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# COMMUNICATING AND EVALUATING LANDSCAPE DESIGN CONCEPTS ONLINE WITH A VIRTUAL REALITY LANDSCAPE MODEL

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## **ABSTRACT**

*The communication between designers and users is needed in order to maintain a high level of engagement among the public participants, especially in case study which is considering the environment. The objective of this research is to investigate if visualization by using Virtual Reality (VR) model is suitable media to communicate landscape design idea from designer to public (users) in case study Situ Leutik Lake. It is answer the question if VR model combined with online questionnaire can be a method to gather public participation in landscape design process for case study which is related with public and environments.*

*The research is started by creating three design alternatives of Situ Leutik Lake in VR model by using Quest 3D. The next step is obtaining public feedback about VR model and selecting the most preferred landscape design alternative. Respondents are asked to investigate three design alternatives by doing walkthrough and bird view in the VR model. After operating VR model, users are asked to fulfill the online questionnaire. In online questionnaire, respondents are asked if they understand about the idea of each design alternatives. Respondents are also asked to select the most preferred design alternative and give suggestions about final design.*

*The results show that respondents understand about ideas of each landscape design alternatives and agree that VR model can be media to communicate landscape design idea. The next result is that landscape design alternative number 3 is the most preferred landscape design chosen by respondents. The feedback from respondents about proposed site is supported the statement of Sheppard et al (2008) that visioning by using VR model can affect awareness, emotion and motivation of community to their environment. For site case which involving publics and considering sustainability of environment, the use of VR model is very useful for giving a good understanding to stakeholders about ideas of landscape designer.*

*Keywords: visualization, virtual reality, design, quest 3D*

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## **INTRODUCTION**

The two ways communication between designers and users is needed in order to avoid misunderstanding and minimize mistakes of final landscape design that cause harmful impacts (Steinitz, 2010). To avoid the misunderstanding, it is important for designers to have abstractions of the real world and future world of design, both in 2D format or 3D visualization (Lange, 2005), as media to communicate design ideas. There are several ways to do visualization such as by using hand drawing, miniature model, 2D photo montage, 3D still image, 3D animation, 3D printing, Virtual Reality (VR) model, etc.

The VR model is a new technology in visualization. By VR model, users are not only can see the simulation of future proposed design in 3 dimension model, but also free to

explore it by doing walkthrough inside model ([www.virtualware.es](http://www.virtualware.es)). It is assumed that by doing walkthrough in VR model, users can have virtual experience about their environments. Nowadays, the high visual qualities and realism become increasingly available in real-time software (Bishop, 2005). Virtual reality such as in game technology is important for landscape architecture works because it can help to make a lot of technical problems easier to understand by provided tools and information handled (Mach, 2008).

The idea of this research is coming from hypothesis that 3D real-time programs for creating virtual reality games are also can be used for visualizing proposed landscape design in Virtual Reality (VR) model. The appropriate real-time software, such as Quest 3D, is needed in this research in order to create VR model. This software is used for developing

game, virtual world, product presentation and landscape walk-through. The reason to choose Quest 3D for creating VR model of the case study is, because the published file from Quest 3D is in executable file (\*.exe) that able to be operated by users in any laptop or computers without installing specific software first.

The public participation is one of methods to gather information about users' response of design proposed. The public participation is very important because it is influencing environmental mediation and decision (Arbter, et al, 2007). The location of landscape designer and stakeholders are in different continents. Internet is an appropriate tool needed in order to do two way-communications between landscape designers and stakeholders which located in different places (Creighton, 2005).



The objective is to investigate about capability of VR model for communicating landscape design idea to proposed users in site case study Situ Leutik Lake. It is answer the question if VR model combined with online questionnaire can be a media to gather public participation in landscape design process for case study which is related with public and environments.

**METHODOLOGY**

The research was held between June and September 2010. The case study, Situ Leutik Lake, is located in the middle of Bogor Agricultural University Campus, Indonesia.

