissue' is left out at this stage to focus on the collaboration between the main architects and the others who will be in-charge of the infill. This phase acts as a top-down order where the support is still designed by the architects to be in control of the building form and layout.

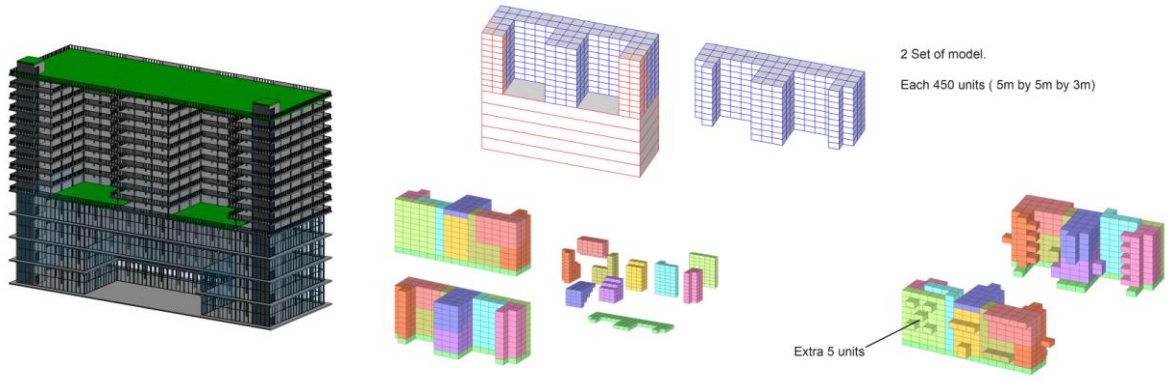

Figure 3: Building broken down into units.

Phase 2 – The 2 groups of 8 designers are each given a different set of parameters to follow during the design process (Figure 4). This is to examine how the level of constraints will

hinder the designers and also check their level of acceptance. The design brief is very raw at this stage to prevent the designers following rules and parameters blindly yet not to the extent of leading them to lose direction. The aim is to find the optimal point between flexibility and control.

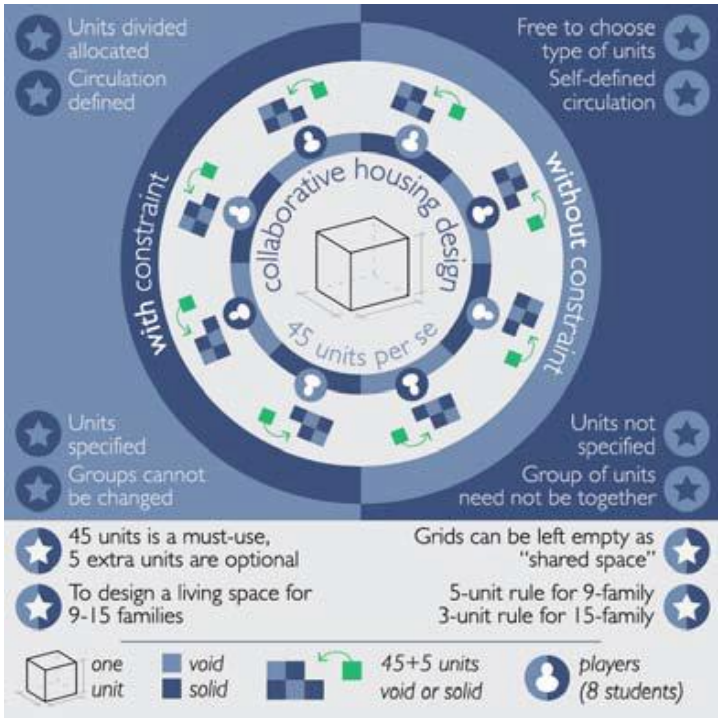

Figure 4: Constraints given to participants.

Each of the designers then chooses their desire positions in the grid system. With the chosen space, they arrange the massing grid units into habitable spaces (Figure 5) that comprise of any amounts of grid units. They are to act as potential occupants as well. Although they are each designing more than a single unit, this does not change the concept much. Each of them still has the choice to choose their neighbors.

