Introduction and Demo of Virtual Reality Technology to Initiate Active Learning in Architectural Design

Intan Findanavy Ridzqo[1], Aliviana Demami[2]
[1,2] Department of Architecture, Institut Teknologi Indonesia, South Tangerang, Indonesia

Article Info

Article history:

Received July 7th, 2023
Revised October 10th, 2023
Accepted October 11th, 2023

Keywords:

Active learning
Virtual reality
Introduction
Demo
Architectural design

ABSTRACT

Architectural education is adapting to the demands of efficient, technology-driven practices, with virtual reality (VR) emerging as a critical tool in bridging communication gaps between architects and clients. This study, conducted by lecturers at Institut Teknologi Indonesia, focuses on their experience implementing VR technology in the High-rise Building Technology class. The initiative spans four sequential stages, with the introduction and demo executed hybridly (online and offline). The authors emphasize the importance of knowledge induction and firsthand demonstrations to familiarize students with VR. Notably, external instructors proficient in VR technology participate in the program. Student engagement and enthusiasm are evident, with offline demo attendance surpassing the online VR introduction seminar. The COVID-19 pandemic has affected students' motivation to learn, and the hands-on VR experience is a revitalizing approach. The two-way interaction between instructors and students enhances interest in in-person attendance. The authors advocate for the continued development of this experience in architectural education, promoting an active learning system using VR across various courses. The paper underscores the potential of VR technology to invigorate architectural education and enhance student engagement in the post-pandemic learning landscape.

Corresponding Author:

Intan Findanavy Ridzqo,
Department of Architecture, Institut Teknologi Indonesia,
South Tangerang, Indonesia,
Email: intan.findanavy@iti.ac.id, intan.findanavy@gmail.com,
Phone No.: +62 896-9715-7024

1. INTRODUCTION

Designing and visualizing an architectural work are no longer enough to be communicated only through 2D and 3D printed images. It is needed, then, that architectural education continues to evolve as the demands of an increasingly fast and efficient practical way aided by technology. As a layman, the project owner needs help to imagine the architectural design he ordered by only staring at drawings and pictures handed by the architect. On the other hand, rendering video also takes time to produce and is static, which makes it hard for the client to feel spaces, their scale, and nuance. A more effective technique is needed.

Interestingly, one of the popular technologies that can help bridge communication design between architects and clients is virtual reality (VR). Virtual reality is the technology where the user can see a virtual environment through devices attached to his head. Not only does a visual rendering add other features as well as audio and fragrance, but the designer could also involve more user senses, which in some cases is proven as an excellent way to sickness rehabilitation [1]. In architectural practice in Indonesia, VR is still a little, mainly for games, entertainment, tourism, and higher education [2]. However, this technology becomes more popular by pursuing digital creative works, including architecture, meaning introducing it to students in higher education is immediately essential.

The conventional paradigm of design creation works only by drawing 2D, an obstacle experienced by secondary and higher education students in Indonesia. Students find it difficult to imagine the integration of one drawing related to the others, making their understanding partial and not thorough. Although 2D is still necessary to draw because of the detail required for constructing real projects, for learning purposes, students must understand the entire system and how all building components work and are related, which cannot be achieved through mere 2D drawings. That is the reason 3D visualization is the core of design. However, this is still not enough because the limitations of 3D graphics seen through a computer screen make students less understand the design intangible, which is only obtained through direct experience [3], [4], for example, how close one meter is, how high a building is visible from 200 meters, or what the finishing texture looks like.

Therefore, VR technology is crucial to introduce specifically in architectural education. In answering these fundamental questions in the architecture learning process, VR is presented as the first step through a stand-alone subject. In the Department of Architecture at Institut Teknologi Indonesia, VR technology is implemented in the High-rise Building Technology course. This course emphasizes exploring various structures, constructions, and technologies inherent in the design of high-rise buildings, including the urban context of high-rise buildings' location. Previously, the design practice activities in this course were drawing 2D plans and 3D, completed with building structural mockups. Because of the need for a more comprehensive understanding, the activities in this class will be enriched with 3D communication through VR.

The use of VR in the learning process in the construction field is gaining popularity and interest. Integration of VR with BIM makes the use of VR more complete and improves the ability of students to respond to these changes [5], [6]. In their class, Hamilton et al. (2021) also noted that VR applications could increase excitement and motivation and produce the expected learning outcomes [7]. VR technology is relatively easy to obtain since this technology is more affordable and compatible with hardware limitations, such as specifications laptops. Various developers provide many feature variations, both in software and hardware. Instructors and students will not meet significant matters to apply VR in class. However, adjustments are still needed regarding individual affordability and device support [8].

This study will share the authors' initial experience implementing VR technology in education. This research is halfway through the entire series of activities that will be subsequently reported. Measurements in this study were carried out to obtain preliminary findings related to the participants' enthusiasm and the advantages and disadvantages of using VR [9]–[11]. Measurements were made by participants who were new to using this technology.