**Research Method**

The research method is quantitative and qualitative methods to conclude answers from respondents that are obtained from online questionnaire. The step of research is started by collecting data mostly obtained from previous research of Situ Leutik conducted by Fatimah, Hadi, Utami, Krisanti, Brodjo, Pratiwi (2007) and finished by final landscape design (Figure 1). In this paper, author wrote about the suitability of the implemented method for case study which involving publics and environment, e.g. Situ Leutik Lake. The landscape design process follows the combinatorial design approach (Steinitz, 2010). In preliminary design phase, author as designer offered three landscape design alternatives of Situ Leutik Lake to respondents (Figure 2). The design alternatives are based on degree of intervention to existing condition. The three design alternatives and one existing model are performed as a VR model of Situ Leutik Lake and tested to respondents.

**Visualization Method**

The method to create virtual reality of landscape model is integrated multimedia, which integrate 2D, 3D and real-time software (Figure 3). The 3D landform is created in

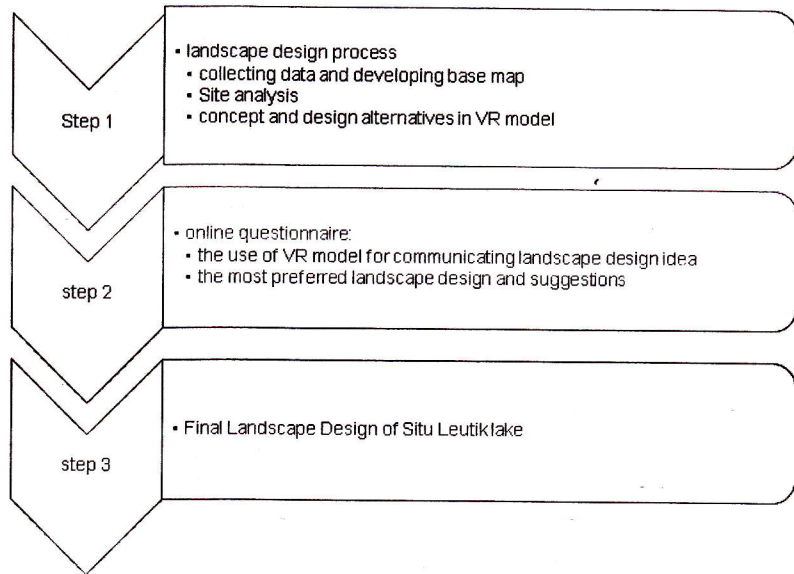


Figure 1. Step of research

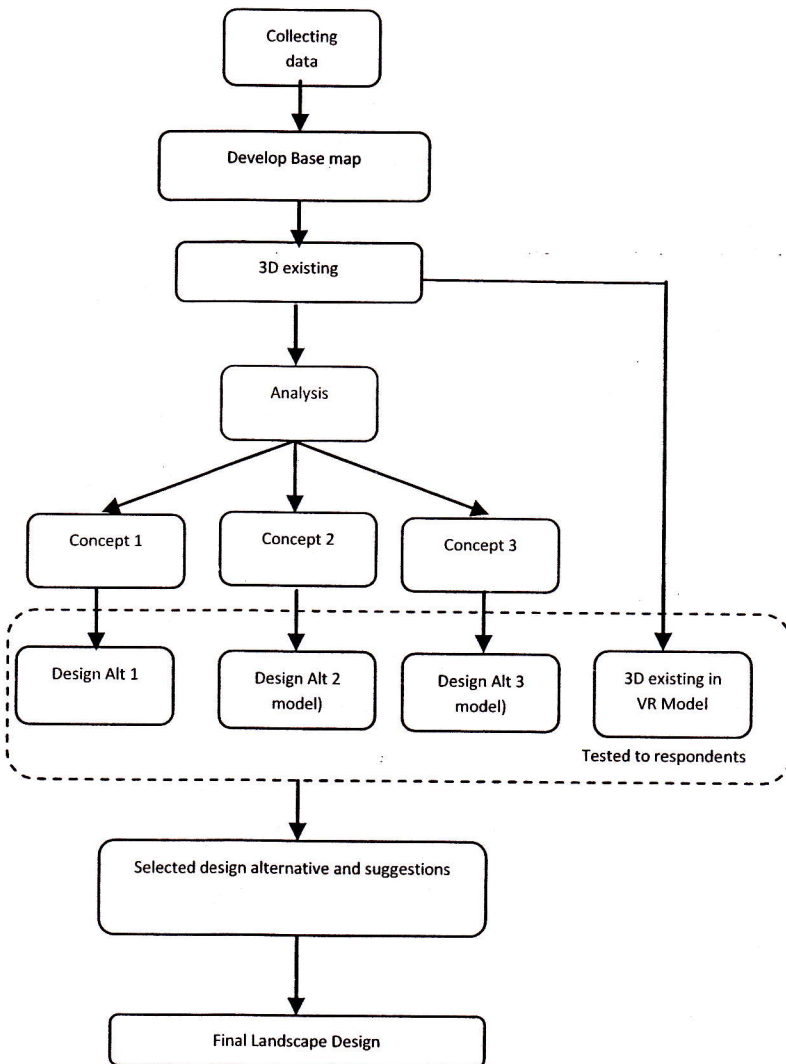


Figure 2. Design process following Combinatorial Design Approach

Google Skecthup and 3D building is created in AutoCAD. All of 3D models are exported to Quest 3D to be combined properly and added with billboard trees and command

channels. The billboard trees are crossed tree images that represent groups of trees on site (Table 1). The billboard trees images selected are the images that almost similar type



with actual vegetation. The billboard trees images is efficient to be used because the size of published file of VR model is smaller than using 3D trees. In the VR model, respondents can compare each landscape design alternatives by changing scene of each model of design alternatives by clicking "D" key on PC keyboard. By comparing the models of design alternatives and existing condition, respondents can see the difference between of them on actual viewer position and able to select the most preferred landscape design alternative.

The other important command is changing camera from human view to bird view. The investigation camera is needed in VR model. Respondents can see the overview of each landscape design alternatives and existing model by clicking key "C" on PC keyboard.

The VR model is also completed with orientation map and arrows for showing actual position of VR model operator (respondents). It is needed in order to give information for respondents about their current position on model and avoid the loss of orientation whenever respondents doing walkthrough inside the models.

The VR model is also completed with screen text for manual instruction of operating the VR model. The screen text will be on or off by clicking key "B" on PC keyboard. The manual instruction is written in Indonesian language, as all of respondents are Indonesian.

The VR model is published as execute files (\*.exe) that able to be opened in each personal computers or laptops without installing specific programs. All of VR models of each landscape design alternatives and VR model of existing condition are put together into one VR model that is tested to respondents.

