Virtual Reality As A Spatial Experience For Architecture Design: A Study of Effectiveness for Architecture Students

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Abstract. Studios. This ability gained through visual design thinking. The spatial experience honed by three dimensional thinking from the medium diversity. The spatial experience learned through a room layout, proportion, and composition. This research used an experimental method and the primary data obtained by a "Likert" scale questionnaire. The Respondents are 50 students of the Architectural Design Studio. Moreover, the analysis focuses on the VR for spatial experience. The result was a descriptive explanation of the effectiveness of Virtual Reality for a spatial experience of architecture students at Technology University of Yogyakarta.

Keywords: Design Cognition, Spatial Experience, Virtual Reality

Background

There was an agreement that the design was one of a product from problem-solving, which consist of a cognitive framework of analysis, synthesis, and evaluation that carried out by the designer. Hubers (2007) describes the goal of a designer was making a good design, such as a space with the good quality of function, aesthetics, structure, and cost calculation.

The architects had a responsibility to provide a good design, just as the architecture students were required to understand the design as well as how to design. Moreover, the architecture students guided by visual design thinking with several cases of designs. For instance, this was a learning activity that honed through me-dium diversity such as scale models as three-dimensional medium and floor plans as a two-dimensional medium. Technology provides a variety of mediums in architectural design, such as Virtual Reality that began to be known as simulation tools. Afterwards, the development of Virtual Reality already used in many fields such as surgery simulation, military strategy, and engineering. According to the background, our main objective is to evaluate the effective-ness of Virtual Reality as a spatial experience for architecture.

Architecture Design

Design is one of a product of logical solution that in Zande's (2006) view could be formed as crafted model or drawing also layout space in Hubers's (2007) that obtained from the design process, which consist of a cognitive frame-work of analysis, synthesis, and evaluation. Both Abdelhameed (2004) and Hubers (2007) added designing is problem-solving in a crea-tive way that involving complex cognitive tasks with a cyclical process. Moreover, the design-ers will get comments on their designs or ideas when those are presented or discussed. The new decision appeared as a reaction of evalua-tion, in other words, the architect proposed a tentative analysis and explore the possible consequences as synthesis, this argument similarly described in the book by Gross (1985, p. 136) that the decision selected on the rea-sonable cause, but it can be changed later.

Spatial Experiences And Simulation

The spatial experience is a subjective assess-ment that emerged through visual perception. According to Mihelj et al (2014), some of the elements that make up the human visual per-ception are the perception of light, the percep-tion of color, and the perception of depth.

Bill Scott (1988) said that medium was an in-termediate that used in the delivery of infor-mation from the speaker to the audience. The purpose is the efficiency of information or message. The architectural presentations tend to use a media in the form of drawings and models. The delivery of information not only through verbal language, but also non-verbal. He added in his book "The Skills of Communi-cating" that the obstacles in communicating caused by the listener may not hear and may not understand what is the speaker means, also listener may not approve the information from the speaker that cause lack of feedback in communication.

Banks et al (2005) said that simulation is the imitation of the operation of a real-world pro-cess or system over time. Many researchers agree that Virtual Reality (VR) is the term, which can be referred to as immersive multimedia or computer-simulated life, replicates an environ-ment that simulates the physical presence of the real world or imagined worlds. Banks et al (2005) added that by changing variables in the simulation, the predictions may be made about the behavior of the system.

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Methodology

Respondents are 50 people from Architecture Design Studio. All of the respondents are archi-tecture students in their 2nd year of study. Likert scale questionnaires were given to the respondent to make an assessment of Virtual Reality.

VR Simulation Design

The VR simulation design is an office building from the Architecture Design Studio project. The design was done by the student with Sketchup software. Moreover, the VR images were rendered using Unity3D and Kubity. The VR tools in this research are Oculus Rift, a portable Head Mounted Display for PC build and VR BOX with a smartphone as a screen.

Fig. 1. VR Simulation Design Process.

The introduction of VR simulation was carried out in the computer laboratory of the Faculty of Science and Engineering at the Technology University of Yogyakarta. VR simulation training activities were attended by 15 students of architecture students. This 1.5-hour activity resulted in several VR simulations.

Fig. 2. VR Simulation Training.

The VR simulation design is the development of 2nd-year student in Architectural Design Studio. The design is an 8-story office building that has been created by students was developed during VR simulation training.

The VR simulation includes exterior and interior visualizations. Interior simulation such as office area, workspace layout, and food court. VR simulation that made by students are then assessed by respondents using a Likert scale questionnaire.

Questionnaire Design

The instruments for measuring the spatial expe-rience is a 7 range of Likert scale questionnaire. The questionnaire contains of 8 positive state-ments regarding to the ability of the media to explain the spatial experience. Each media rep-resented from Strongly-Agree to Strongly-Disagree.

Table 1. Likert Scale Questionnaire Design.

Questionnaire								
No.	Pernyataan	Answers						
		SA	A	AS	N	DS	D	SD
A1.	I'm sure to know the size of space in the room through Virtual Reality simulation							
A2.	I can feel the human scale in the room through Virtual Reality simulation							
A3.	I'm sure to know the type of material in the room through Virtual Reality simulation							
A4.	I can clearly see the lighting in the room through Virtual Reality simulation							
		VG	G	SG	Un	SB	B	VB
B5.	Representation or quality of room size through Virtual Reality simulation							
B6.	Representation or quality of human scale through Virtual Reality Simulation							
B7.	Representation or quality of material through Virtual Reality simulation							
B8.	Representation or quality of lighting through Virtual Reality simulation							
Virtual Reality Write down your feedback for Virtual Reality technology								
SA : Strongly Agree A : Agree AS : Agree Somewhat N : Netral DS : Disagree Somewhat D : Disagree SD : Strongly Disagree		VG : Very Good G : Good SG : Somewhat Good Un : Undecided SB : Somewhat Bad B : Bad VB : Very Bad						

Analysis And Result

Questionnaires are divided into statement A and B. Statement B is a confirmation of Statement A. The end of the questionnaire is a feedback or comment. The conversion of 7 range Likert, from strongly agree to strongly disagree were range from -3 to 3. The results displayed into graphical diagrams and describe in qualitative form.

