Evaluating the use of 3D computer visualization to support user's participation in architectural design process

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Abstract

The process of architectural design nowadays is complex not only due to the design demand but also because of the possibilities of computer tools that allow users to explore and develop design using computer models, virtual environments and other form of interactive applications. The majority of these models are developed at a later design stage, have relatively short life spans and are often abandoned once the project reaches its conclusion (Paranandi and Sarawgi 2002). This paper aims to evaluate the use of three-dimensional (3D) Computer Visualization (CV) in supporting the user's participation in the architectural design process. According to Whyte (2002), 3D CV can either be used in the design process to fully involve the users in making decisions through a participatory design approach, or to give a more limited range to make changes. It gives the users greater opportunities to understand and possibly participate in the design process (Batty et al. 2000; Kwartler and Longo 2008). In contrast, it may also mislead (Franz 2005) and not represent reality (Schaik 2010) . As a result, the role of 3D CV and the users' participation remain unclear. In this research, a semi-structured interview was carried out involving thirteen architectural practices in Malaysia primarily to evaluate these issues. It then reports the early findings of the survey that will be used as part of the recommendations on the role of 3D CV and its contribution to design participation.

Introduction

Any building to be designed well must meet the needs and the wants of the user who will use it and the architect shouldn't consider the design process as a chance to present his character (Sanoff 1990). User and architect should work together to ensure the success of this process. Zeisel said that it is necessary for the architect and the user to understands what each of them means if they want to design together (Zeisel 1981). However, there can be differences between what the architect understands as compare to the users. As Towers (1995) and Laurini (2001) explain, it is so difficult for the layman to understand and read what the architect wants especially when the architect uses his own tools and media. Nowadays there are many computer tools which can help the user to understand, explore and develop design using computer models and virtual environments. Three-dimensional (3D) Computer Visualization (CV) is one of these models that can give the users greater ability to understand and therefore to participate in the design process (Kwartler and Longo 2008; Batty et al. 2000).

Many design organisations utilise 3D CV as a tool to enhance the users' understanding and involvement in designing their environment but still there is a considerable disagreement about the effect of this use particularly with regards to the extent of participation allowed in the design process (Whyte 2002). So it is unclear whether 3D CV or the conventional tool will be more helpful particularly in supporting the users' participation in the architectural design process. According to (Schaik 2010) much research has confirmed the positives potential of 3D CV for public consultation. On the other hand, a few designers have yet to consider computer as a tool for creative design (Bryan Lawson and Loke 1997) as

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well as support the design participation.

While several studies explore the use of CV in supporting the public participation in urban planning and large projects (Laurini 2001; Simons 1980; Schaik 2010; Sunesson et al. 2008; Whyte 2002), there are few studies that explore the use of CV to support the user's participation in small projects, such as a house. This paper aims to evaluate the use of 3D CV to support user's participation focusing on residential design especially housing design. A semi-structured interview was prepared and participated by thirteen architectural practices in Malaysia.

Methods

A qualitative research method was used to evaluate the role of 3D CV in supporting the users' participation in the architectural design process. A semi-structured interview technique was adopted to acquire data for this research. The questions are pre-determined with an open-ended format (York 1998). Open-ended questions in the semi-structured interview provide more freedom for the participant to talk in his own words without restrictions and to raise more issues and views (Kadushin 1990). The questionnaires were developed based on earlier work by Pise (2006).

Selection of participants

The participants were selected from the Malaysian Institute of Architects (*Pertubuhan Arkitek Malaysia (PAM),* available at*: http://www.pam.org.my/*). An invitation letter was emailed between April and July 2010 to 170 Malaysian Architectural Firms from the PAM list. The target population was restricted to the architectural firms who use the 3D CV in their design process. Out of 170 invitations, only 29 replied and 13 firms agreed to participate. All 13 participants were contacted to confirm the date and the place of the interview. The

interviewees were 2 female and 11 male architects, aged between 31 and 54 years old. The firms that the participants represented ranged between small with 2 employees and large with 70 employees.

Pilot test of the semi-structure interview

Pre-testing (Pise 2006) was adopted in the interview. A pilot interview was conducted with the participants to comment on the content and structure.

Data analysis

The method used to collect data was to interview architects individually using a semi-structured approach. This approach generated considerable information about the architects' personal experiences of using 3D CV in terms of users' participation in the architectural design process. The interviews were between 30 and 80 minutes long and they were conducted at the participants' workplaces by one of the authors. All of the interviews were recorded and then transcribed into a text document. Nvivo 8 software was used to facilitate the textual data analysis as recommended by Smyth (2008). Content analysis procedures were adopted from (Riffe, Lacy, and Fico 2005; Baxter 2009) to analyse the text document.

Results of 3D CV and users' participation in the early stage of design

The results from the interview showed two different standpoints – the advantages and disadvantages of the use of 3D CV and its impact to the users' participation in the early stage of design.