**Public Participation Method**

The respondents selected are students and teacher staffs at Depart-

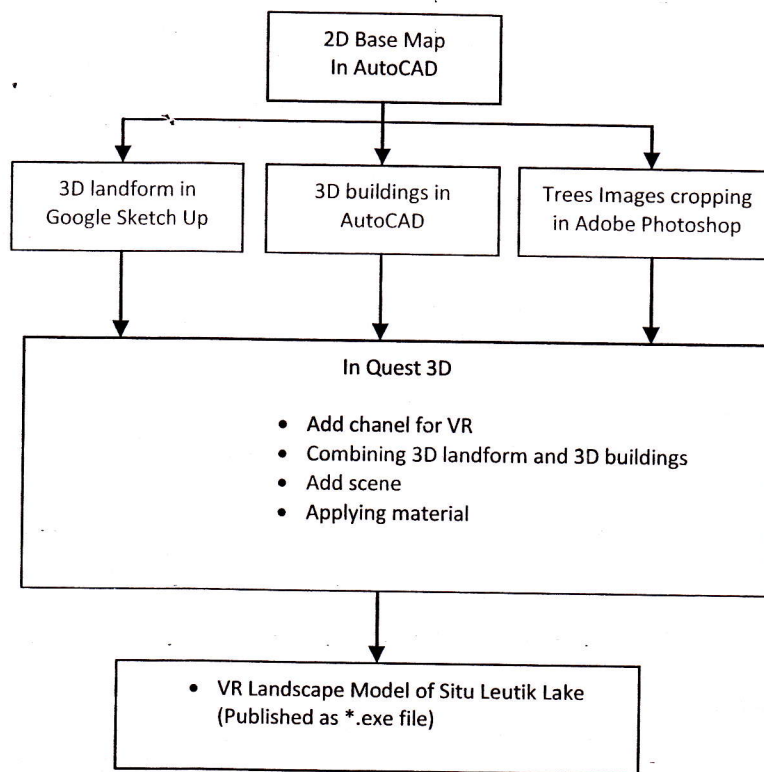


Figure 3. Diagrams of Visualization Method to create VR landscape model

Table 1. Tree images

Type of vegetation / example	Billboard image
Deciduous/ Rubber trees	
Deciduous/ Albizia Trees	
Deciduous/ any trees beside rubber trees and albizia trees	
Evergreen tree/ <i>Pinusmerkusii</i>	
Coconut & Palm trees	
Bamboo	
Bushes	
Grass	
Water grass	



ment of Landscape Architecture, Faculty of Agriculture, Bogor Agricultural University. The reason to choose this group of respondent is based on consideration that they have competency and knowledge in landscape architecture and they are assumed familiar with the site selected. The VR model and online questionnaire are sent by email to 129 students and 21 teachers of Department of Landscape Architecture, Bogor Agricultural University. From total 150 respondents candidate invited, there are 36 respondents fulfilled the online questionnaire.

The method to get public participation is online by using online questionnaire. The VR model, together with link of online questionnaire was sent to respondents via email (Figure 4). Respondents downloaded the VR model and operated it in their PC. After doing walkthrough inside VR model, respondents fulfilled online questionnaire. Respondents give their answer online in every PC that is connected to internet. They can answer and fulfill the online questionnaire anytime and anywhere. Each respondent's IP address is saved in online questionnaire database.

The online questionnaire is created by using trial online software "Qualtrics" in [http://www.qual-](http://www.qualtrics.com/)

[trics.com/](http://www.qualtrics.com/). The online questionnaire is valid from 2 August 2010 until 2 September 2010. The page of online Questionnaire is [http://qtrial.qualtrics.com/SE?SID=SV\\_aicY3v0p747x6TO](http://qtrial.qualtrics.com/SE?SID=SV_aicY3v0p747x6TO).

There are twenty one questions in online questionnaire. The first three questions are about respondents' identity, the next thirteen questions are about the capability of VR model to communicate landscape design idea and the last five questions are about landscape design alternatives of Situ Leutik Lake. The recapitulations of respondents' answers are saved in Qualtrics' database, and able to be downloaded as Microsoft office and excel file as text, tables and

diagrams. Figure 4 show the online questionnaire method to get public participation.

### LANDSCAPE DESIGN ALTERNATIVES

The concept of first landscape design alternative is low intervention to existing condition. Almost all of existing landscape elements is preserved in order to conserve ecology. The additional landscape elements are only two promenades connecting two building cluster, Faculty of Fisheries and Marine Science and Centre of Library. By this promenade, people can walk between two building clusters once enjoy the view along waterfront (Figure 5 and 6).