2. RESEARCH METHOD

This research is part of the High-rise Building Technology course at the Architecture Study Program Institut Teknologi Indonesia in the second semester of the 2021-2022 academic year. This paper examined students' enthusiasm for adapting to new technologies through this course. Designing the VR implementation in class was formerly discussed among authors and two VR and BIM practitioners, Svetlin Petrov from Kousou Inc. Jakarta, and R. Harbayu Wiryawan from Archilantis. The complete series of VR implementation consists of four stages throughout the semester: the introduction, demo, installation, and exhibition, which are implemented through four activities held alternately online and offline (hybrid) (Table 1). In this paper, the authors limited the discussion to the introduction and demo stages, which were carried out in the 2nd and 9th lectures from 16 lecture sessions.

Forty-three students in this course are 6th-semester students who have previously taken the Computer in Architecture course, meaning that participants are familiar with and can design architecture using digital software. The effectiveness of these two activities is assessed from the student attendance rate and feedback drawn from questionnaires. Finally, the result will be discussed qualitatively.

Table 1. Timetable of implementation VR along the course.

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Regular class	VR Introduction	Regular class	Regular class	Regular class	Regular class	Regular class	Mid-semester evaluation
Week 9	**Week 10**	**Week 11**	**Week 12**	**Week 13**	**Week 14**	**Week 15**	**Week 16**
VR Demo	VR Installation	Regular class	Regular class	Regular class	Regular class	Regular class	VR Exhibition

2.1 Stage 1: Public Lecture as Introduction

The first stage of VR implementation in class is an online public lecture. The speakers are practitioners who have experienced much work involving VR technology in their architectural design. This lecture is open to the public. Intentionally, the students and the larger public would gain insight into this technology. This open lecture would make students available and aware of public enthusiasm. The assessment at this stage is students' attendance, which is recorded through Google Forms.

2.2 Stage 2: Demo using VR Glasses

The second stage is the demo session. In this session, the students will experience using a VR device directed by the instructors one-on-one with the students. The instructors in this session are VR practitioners in architectural works and are assisted by the lecturers. By trying the ideal device lent by the instructor, students will make the student understand the work and features of the device firsthand. Instruction from instructors to students is delivered in Indonesian and English. The assessment at this stage is students' attendance, which is recorded through Google Forms and survey questionnaires. Students must also fill out questionnaire questions online through Google Forms, which must be filled out right after trying VR.

2.3 Stages 3 and 4: Practicing Importing 3D Design into VR File and Exhibition

Stage three, which had yet to be implemented, is practicing importing the 3D file into a VR-readable file. This stage will be implemented after the complex knowledge about high-rise buildings has been delivered to students. The students will be asked to reconstruct famous high-rise buildings worldwide and provide structure, construction, and façade details. After that, the students have to put some viewpoints in the 3D file that can be seen through VR. At the end of the semester, all the students will exhibit their projects in a public area so other commuters can experience the VR and appreciate the students' work. These four stages are hopefully developed as active VR learning, starting with knowledge induction, first-time experience, preparing objects to deliver, and communicating the design to people.

3. RESULTS AND DISCUSSION

3.1. Stage 1: Introduction through Online Public Lecture

As a public lecture activity, the introduction stage was delivered online via ZOOM by two speakers with experience using this technology in their projects (Figure 1). The speakers discussed two viewpoints of virtual reality technology: VR is a new way of communicating technical building modeling enhanced with BIM, and the other is "impossible," imaginative architectural design. The first topic was delivered in Indonesian, and the second in English [12]. The introduction lecture is intended to provide an overview of what VR is, the pluses and minuses of using VR, how VR operates, and how VR is related to some software.

This session was open for public attendance and not limited to students participating in this class. The number of participants who attended this public lecture according to their attendance self-record through Google Forms was 107 people, consisting of 19% of students in this High-rise Building Technology class, 51% of other internal civitas academics of the Department of Architecture ITI, 22% of the academic community from other universities, and 8% of others were architecture practitioners (Figure 2). As 19% of this course's students attended, they were only 47% out of the students in this class, meaning only 20 students attended out of 43 students enrolled in this course.

All students of this High-rise Building Technology course wished 100% to be present in this public lecture because it was part of the class session that must be attended. However, the graph above shows that the students present were, at most, half of the class. Many students who missed this lecture might make

some assumptions. First, the absent students might think that this public lecture was additional, meaning that attendance is counted as voluntary. It was held publicly online with a large number of participants, even more participants coming from other institutions. The massive number of participants would make them suppose that lecturers' observation of student attendance will be loose.