Advantages of 3D CV

Most of them agreed that 3D CV helped the user to understand the design, and

encouraged participation. Eleven out of thirteen respondents considered this issue as the most potential positive effect. Seven firms pointed out that it was much easier now by using 3D CV due to the fact that the client can understand better on the information thus allowing pertinent comments and participation in the design process similar to studies carried out by (Bilda and Demirkan 2003; Laurini 2001; Simons 1980; Schaik 2010). The respondents also mentioned about the difficulties of clients to understand the sizes and scale of the project. Three firms pointed out that normally after they saw the 3D, users suggested changes related to the size and scale, to enlarge this room or to make that space smaller, because with 2D they were unaware of comparative size.

The second advantage was that 3D CV was able to save cost and time. The respondent in one firm said that, "*For me the normal linear way takes a lot of time but by 3D I can save a lot of time, I can cut 50% of the needed time because I can think and draw at the same time*".

Rahimian and Ibrahim (2010) concluded that the 3D sketching interface makes design creation much faster. According to (Whyte 2002) by using 3D interactive visualization we can reduce the cost of making design changes at the construction stage by finding out the design errors and incompatibilities before we go to that stage, and therefore the amount of time, materials and money wasted on site can be reduced. One respondent observed: "*When we do 3D we increase the time a little, may be two week extra, but at the same time we reduce the time in any changes in the construction phase*".

Six respondents in the interviews explained that 3D CV helped the users to experience the design before it is built. The user able to experience the 'walk-through' the house, visualise the effect of lighting and experience the texture of the wall. The user also can experience the spaces and vertical circulation. One respondent mentioned that he could use 3D CV to justify to his client on the lighting investment. Schaik (2010, P.563) explained that,

"*A lack of presence represents a loss of the experience of 'being there' that interactive 3-D visualization provided*". So if the user is introduced with such experience earlier, any design misinterpretation can be avoided before construction change.

Apart from this, 3D CV suggested a communication platform between the user and the architect. One respondent said that, "*Last time when we don't have the computer visualization it was very difficult to communicate with our clients ... But nowadays with 3D computer visualization I can start to change instantly directly with him*". In this context, design changes are possible with options to be represented to the client to better understand the design, express their views (Schaik 2010) and changes.

These advantages are strongly inter-related with the early design stage primarily to facilitate the users' participation of the design process as shown in Diagram 1.
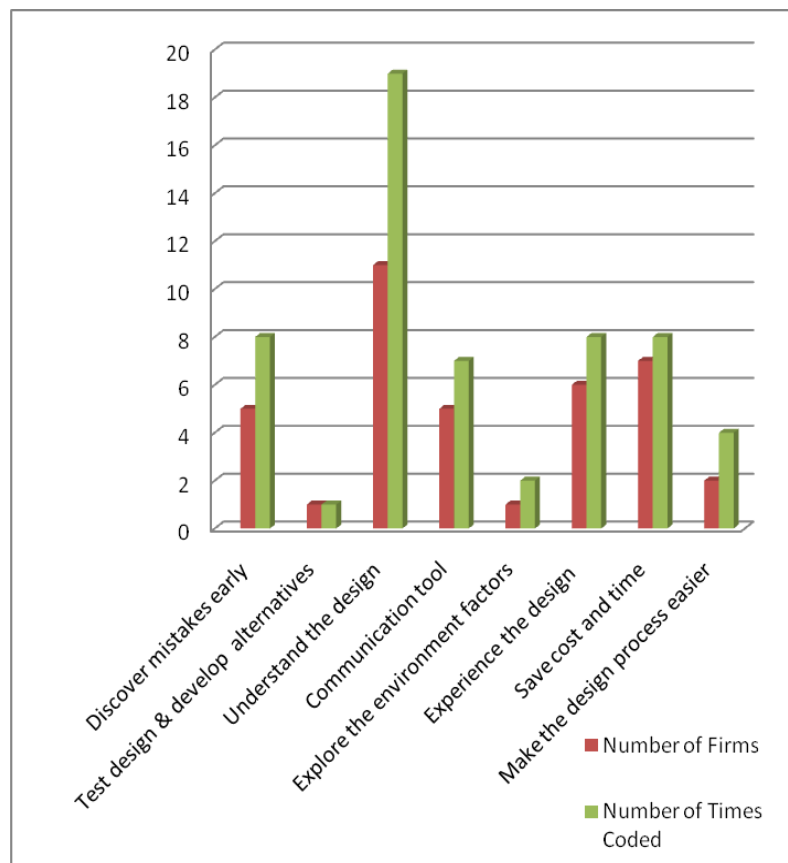

Diagram 1: The advantages of 3D CV in the early design stage.

Disadvantages of 3D CV

In contrast there are still sceptics who highlight with different concerns in relation to 3D CV. Most of them agreed that the visualization was not more than a 'selling device' in the final design stage and inconsistent with the built solution. Six firms concluded that it was just to impress the client thus promoting the architect's design. As one respondent said that, *"most of the architects just use the 3D modelling at the end of the day to promote their products. Some of the clients get cheated by the beautiful picture"*. In fact design participation would be low as there was nothing much to be explored and discussed. This was also highlighted by Whyte (2002) as difficult to focus attention on the relevant issues at early stages and may make designs look fixed. Four respondents explained that once the building was constructed and finished it did not look like the 3D visualization. One of the key reasons to this was the user's budget constraint which excluded of some elements and materials. One respondent said that, *"When we use the 3D computer it looks beautiful but it isn't actually consistent with the budget of the client. Many elements impressed the client in the very beginning but once the design moved to the construction stage then a lot of things will be cut down because of the budget constraints"*.