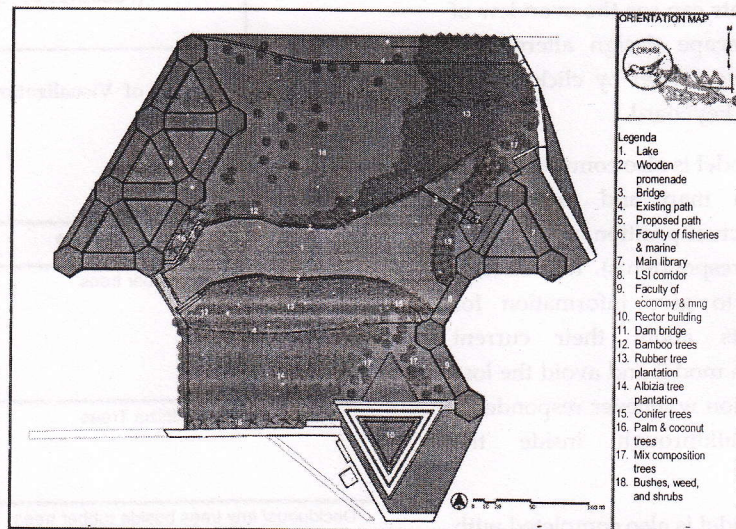


Figure 5. Site plan of design alternative 1  
Source: Own representation

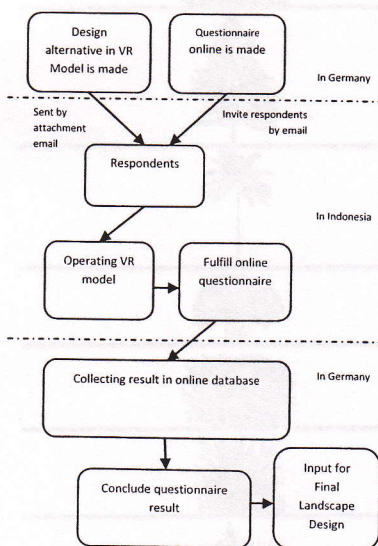


Figure 4. Diagram of public participation method

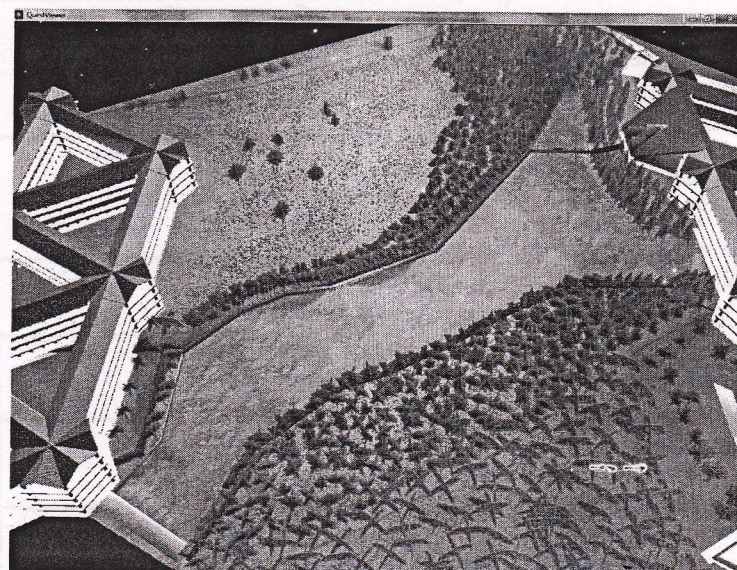


Figure 6. Bird view of design alternative 1  
Source: 3D VR of design alternative 1 by using Quest 3D



The second landscape design alternative give more changing to landscape scene than the first landscape design alternative (Figure 7 and 8). Some trees near waterfront are logged paved promenade. But the number of trees is increase on north side. There is a little arboretum with collection of trees that can be used for outdoor practicum class.

The third design alternative is combination between concept of design alternative 1 and design alternative 2. The users are given opportunity to enjoy sight viewing on the lake, waterfront and land. It is giving more option and opportunity

to various user preferences to walk along waterfront or along slope (Figure 9 and 10).

**Questionnaire Result**

The public participation is a step after landscape design process finish. The VR model was performed to respondents in order to obtain their opinion and suggestion about VR model and final landscape design.

**Respondents & Ability to Operate VR Model**

From 36 respondents who fulfilled online questionnaire, six of them are below 20 years old (17%), twenty

eight of them are between 21-25 years old (78%), one of them is between 36-40 years old (3%) and one of them is over 40 years old (3%) (Figure 11). The most of respondents (94%) are students and relatively young people below 25 years old. The first question is about ability to open and operate VR model. All respondents give positive answer that they can open VR model and operate it. In question about ability to open and operate VR model, all respondents answer that they can open VR model in their laptop or PC (100%). This result shows that VR model in executable file (\*.exe) can be opened in each laptop or PC with Windows operating system without installing special software.