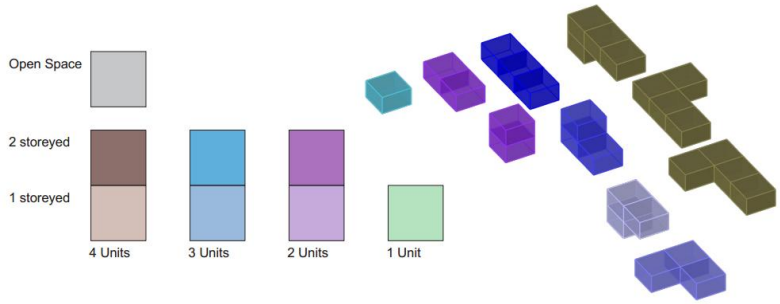

Figure 5: Housing types comprise of various number of units.

This phase is the important bottom-up approach to examine the potential problems faced when each designer are trying to inject their individual design quality into the whole building and also as the potential occupants with specific demands and needs and design to accommodate them.

Phase 3 – With the grid units all distributed and the designers defined their unit typologies and floor plan, they will put their design together and analysis the outcome of it. Discussions are conducted between de-signers to resolve any conflict of interest. Circulation to each units and core, allocation of public spaces and greenery and the possibility of shared program spaces are considered and resolved among each group.

Phase 4 – At this stage, what is left is the façade of the building. Each designer has their desire direction of view, choice of opening types and even material. The main architect steps in at this phase to maintain control to prevent the outlook of the building from becoming too chaotic. Privacy issues will be observed at this stage which could affect the unit layouts and changes will have to be made if necessary.

3. 2. STUDIO OUTCOME

Under the condition of a fixed plan layout by the main architect, the de-signers are each given a number of unit cubes to fill up the plan (Figure 6, left). Each cube does not necessary resemble a unit: it can resemble a public space, a void or a green plot. The whole mission is to create an environment that each individual designer will imagine themselves living in.

The designers will then work together to generate a circulation such that each space will be accessible. As this is a design exercise, safety and fire escape issues are considered minimally; the only requirement is that the circulation should reach the core. The main architect will then collate the data for the designers to move to the next stage of planning (Figure 6, right). As they go into details, they will realize some problems and would need to shift their cubes around, which would then require further discussions.

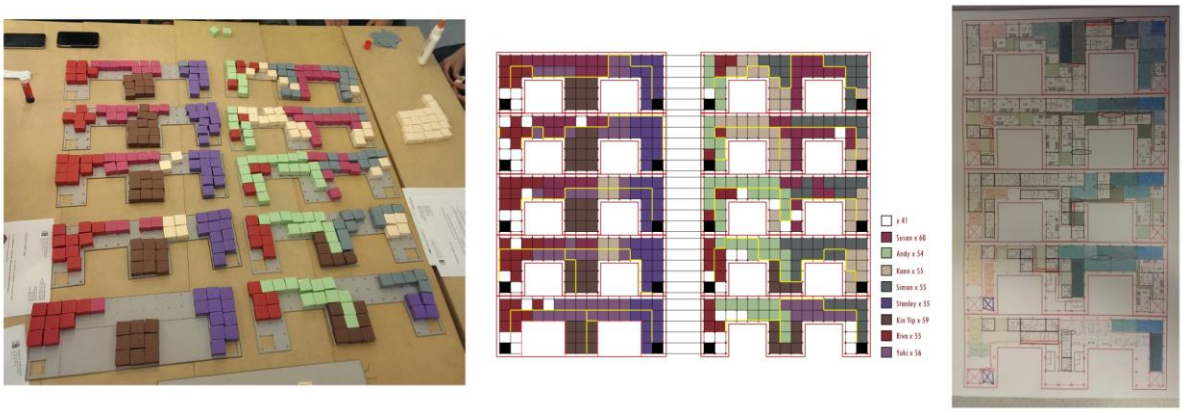

Figure 6: Different stages of collaborative planning.

After a few rounds of discussion, the designers go into the discussion of the building outlook. The main architect will collate the plans and models to check if they are any problems with the overall model. As the designers work individually most of the time and discussion only hap-pen once a week, problems are bound to happen; crashes of model components, inconsistent planning and issues of privacy where windows outlook to each other etc. At the same time, the main architect will also request each group to provide more public spaces or increase the porosity of the building for more ventilation. Models are built at this stage

where the designers will have a better view of parts of the buildings that are not receiving enough sunlight. This would encourage an-other level of discussion which might need to go all the way back to the planning stage (Figure 7, right).