Another key highlights was raised by five respondents concerning on the cost and time. According to Whyte (2002) and Hanzl (2007) the time to construct the 3D digital model is considered as a barrier to the use of this medium. Even worst with the 'finished' look, most users scared to suggest changes. One respondent explained that, *"It is possible that the user will be afraid to make changes if the design looks too finished. Even the architect himself after he spends a long time doing the 3D and the finishes, will be reluctant to change the design"*. As such it pushed the architect to convince the user that the design is good, thus hindering any participation. Apart from this, some designers even used the advantage of visualization to suggest a distortion of space so that it looks bigger or Dorta (2001) defines as

deform of reality. Some architects translate the 3D to 2D drawings that are essential for construction. Concerning this, one respondent said that "*I am against those who use the computer to generate a 3D model at the beginning and then they go to 2D. By this way the function will follow the form which is wrong in my opinion*".

In the context of creativity, three respondents agreed that 3D CV limits the overall creativity. One respondent explained that, "*Your hand is closer to your mind than the computer. What you have in your mind go straight by your hand to the sheet. But if you use the computer your mind will not wait you until you translate all your ideas into drawings. So you will lose many ideas while you are using the computer to translate one idea*".

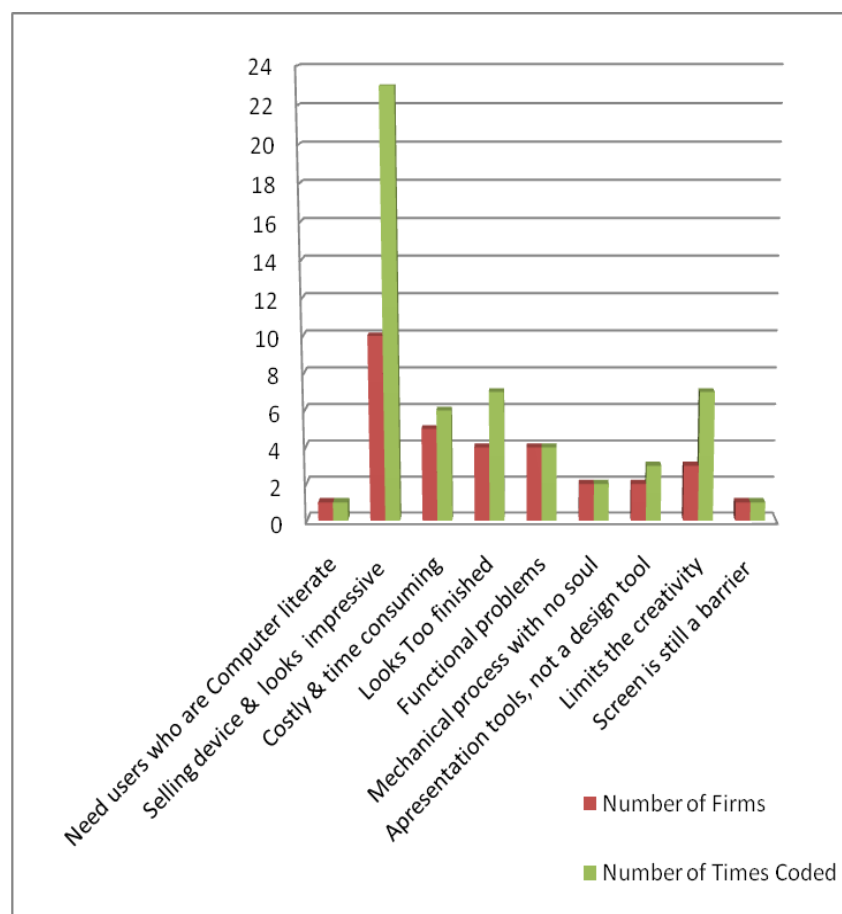Diagram 2 summarizes the disadvantages of employing 3D CV in the early design stage.

Diagram 2: The disadvantages of 3D CV in the early design stage.

Conclusion

This paper has reported the results of the interview to outline the impact of 3D CV and users' participation in the early stage of design. It showed different viewpoints about the strengths and weaknesses of 3D CV. Among the key advantages were, 3D CV suggested an effective aid to increase users participation as it provided a better visualization (e.g. comparison, experience the environment and design layout), saved cost and time, helped to identify design deficiencies, and aided as a good communication tool. On the other hand, a few respondents were still sceptical on the role of 3D CV even though with the wide availability of the digital interaction and visualization options. It may be impressive but unable to reveal the 'real' design solution. Apart from this, it is too costly and often took longer time to complete. The finished look suggested less participation thus limiting creativity of the content but the 'screen and interface' of the computer. Considering both viewpoints, it can be concluded that the advantages or disadvantages are relatively depend on the utilization of 3D CV between the users and the designers to support or suggest a better platform of design participation.

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