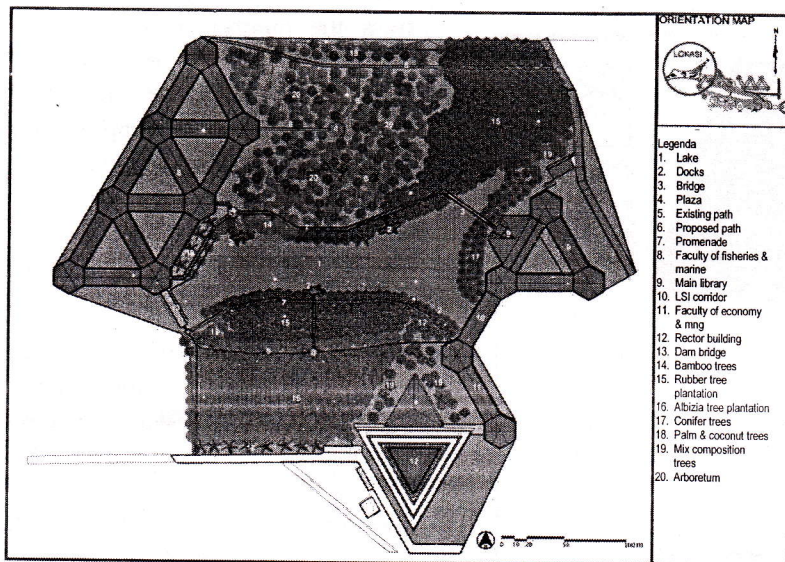


Figure 7. Site Plan of design alternative 2  
Source: Own representation

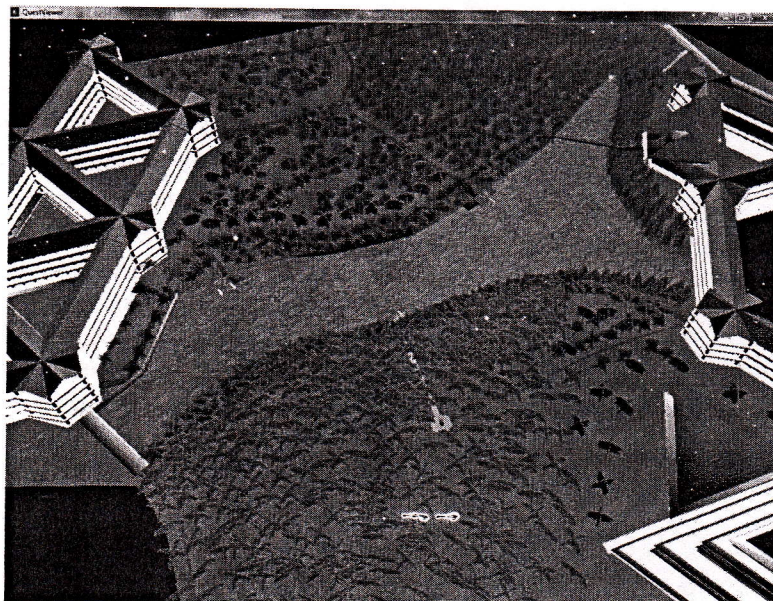


Figure 8. The bird view image of design alternative 2  
Source: 3D VR of design alternative 2 by using Quest 3D

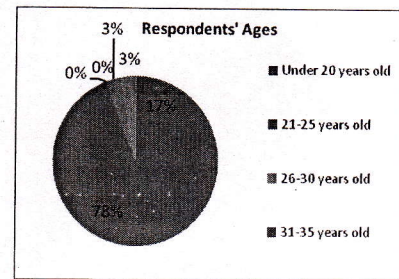


Figure 11. Diagram of Respondents' Age

From the question about ability to do walkthrough in VR model, all respondents give positive answer. They are able to do walkthrough inside VR model (100%). It shows that respondents understand about the manual of operating VR model to do walkthrough by using arrows button on PC keyboard. The manual in VR model is very important in order to give explanation to respondents about how to operate VR model.

