Applying the Think-Aloud Method for Usability Analysis in the Peking Metagamelan Virtual Reality Learning Application

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Abstract. The rapid development of technology affects people's lives, including education, and virtual reality is one of many digital learning media that can be useful for learning. Virtual reality allows users to interact with the environment through a virtual world. With this concept in mind, an application to support *gamelan* learning based on virtual reality was developed called Peking Metagamelan Virtual Reality. Peking is a *gamelan* instrument made of bronze with rectangular blades. In its development, opinions from the user side on the performance and usability of this application are indispensable. Therefore, the Think-aloud method assisted in the usability analysis process in the VR Metagamelan Peking application. The Think-aloud approach helps to express what the user feels and thinks when using the application. The research process involved five respondents from various educational backgrounds and different experiences. Respondents were asked to work on several task scenarios that were ordered. During the task scenario, respondents were asked to convey their thoughts regarding the application they were trying. The results were then analyzed and produced some recommendations for further improvements to the VR Metagamelan Peking application. The recommendations included improving the application interface, adding several features, and reducing the character's speed.

Keywords: learning media, virtual reality, usability, think-aloud, Peking *gamelan* instruments.

1. Introduction

Technological developments have affected life, especially education. Many digital technologies become learning media, either visual, audio, or a combination of audio and visual [1]. These learning media, especially audiovisual, creates learning that is more interesting for students and can increase learning

motivation [2]. Besides, it allows for two-way communication and direct student interaction with their learning material [3]. Virtual reality is one of today's audio-visual-based technologies that can support interactive learning [4].

Virtual reality technology enables real-time, on-demand visualization and interactive features in various 3D virtual worlds that resemble real-world scenarios [5]. The word virtual means being present using a communication device connected to the internet network, and the word reality means truth. In simple terms, Virtual Reality (VR) allows users to carry out simulations by presenting audiovisual and three-dimensional atmospheres as if they are directly involved with their environment [6]. Virtual reality is essential o to train users in an environment close to actual conditions and their future work environment to prepare users for better preparation [2]. Learning through screen media, such as computers, is included in virtual-based learning [7]. Video conferencing and 360 videos are examples of technology used to assist virtual learning. In a video conference, users seem to be present and can interact. However, there is still a wall between the real and virtual worlds. In 360 video, the user is a passive viewer who cannot interact directly because the video is purely a linear recording. In contrast to VR, users can interact and completely block the real world as if the user feels what is in the VR [3].

The brain can function better through VR applications because it involves the user's vision, hearing, and physical behavior during direct interactions using VR [8]. VR technology helps in the training process of an agency or school so that participants can better understand and add to the participant's experience [5]. This VR technology can also provide users with repeated exercises that increase the efficiency and effectiveness of learning without increasing costs because VR can be used anywhere and anytime. Therefore, the VR environment is an essential part of the modern educational process in acquiring knowledge and skills. Moreover, VR converts experience into valuable knowledge and skills, which are crucial and valued in the industry [8], encouraging many 3D applications utilizing Virtual Reality to assist teaching and learning [5]. One example is Peking Metagamelan Virtual Reality.

Peking is one of the instruments in *gamelan* whose shape looks like a rectangular blade, which is still in the same family as the Saron and Demung instruments. However, Peking has a smaller and higher octave than Saron and Demung [9]. Meanwhile, Peking Metagamelan Virtual Reality is one of the efforts to preserve the culture of Gamelan Music Arts, especially Peking instruments. Through this VR application, *gamelan* musical instruments can be introduced to anyone without the need to own these musical instruments. Many parties will later use this application, especially people who want to study *gamelan* music more deeply. In addition, it can attract anyone's interest in learning to like to learn and get to know *gamelan* differently. With VR, Metagamelan Peking provides a new experience for users in learning and playing *gamelan* musical instruments.

According to Jakob Nielsen, software design must be user-friendly, and not only software sophistication must be considered. However, what about user comfort and ease of using the tool? [10]. Therefore, the developer requires an evaluation or user assessment of the VR Metagamelan Peking application so that in the future, users can feel comfortable and satisfied with using this application. Developers use Usability Testing to test how comfortable and easy it is for users to use VR Metagamelan.

Usability testing is a quality analysis technique to determine software's simplicity for users. The usability aspect achieves software success as a sign of acceptance by users. Users will no longer need to spend much time reading a software manual or figuring out the interface [10]. Therefore, a software test is required to avoid wasting time. Many usability testing methods, such as Heuristic Evaluation, Thinking-Aloud Protocol, and System Usability Scale (SUS), can evaluate usabilities [11]–[13]. Although so, the core elements in most usability tests are the facilitator/researcher, task, and participants. The facilitator/researcher is in charge of giving assignments to participants. While the participants are doing the task, the facilitator observes the participant's behavior and listens to feedback. The facilitator can also ask follow-up questions to get details from participants regarding the interface when working on the task [14].

All usability testing studies involve participants performing some assigned tasks in one or more designs. However, two types of data can be collected in a user testing study, called qualitative and quantitative. Qualitative testing gathers insights, findings, and stories about how people use a product or service. Qualitative usability testing consists of observational conclusions that identify design features that are easy or difficult to use. This form of usability testing is more general than quantitative and does not require many participants. Qualitative usability testing is best for finding problems in the user experience. Meanwhile, quantitative usability testing collects metrics describing the user experience. The two most common metrics collected in quantitative usability testing are task success and task time. Quantitative usability testing is best for gathering benchmarks [15].