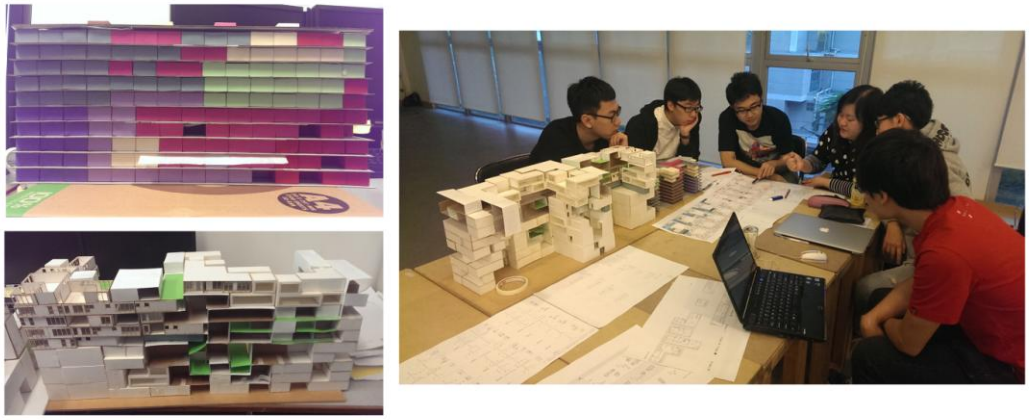

Figure 7: Different stage of form designing.

When every architecture component and conflict is settled, the de-signers will generate a façade for their individual design. Computation comes into play as they have to generate a coherent building design yet individual design character. One of the groups came up will 'verticality' which each facade will follow the rules of having strong vertical elements (Figure 8).

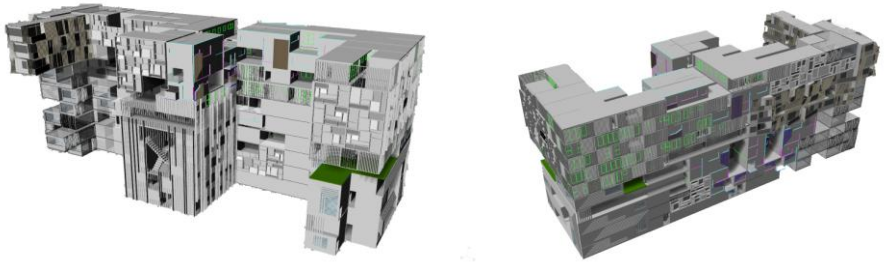

Figure 8: Building form with façade design.

At the end of the studio, a survey is given to every designer to give feedback with respect to this design methodology. 95% of them although met with a lot of difficulties, expressed their desire to use this de-sign method, if available, to design a place of their own in the future.

4. EVALUATION & DISCUSSION

Gamification is nothing more than a means compared to the design aspect of this research. Efficiently designed, gamification techniques will be subtly integrated into the loop in which standard and non-standard information types will be parameterized with each other. Though predicted, limitations of gamification such as 'pontification' will be explained in detail in future works. Briefly, it is to say that the design of gamification elements play a major role in creating an engaging experience which is the aim of this project.

The two final designs are evaluated with respect to the constraints given to them. As the design process is very open ended, the designers can change the constraints as they see fit as long as the whole groups agreed to it and the main architect (the author) gives the go-ahead. Especially in the first group with more constraints (Figure 9 right), some constraints are removed as they find them being too restrictive in generating creative design options. As for the group without much constraints (Figure 9 left), they on the other hand develop their own constraints so all the designers can follow a certain 'style'. The constraints in each group are then compared to determine the type of parameters that the main designer needs to define in the overall building level so that optimal control versus freedom can be given to the individual designer's creativity.