Overall, respondents do not have difficulties to operate VR model. In question about the degree of difficulties to operate VR model, twenty five respondents (69%) answered that the operation of VR model is not difficult and not easy (neutral), seven respondents (19%) answered it is easy to operate VR model and one respondent (3%) answered it is very easy to operate it. Only three respondents (8%) men-



tioned that it is difficult to operate VR model of Situ Leutik Lake. This result and previous result show that most of respondents do not have problem to operate VR model of Situ Leutik Lake (Figure 12).

**Capability of VR Model to Communicate Landscape Design Idea**

In online questionnaire, respondents are asked their opinion if VR model of Situ Leutik Lake can represent the real world of Situ Leutik Lake. Almost all of respondents, thirty five people (97%) agree that VR model of Situ Leutik Lake can represent the real world of Situ Leutik Lake. Only

one respondent do not agree that VR model can represent the real world of the lake.

The next important question is about the capability of VR model to communicate landscape design idea from designer to client. Almost all of respondents, thirty five people (97%), agree that VR model can be used as media to communicate landscape design idea to clients or stakeholders. Only one respondent (3%) do not agree that VR model is not a suitable media to communicate landscape design idea to stakeholders (Figure 13). This is a positive result, that in case study Situ Leutik

Lake, respondents agree that VR model can be media to communicate landscape design idea from designers to stakeholders.

There is an essay text box question about the reason about why VR model can be media to communicate landscape design idea to stakeholders. The most answer is because visualization by VR model almost similar with the real world in 3D so users can understand clearly about future design.

The landscape design alternatives that are performed by using VR model is easy to be understood by respondent (Figure 14). It can be seen from the number of people who understand (red bar) is more than people who not understand (blue bar) of idea of each landscape design alternatives. It is an advantage to have VR model in communicating landscape design idea because VR model can give clear explanation about the proposed site.

The results above show that VR model is suitable media for communicating landscape design idea from author as designer to respondents. The idea of each landscape design alternatives is understandable and respondents' feedback is coming after they operate VR model and investigate each landscape design alternative.

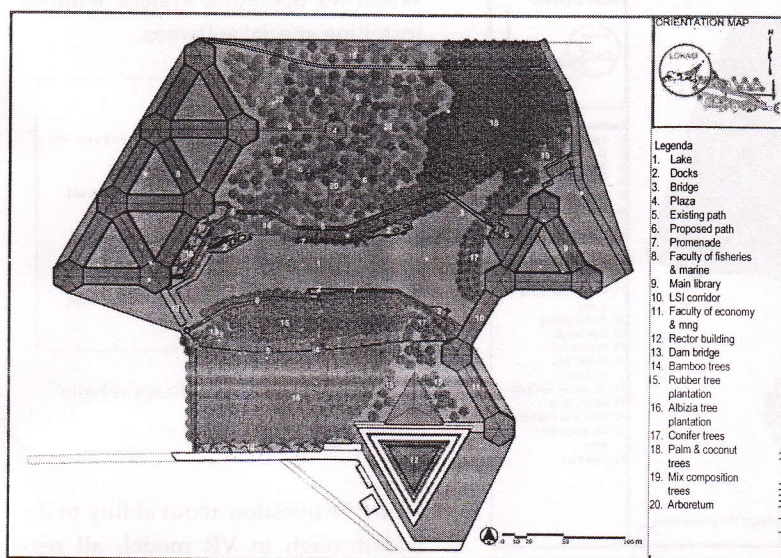


Figure 9. Site plan of design alternative 3  
Source: Own representation



Figure 10. Aerial view of design alternative 3  
Source: 3D VR of design alternative 3 by using Quest 3D

**Discussion**

There are several information that are not obtained yet from respondents by online questionnaire. Author sent the invitation to be respondents to 129 students and 21 teachers of Department of Landscape Architecture, Bogor Agricultural University as sample of users group, but only 36 respondents (34 students and 2 teachers) give feedback. The reason why the rest of respondents did not give responses is still a question. In invitation email, there was no request to reply if respondent candidates are pleased to be respondents or not. In online questionnaire and invitation email of the next research, it is important to ask why