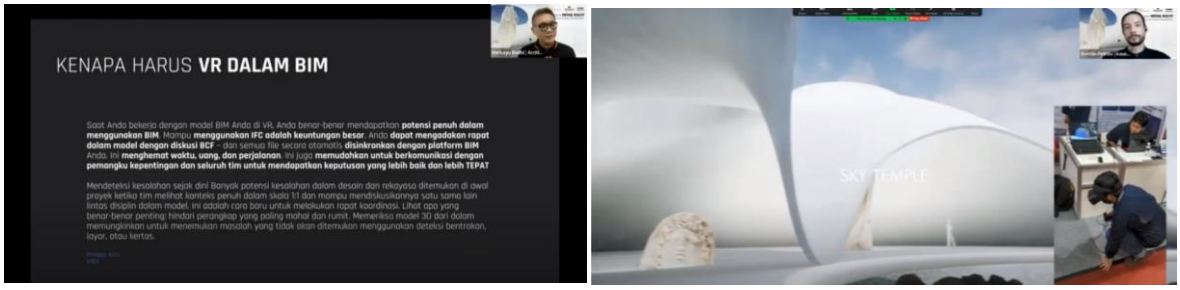

Figure 1. R. Harbayu Wiryawan and Svetlin Petrov delivered an online public lecture.

Another reason that made students' interest low and reluctant to attend was the language barrier. The students who were not used to speaking or reading in English needed help understanding the international speaker's explanation. Authors considered this issue a national student problem in higher education that needs to be fostered. In addition, the public lecture was held too early, in 2nd session of the whole class sessions, which made students need help understanding the concept (misconception) of using VR technology in this course [13], [14]. Less than half of the overall students' enthusiasm for this public lecture should then be mitigated in the following activities.

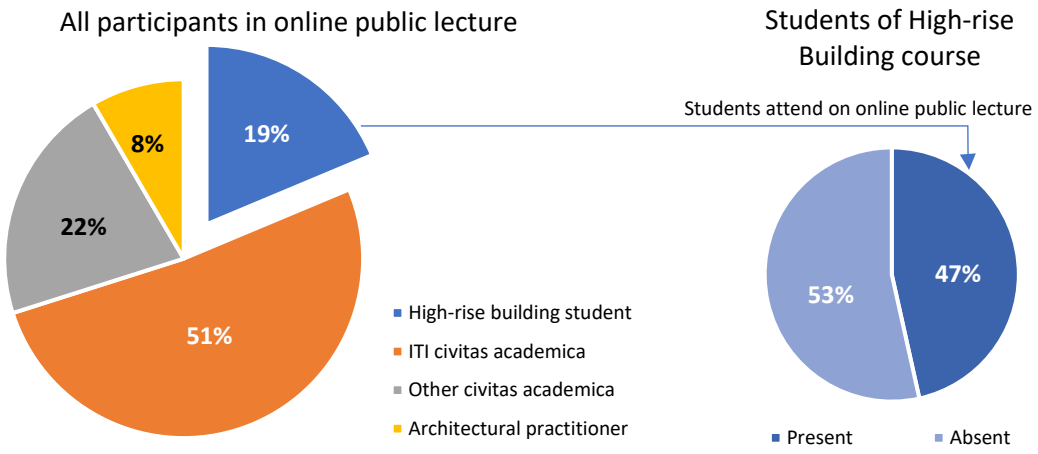

Figure 2. Percentage of online public lecture participants.

3.2. Stage 2: Demo using VR Glasses

After evaluating the implementation of the introduction stage, improvements were made to the second execution stage, namely the demo session. The activity was announced to students by the lecturer two weeks earlier, emphasizing the importance of this session for students to experience using VR devices firsthand. Because there are problems with student discipline in attending activities, lecturers also gave regulations for student punctuality and discipline in this current announcement. The announcement was delivered through WhatsApp Group, so the information was one click directly close to students. The phenomenon of time discipline was undeniable since, during the COVID-19 pandemic, students were vulnerable to distractions with daily activities at home [15].

In the demo session, two stations were equipped with one VR set. The two stations had different points of view. Station A was an architectural design station that instructor Svetlin Petrov ran to showcase architectural space experience. The objects observed in this station were imaginative spaces, texture, lighting,

and sound. The other station had instructor R. Harbayu Wiryawan with technical building modeling. The student would act as the owner who wanted to supervise the building construction. The devices used at these two stations were Oculus Rift connected to a CPU or laptop. The data accessed from the CPU or notebook must be processed online.

A total of 43 students were divided into 22 groups consisting of two people. Each student will only experience it once, using one VR device at one station for 5 minutes. One student in one group will use the VR (user), and another group while his friend in the group is in charge of accompanying him and observing through a projector screen what his friend sees (observer) in VR glass (Table 2). Each student was equipped with a VR eye mask, while wipes and alcohol were also prepared at each station to clean the devices after each use to prevent transmission of COVID-19. An ample hall space was also ready to accommodate this activity.