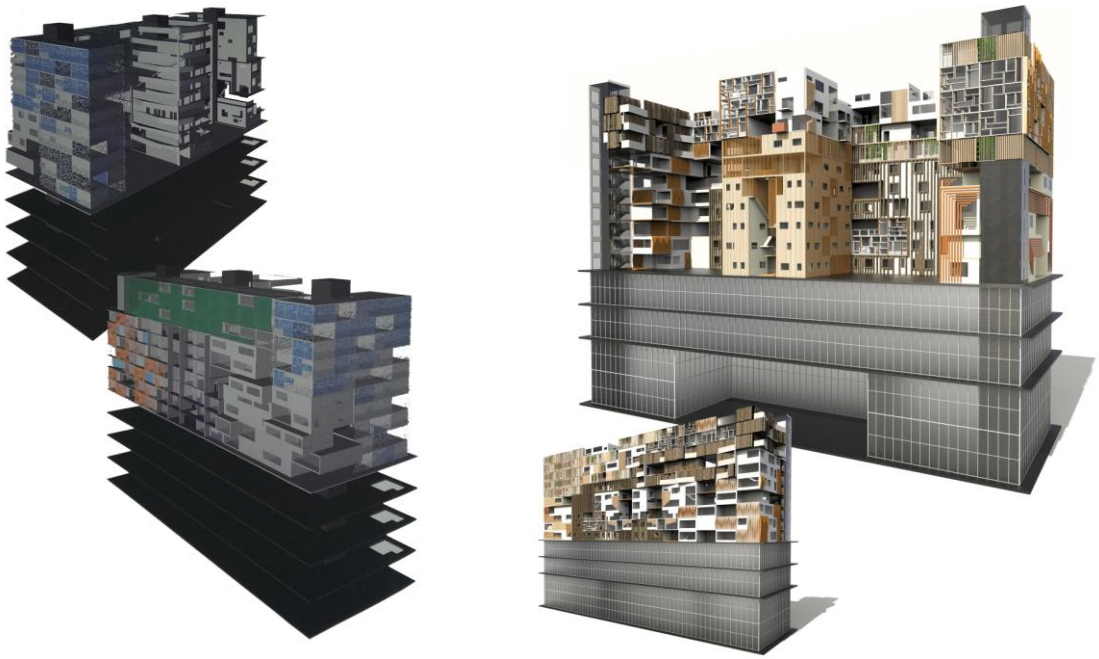

Figure 9: Final design of the 2 groups.

By comparing the process and outcomes with the constrain set, we realise that instead of giving specific parameters, it will be more efficient for the main architect to just provide general guidelines and limitations. However, this would also need the main architect to keep close inspection of every designer so that they will not divert too far away from the main objectives. Some other observations that affect the design process include the gap in the knowledge of design tools among the group members. The need to meet up for discussions also hinders the progress; the different working schedules of each designer make it hard for them to come together.

During the collaboration process, there are sure to have conflicts. By collating the design processes and with the main architect being involved in it as well, the outcome could help to develop ways and meth-od to resolve them. With the adoption of such design methods, a system to keep track of the design ideas of each designer will also be necessary. The advantage of this design studio being done at present time is the abundance of digital tools.

Designs are done mainly in computers; parametric design and computational method are widely adopted nowadays as well. In this design studio, models are created in 3-dimensions model-ling tools such as Rhino3D. Parametric tools such as Grasshopper, a plug-in for Rhino3D are also used to generate more complex shapes. The idea is to push the limits of this design approach artistically and digitally. The design outcome which is generated with CAD could then be studied to develop algorithms to automate some of the design processes allowing more time for design.

This paper demonstrates the demand for a next step of research to create an integrated system to allow better communication among the users and also with the main architect which could promote the forming of communities during the process. Data collecting is also necessary to facilitate the information flow which is very important to keep every individual in the loop of each other design progress and the decisions made at every point in time. Building information modeling (BIM) could also come into play; with the large amount of information flow, if they can be collated into a BIM system, it could improve the design speed and efficiency. A web-based tool is definitely preferred as this could allow user access anywhere and anytime.

The design process can also adopt a more community approach in-stead of purely an 'instruct-and-follow' design approach. Each users can be responsible for a specific role such as circulation planning, public space function planning etc. In this way, everyone will collaborate with each other due to their specific roles and understand each other demands and needs before stating their own. There might be bias situation but that is where the main architects will step in. In other words, it is quite similar to designing a village but compressed into a vertical building where everyone comes together to build their desired environment with the help of digital design tools.

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