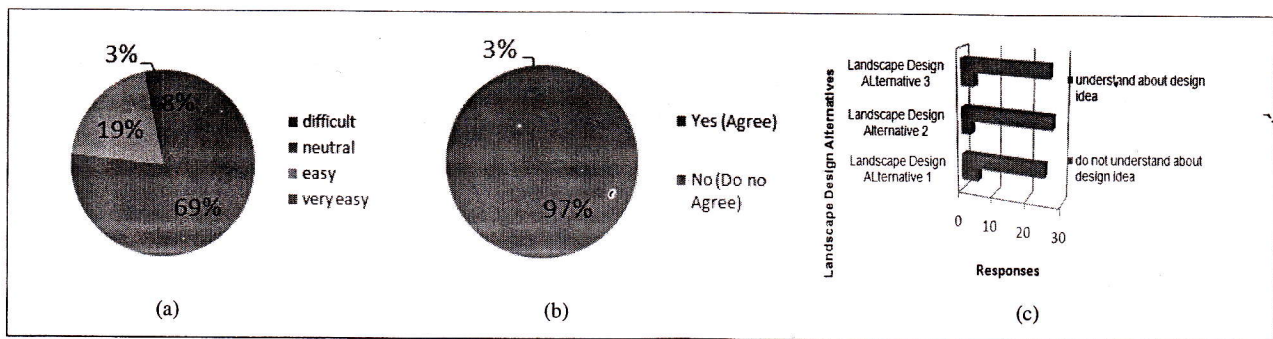


Figure 12. (a) Diagram of degree of difficulties of VR Situ Leutik Lake Operation (b) Proporsion of respondents who are agree that VR Situ Leutik Lake can be media to communicate landscape design idea of Situ Leutik Lake (c) Number of respondents who understand and do not understand about landscape design ideas.

Source: Questionnaire Result

respondents cannot download, open and operate the VR model.

The respondent sample are students and teachers of Department of Landscape Architecture. It is only one of department from 34 departments in Bogor Agricultural University. The students and teacher of other departments are also related with Situ Leutik Lake. In the next research, it is important to ask about users' opinion and suggestions from students and teachers of other departments of Bogor Agricultural University. But it is a challenge for author because there will be more various suggestions to be concluded.

## CONCLUSION

Visualization in VR model is very important for landscape architecture works. In case study Situ Leutik Lake, respondents agree that VR model of Situ Leutik Lake can represent the real world of Situ Leutik Lake. Respondents also understand about landscape design idea from each landscape design alternatives in VR model. This result shows that VR model is suitable media to communicate landscape design idea between author as landscape designer and users.

The feedback from respondents shows that VR model can stimulate cognition, awareness and emotions of users about design development of Situ Leutik Lake. By VR model of Situ Leutik Lake, respondents can see the changing of environments between existing condition and each

landscape design alternatives. Forcase study which has strong relationship with environments, visualization of the environmental changes in VR model is very important in order to stimulate response and feedback from respondents. It is supporting the statement from Sheppard, et al (2008), that visioning workshops by using 3D visualization can influence participant engagement, credibility, cognition, awareness, emotions, motivation and behavior of public participants.

The integrated multimedia, i.e. AutoCAD and Google Sketchup for creating 3 dimensional model and Quest 3D for creating VR model, is a suitable method for developing VR model that represent the real world of Situ Leutik Lake. The VR model is valid and accurate because respondents agree that VR model of Situ Leutik Lake can represent real world of Situ Leutik Lake. One of advantage to use Quest 3D in developing VR model is the published file of VR model is executable file (\*.exe) that can be transferred online by email or web storage and can be operated in any PC with Windows operating system without installing specific program first. VR model in executable file combined with online questionnaire is effective media to be used for public participation in landscape projects which the landscape designer and stakeholders are located in different places and hard to be invited in the same place and the same time.

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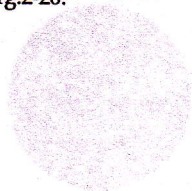
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