Table 2. Time allocation and the role of students at each station.

Time	 **Station 1 (Architectural)**	 **Station 2 (BIM)**
0" 0' – 5" 0'	Group 1 Student A: user Student B: observer	Group 2 Student A: user Student B: observer
5" 0' – 10" 0'	Group 2 Student A: observer Student B: user	Group 1 Student A: observer Student B: user

Student attendance was self-recorded on the attendance sheet before the demo session opening. The rate of student attendance was better. The attendance rate was 79.06%, meaning 34 out of 43 students were in this session. The students' enthusiasm for VR increased through this activity. When they were playing the role of 'users,' the students were enthusiastic, open to exploring the objects they saw in VR glasses, and could interact with the instructors at each station. This enthusiasm means students get immersed, interact, and imagine what they observe [16], [17]. On the other hand, when they were playing the role of 'observer,' the students also kept following through the projector screen, ensured their 'user' friend did not move too far, and stayed careful of things among them, such as the computer table and electricity cables, and documented their partner during their VR exploration (Figure 2).

After students finished doing the demo, they were required to fill out survey questionnaires that had been prepared. The questionnaire, which was filled out online through Google Forms, was intended to find feedback from students regarding their first-time experience of trying VR. All students present filled out the survey questionnaire. The questionnaire consisted of 12 closed questions with scaled answers, one closed question followed by an open-ended question, and an open-ended question about their comments using VR and improvements needed for the future. The students will answer for scaled question types with numbers ranging from 1 to 5. The smallest number means the student experienced the question very severely, and the largest means very well. These feedback questionnaires were inspired by the research of Salman and Ahmed [18] and Rogers [19].

3.2.1. The result of a scaled closed question.

The closed question section included questions about student's preference to use VR technology in the studying process (questions no. 1 and 2) (Figure 3 and Figure 4), student's vision of VR technology used in architectural design sector in the future (questions number 3 – 7) (Figure 5 to Figure 9), VR technology is

easy to use (questions number 8 and 9) (Figure 10 and Figure 11), and student's willingness to apply VR technology in their future (questions number 12 – 14) (Figure 14 to Figure 16). These twelve first questions are to determine current students' awareness of the application of this technology in the future.

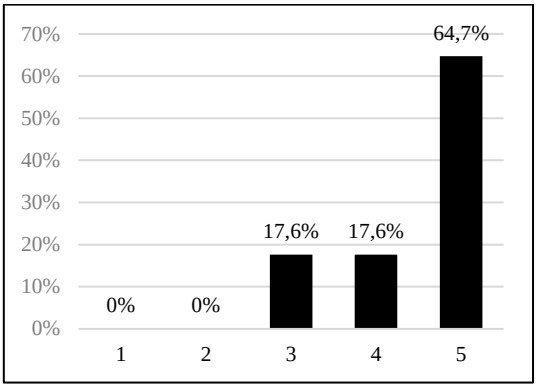

Figure 3. Graph of student responses to Question 1: "I like using virtual reality technology for learning."

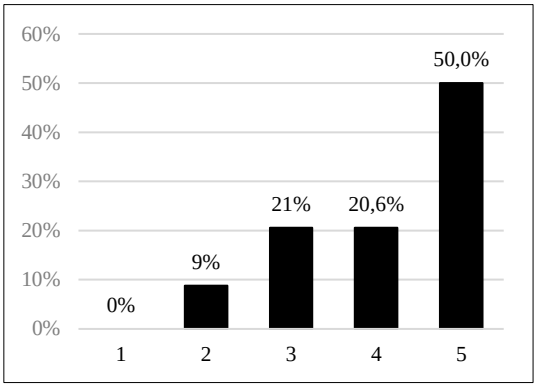

Figure 4. Graph of student responses to Question 2: "Using virtual reality technology is regarded as my learning style."

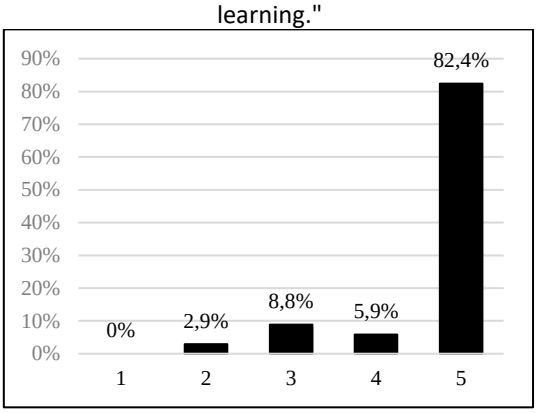

Figure 5. Graph of student responses to Question 3: "Virtual reality technology provides ease in communicating architectural design."