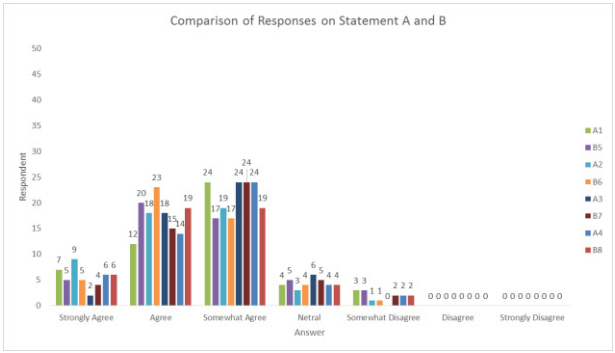

Fig. 3. Comparison of Responses on Statement A and B.

Figure 3 illustrates the comparison of responses on statement A and B. The change of voter amount in the answers was insignificantly different. The insignificant changing of voter value between statement A and B indicates the validity of the answer.

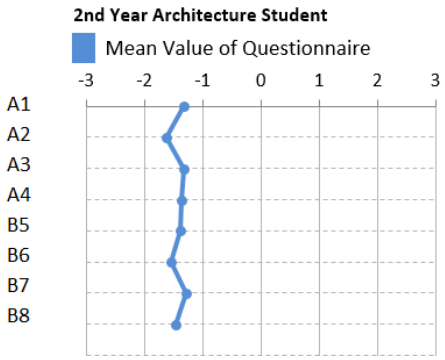

Fig. 4. Mean Value of Questionnaire.

Figure 4 shows the average results of the as-sessment of the questionnaire. Diagram reports that the average results are in the range of -1 and -2. This means that the results of the as-sessment of the VR simulation as a learning experience are in a good range.

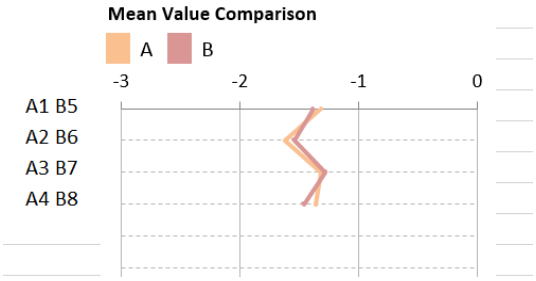

Fig. 5. Mean Value Comparison.

The diagram reports the changing mean value of statement A and B. The mean value of statement A number 1 or called A1 is -1.32 and statement B number 1 or called B1 is -1.38. The mean value of statement A2 is -1.62 and B2 is -1.54. Mean value of A3 is -1.32 and B3 -1.28. Mean value A4 is -1.36 and B4 is -1.46. The insignificant changing of mean value between statement A and B indicates the validity of the answer. So that this agrees the VR simulation has a good impact on a spatial experience of architecture design for 2nd year architecture students.

Feedback analysis was done by classifying the comments into several categories. Feedback categorized into 3, such as hardware, software, and personal perception.

Table 2. Feedback Response.

(hardware)		(personal)		(software)	
(+) Feeling Comfortable	(-) Uncomfortbale, dizzy after using VR tool	(+) Bring up the ability to feel the scale of space, interested in VR	(-) not interested in VR, not understanding VR	(+) Good Quality of visual and lighting	(-) Poor Quality of visual and lighting
2	9	18	0	21	3

The hardware category is the assessment of the VR simulation tool, the software category is the assessment of the quality of VR simulation, and the personal category is the personal perception or response to VR technology for an architecture student. The feedbacks are de-scriptive and then transform into the chart form.

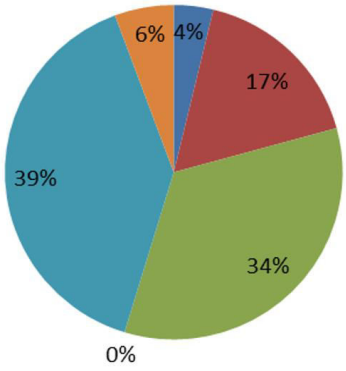

Fig. 6. Percentage Of VR Feedback.

Figure 6 shows the percentage of feedback. The highest percentage is 39% of feedback on the VR software, which response to the good quality of visual, and lighting from the VR simu-lation. The next second highest percentage is 34% at the personal perception, which VR simulation bring up the ability to feel the scale of space and they interested to learn more about VR. But as many as 17% of respondents said that they are feeling uncomfortable and dizzy after using VR tools simulation.

Conclusion

The questionnaire analysis showed that the changing of the mean value and voter amount from statement A and B were insignificantly changed. So that this agrees the VR simulation has a good impact on a spatial experience of office building design for 2nd-year architecture students.

Furthermore, the effectiveness of VR as a spatial experience for architecture design was shown from 39% of the 2nd year architecture students agreed with good quality of visual and lighting from The Kubity application as VR software. Followed with 34% of 2nd-year architecture students states that VR simulation brings up the ability to feel the scale of space and they are interested to learn more about VR. However, 17% of respondents felt uncomforta-ble and dizzy after using VR tools.

Suggestion for the next research and for other fellow researcher is in the preparation phase of VR simulation. Similarly with hardware and software selection tools for simulation. Virtual Reality simulation needs an optimization for hardware and software in architecture design.

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