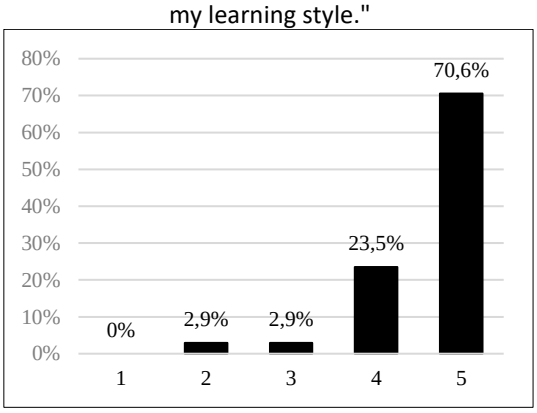

Figure 6. Graph of student responses to Question 4: "Virtual reality technology allows me to explore further."

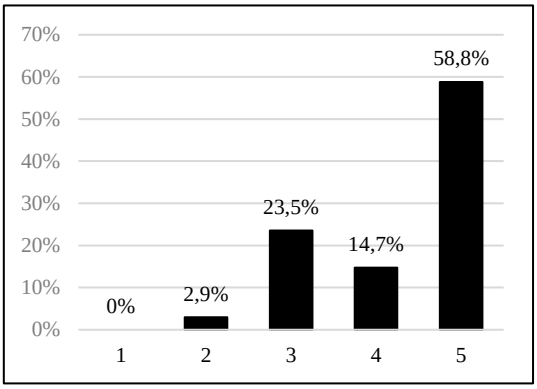

Figure 7. Graph of student responses to Question 5: "Virtual reality technology facilitates the need to learn the recent applications I require."

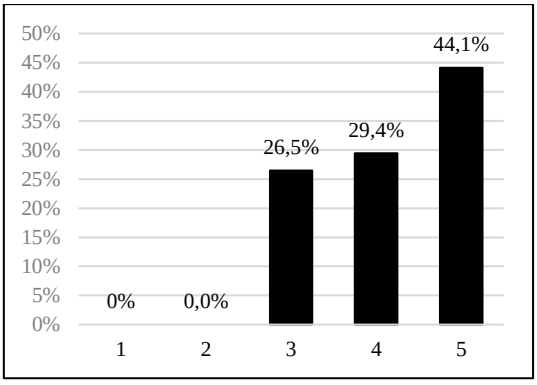

Figure 8. Graph of student responses to Question 6: "I intend to use virtual reality technology for the foreseeable future and in my professional practice."

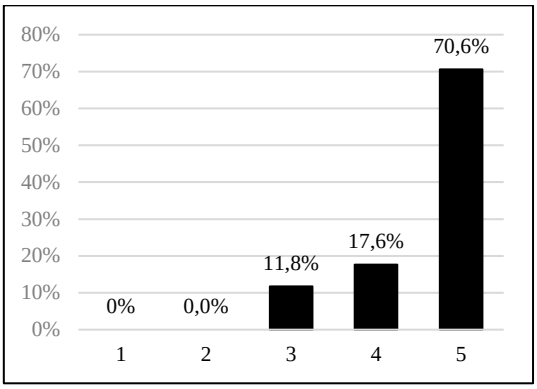

Figure 9. Graph of student responses to Question 7: "Virtual reality technology will be needed."

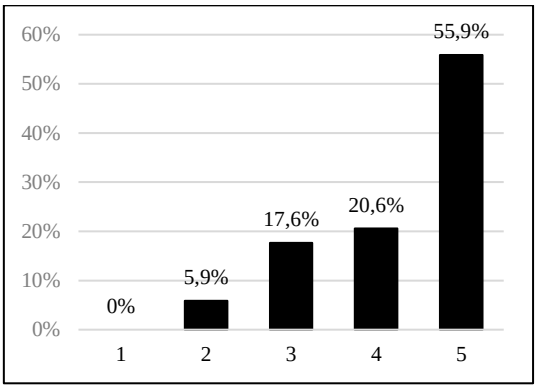

Figure 10. Graph of student responses to Question 8: "Virtual reality technology is easy to use."

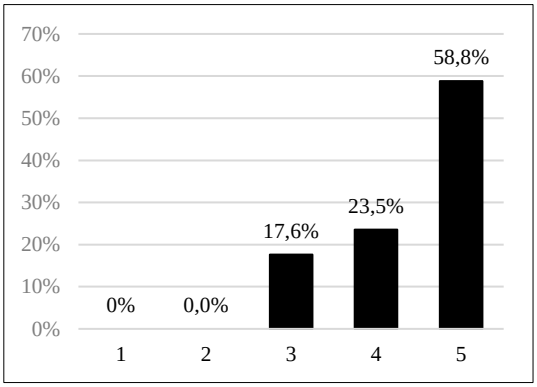

Figure 11. Graph of student responses to Question 9: "I use virtual reality technology because it's fun."

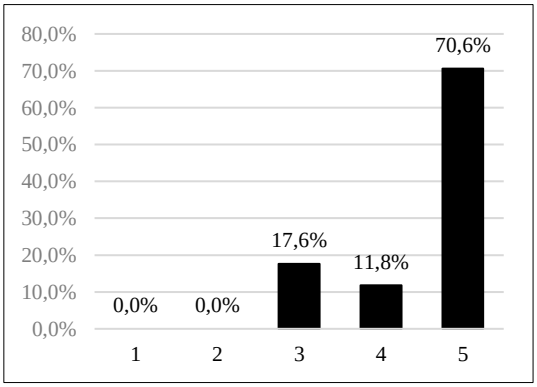

Figure 12. Graph of student responses to question 10: "I openly accept the use of current technologies like this virtual reality technology."

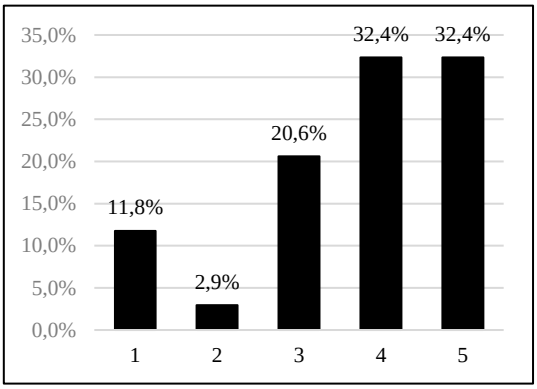

Figure 13. Graph of student responses to Question 11: "I can design a product using virtual reality technology."

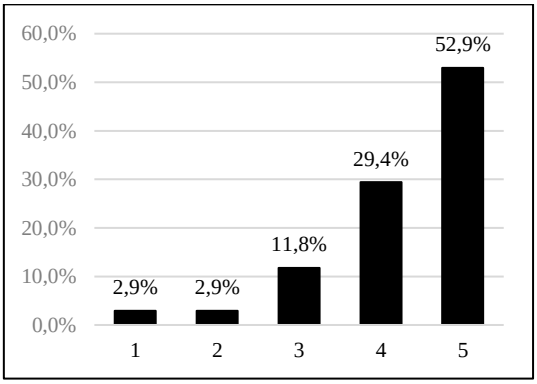

Figure 14. Graph of student responses to Question 12: "I use virtual reality technology applications on the recommendation of professionals and academics."

Students' answers to almost all questions show positive responses. Nearly half or more students agree that VR is a helpful device to communicate architectural design during the study process and in future professional work. Only very few students answered that they disagreed with VR technology. Though most students know that VR technology will be a promising technology in the future, the result of question number 11 (students' capability to design a product using VR technology) is that some students need more confidence in creating with VR. It is understood that VR technology was just introduced to them, not the method. However, it also could be a note for the lecturer to encourage and motivate these students during the workshop session so that they can trust themselves in the future.

3.2.2. The result of a closed question followed by an open question.

After being given the scaled-answer questions, students were asked whether VR technology is comfortable and, if not, optionally to describe the inconvenience they have felt. In this section, there are two questions. The first is answered with yes or no, and the second is an open, short description. The first is compulsory, and the latter is optional, which must be filled if the first question is answered yes.

The students who answered that they felt uncomfortable using VR glasses were only 15%. They felt so because 50% felt dizzy, and 37% had unclear vision (Figure 15%). This dizziness was experienced because of the duration they felt relatively long, the slightly heavy device, and the tight headband. The students who had an unclear vision of them also felt eye fatigue. Focusing on closed digital objects watched closely by the eyes will be very difficult for those with myopia or hypermetropia. However, this problem could be overcome because VR devices have an eyesight adjustment feature. The students were not familiar with this feature because of the first experience. On the other hand, another minor problem was the limited moving area because of the limited cable connection length of the device, which is five meters long (Figure 16).

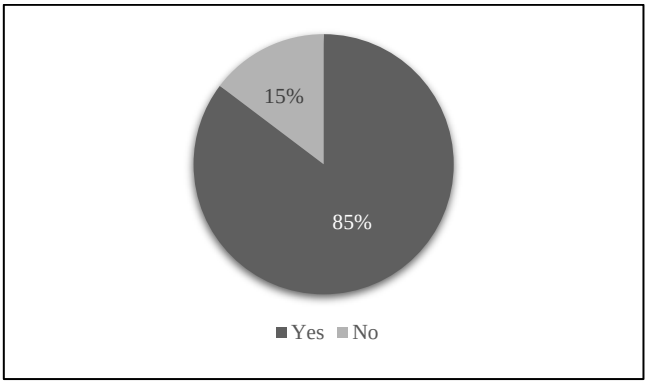

Figure 15. Graph of student responses to Question 13: "I feel comfortable using VR."

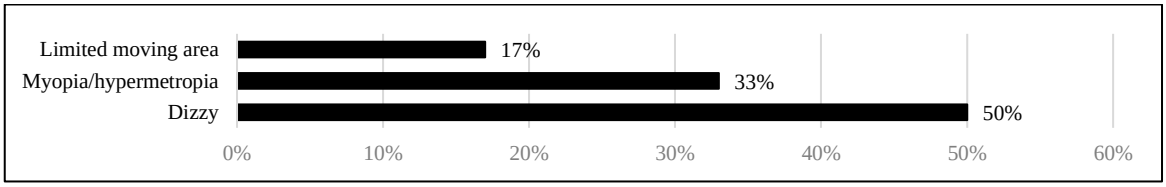

Figure 16. Graph of student responses to Question 14: "What makes you uncomfortable?"

3.2.3. Students' commentaries about their experience

At the end of the survey questionnaire, the students were asked about their comments about experiencing virtual reality technology and their wishes for future development. This question is as vital as other questions, especially to know students' ideas about applying this technology to the learning process and the coming professional world they will enter. The following are the relevant results:

- This VR technology is excellent and efficient. However, considerable costs must also be incurred to support importing it and getting good results.
- VR technology is very efficient in presenting our designs to clients. However, it needs more investment to be able to apply it, and it is necessary to learn more about supporting software, which also needs adequate specification devices.
- VR technology in architecture is new, so it takes time to learn it.
- VR technology helps us in presenting the design results in real terms. We can feel the space for real.
- VR technology provides new knowledge and exciting experiences.
- Investing in this technology in the Department of Architecture VR laboratory is necessary so the students can learn it together and share, as its price for individuals is still high.

Some of the above answers highlight the cost of VR technology, which is less affordable for most students. The fee includes the price of the device itself, the supporting hardware and software components, such as a high-specification computer or laptop, and paid software. On the other hand, students look for fast payback as they do not see that technology is an investment, both the knowledge and the physical device. It is essential that in the learning process, the teacher or lecturer always uses this technology continuously in every course and the value behind it. This way will gradually convince students that technology is a certainty. On the other hand, the faculty or department essentially has a VR laboratory to deliver ideal sight to the student.

4. CONCLUSION

This paper aims to present the author's experience in a learning strategy that implements VR technology in the High-rise Building Technology course, starting with a public lecture as an introduction and then continuing with demo activities. This paper reveals the steps of how all the activities were carried out. The effectiveness of these two activities was assessed from the student attendance rate and feedback questionnaires. Student attendance increased from online seminars to offline demo activities. Two-way interaction with instructors encouraged students to be more interested in coming to class. The feedback results also show that students received VR technology well, although some still needed to decide whether they could create projects with VR technology. Although most students feel comfortable, some students reviewed the limitations they experienced while using this device.

Despite the rising enthusiasm, the students still needed to be fully attended. Attendance is still a worry for the lecturer because the academic atmosphere has decreased since online lectures during the COVID-19 pandemic in March 2020 until the resumption of alternately offline and online lecture activities (hybrid), which were possible to hold since March 2022. The students, who were accustomed to the distraction of activities that occur at home and currently must be expected to focus on studying, need time for students to get up and back enthusiastic in their studies.

This research still needs to be completed. After the introduction and demo stages, students will go through the following steps to apply VR technology in this course project. The continued discussion about this research will be explained subsequently. Through this paper, the authors hope this experience can be further developed in architectural education to promote an active learning system using virtual reality in class.

REFERENCES

[1] L. Paletta *et al.*, "Virtual reality–based mindfulness training, sensory activation and mental assessment in dementia care," *Alzheimer's & Dementia*, vol. 16, no. S7, p. e047344, Dec. 2020, doi: https://doi.org/10.1002/alz.047344.

[2] A. Habibah, D. A. Pujiarti, A. Widyanti, and H. R. Soetisna, “The Potential and Challenges of Virtual Reality in Indonesia”.

[3] P. Wang, P. Wu, J. Wang, H.-L. Chi, and X. Wang, "A Critical Review of the Use of Virtual Reality in Construction Engineering Education and Training," *Int J Environ Res Public Health*, vol. 15, no. 6, p. 1204, Jun. 2018, doi: 10.3390/ijerph15061204.

[4] S. Mastrolembo Ventura, F. Castronovo, D. Nikolić, and A. L. C. Ciribini, "A framework of procedural considerations for implementing virtual reality in design review," in *Proceedings of the 2019 European Conference on Computing in Construction*, 2019. doi: 10.35490/ec3.2019.160.

[5] S. Y. Ghanem, "Implementing virtual reality - building information modelling in the construction management curriculum," *Journal of Information Technology in Construction*, vol. 27, pp. 48–69, Jan. 2022, doi: 10.36680/j.itcon.2022.003.

[6] A. G. Abulrub, A. Attridge, and M. A. Williams, "Virtual reality in engineering education: The future of creative learning," *International Journal of Emerging Technologies in Learning*, vol. 6, no. 4, 2011, doi: 10.3991/ijet.v6i4.1766.

[7] D. Hamilton, J. McKechnie, E. Edgerton, and C. Wilson, "Implementing Immersive Virtual Reality Innovative Practice in Higher Education 206 Innovative Practice in Higher Education Hamilton," vol. 4, no. 2, 2021.

[8] M. Abdelaziz, “Challenges and Issues in Building Virtual Reality-Based e-Learning System,” *International Journal of e-Education, e-Business, e-Management and e-Learning*, vol. 4, no. 4, 2014, doi: 10.7763/ijeeee.2014.v4.347.

[9] H. C. Gomez-Tone, M. Alpaca Chávez, L. Vásquez Samalvides, and J. Martin-Gutierrez, "Introducing Immersive Virtual Reality in the Initial Phases of the Design Process—Case Study: Freshmen Designing Ephemeral Architecture," *Buildings*, vol. 12, no. 5, p. 518, Apr. 2022, doi 10.3390/buildings12050518.

[10] F. Castronovo, R. Schaffer, and V. R. Kandi, "Lessons learned from implementing virtual reality in an introductory engineering course," in *ASEE Annual Conference and Exposition, Conference Proceedings*, 2020. doi: 10.18260/1-2--34910.

[11] M. Raja and G. G. L. Priya, "An Analysis of Virtual Reality Usage through a Descriptive Research Analysis on School Students' Experiences: A Study from India," *International Journal of Early Childhood Special Education*, vol. 13, no. 2, 2021, doi: 10.9756/INT-JECSE/V13I2.211142.

[12] Arsitektur ITI, "Architecture in Virtual Reality: A New Way of Design and Communication," *https://www.youtube.com/watch?v=N-NXar82FaU*, 2022.

[13] N. Fauza, E. Ernidawati, and D. Syaflita, "DIFFICULTY ANALYSIS OF PHYSICS STUDENTS IN LEARNING ONLINE DURING PANDEMIC COVID-19," *Jurnal Geliga Sains: Jurnal Pendidikan Fisika*, vol. 8, no. 1, p. 49, Jun. 2020, doi: 10.31258/jgs.8.1.49-54.

[14] P. D. Sundari and W. S. Dewi, "Interactive recitation methods as a solution to the students' deepening physics material during the Covid-19 pandemic," in *Journal of Physics: Conference Series*, 2021. doi: 10.1088/1742-6596/1876/1/012071.

[15] R. A. PUTRI, “DAMPAK LEARNING FROM HOME PADA MASA PANDEMI TERHADAP KEDISIPLINAN BELAJAR MAHASISWA IAIN BATUSANGKAR DI KELURAHAN PASAR BARU KOTA PADANG PANJANG,” 2021.

[16] Z. Li, Y. N. Cheng, and Y. Y. Yuan, "Research on the application of virtual reality technology in landscape design teaching," *Kuram ve Uygulamada Egitim Bilimleri*, vol. 18, no. 5, pp. 1400–1410, Oct. 2018, doi: 10.12738/estp.2018.5.037.

[17] A. Paszkiewicz, M. Salach, P. Dymora, M. Bolanowski, G. Budzik, and P. Kubiak, "Methodology of implementing virtual reality in education for industry 4.0," *Sustainability (Switzerland)*, vol. 13, no. 9, 2021, doi: 10.3390/su13095049.

[18] A. Salman and M. Ahmed, "IMPLEMENTING ACTIVE LEARNING STRATEGIES IN A STRUCTURAL ANALYSIS AND DESIGN COURSE: PEDAGOGY DEVELOPMENT AND LESSONS LEARNED," Nov. 2018, pp. 7138–7144. doi: 10.21125/iceri.2018.2715.

[19] S. L. Rogers, "Cheap, accessible, and virtual experiences as tools for immersive study: a proof of concept study," *Research in Learning Technology*, vol. 28, 2020.

BIOGRAPHIES OF AUTHORS

Intan Findanavy Ridzqo	Intan Findanavy Ridzqo (Intan) is a lecturer at the Department of Architecture Institut Teknologi Indonesia. She received a Bachelor of Engineering from Universitas Diponegoro and a Master of Architecture from Universitas Indonesia. Her research interests are building structures, construction, and joineries. She also gets a Green Professional (GP) certification from GBCI.
Aliviana Demami	Aliviana Demami (Aliviana) is a lecturer in Department of Architecture Institut Teknologi Indonesia. She obtained a Bachelor of Architecture from Institut Teknologi Indonesia and a Master of Architecture from Institut Teknologi Bandung. Her research interest are architectural design and interior.