Qualitative usability testing will be used in the Usability analysis process because it focuses on finding problems in the VR application's user experience. According to Raluca Budiu, the proper method for qualitative testing is the think-aloud protocol [15]. Based on the literature, the Think-Aloud method analyzes problems in user experience or User Experience (UX). Think-Aloud can work for usability testing in VR to directly see user behavior and observe users' experience using VR now. Also, users can convey their thoughts, opinions, and feelings when interacting directly with the product [16]–[18]. This method aims to provide direct benefits in giving views on the user experience using the Metagamelan VR application.

Think-Aloud is a system testing method that engages users or end-users by expressing what users feel or think when using the system. Verbalization or user behavior allows observers to interpret problematic parts of the interface. Everything the user says can be recorded to get important points that help the analysis process. The think-aloud process asks participants to express their thoughts, feelings, and frustrations to the facilitator when working on a task [19].

The think-aloud method has several advantages. Its main function is as a window to the soul, meaning that the think-aloud method allows the author to determine what the user thinks about the interface design being worked on [20]. In particular, the authors hear from users' misunderstandings, which usually turn into actionable redesign recommendations for users' convenience. This method is relatively cheap because it is enough to sit near the user and record whatever the user does regarding the task given. This method can also motivate the development team to pay attention to the usability of their applications because developers can hear directly from users' evaluations of their work [21].

Besides advantages, the think-aloud method also has areas for improvement; when interviews with passive users are conducted, the expected feedback is often not obtained. Some users provide comments that do not match the facts, making it difficult for the developer to create software at the user's convenience. Therefore, extensive insight is needed to encourage users to be able to express their opinions directly without being filtered [21]. Testing can be conducted in a closed room protected from all interference to minimize bias errors.

This research requires several references from previous studies, which will later be used as research support. Based on the literature references obtained, here are some studies that are used as a reference for conducting this research. Mohammad Reza Mazaheri Habibi, Reza Khajouei, et al. in a study entitled "Usability testing of bed information management system: A Think-Aloud method" [16]. This research discusses usability testing from the Bed Information Management System (BIMS) using the Think-Aloud method. This research focuses on evaluating the quality and usability of BIMS applications. The results are in the form of recommendations to improve the appearance of the system layout and provide training to users to use the system.

The second study that became a reference was the work of Sifra Bolle, MSc, Geke Romijn, MSc, et al. entitled "Older cancer patients' user experiences with web-based health information tools: A think-aloud study" [18]. The study was conducted on cancer patients' health information tool websites. The focus of this study is to determine whether users, particularly cancer patients, and doctors, can find it easy to use the website. The last research was the research of I M A O Gunawan, G Indrawan, and Sariyasa.

The study was titled "User experience evaluation of academic progress information systems using retrospective think aloud and user experience questionnaire" [17]. This study aims to identify problems and user satisfaction when using the Academic Progress Information System (SIsKA).

Many previous studies have used the think-aloud method. However, it is still rare to use this method to test VR applications. The following is an example of trying a web-based application on a health information system for cancer patient users. This test found that cancer patients needed a web that was simple and had complete information to help them monitor their health [18]. Based on this example, this study will use Think-Aloud to analyze the usability of the Metagamelan Virtual Reality application. The VR analysis will involve existing features, including the layout of the space used in the application and the suitability of the size to the original form.

Thus, the results of this usability analysis can serve as a reference for improving and developing the Peking Metagamelan Virtual Reality to achieve better user satisfaction. Also, it will help ensure that it is appropriate for the learning process.

2. Research Method

The Think-Aloud method tests the usability of a system that involves users through continuous verbalization of what users feel and think when using the system. This method allows researchers to observe the actual reactions of users during the use of tools or applications [22], [23]. In practice, this research was divided into several stages: literature study, problem identification, research design using the Think-Aloud method, usability testing using the Think-Aloud method, analysis and processing of test results data, and improvement design [17].

2.1. Literature Study

The literature study is the first stage of collecting literacy data and information from several previous journals and articles. This stage determines appropriate types of usability testing methods. In addition, this stage helps provide information to cover the weaknesses and shortcomings of previous research.

2.2. Problem Identification

Problem identification is the stage for finding problems that will be examined based on the usability method determined in the previous step. The usability testing method used was Think-aloud. Therefore, the problem will be the feasibility test and user comfort in using the Peking Metagamelan Virtual Reality.

2.3. VR Testing Design with the Think-Aloud Method

The research design first determined the characteristics of the respondents and the task scenario in a sequence of tasks for the respondents. In addition, some interviews would help to find out the respondents' responses regarding the application.

2.3.1. Respondent

This study involved five respondents. Even though the number of respondents was small, it was still sufficient to understand user behavior in several given task scenarios [24]. Respondents also comprised two lecturers/experts who understand Human-Computer Interaction (HCI) and three students. The following are the characteristics of the respondents.

Table 1. Demographic characteristics and respondents' background

	Number respondents (n = 5)
	n (%)
Gender	
Male	2 (40)
Female	3 (60)
Education background	
High school	3 (60)
Bachelor's degree or higher	2 (40)
Occupation	
College student	3 (60)
Lecturer	2 (40)
Understanding of UI/UX	
Low	0 (0)
Average	3 (60)
High	2 (40)
Understanding of *gamelan*	
Low	3 (60)
Average	1 (20)
High	1 (20)

2.3.2. Task Scenario

The task scenario arranges respondents' actions to do to the VR application interface. This task scenario is made according to actual conditions, as if the respondent seems interested in learning *gamelan* through the VR application [17]. Task scenarios are designed based on the amount of functionality in the application you want to test. The author used nine task scenarios as a usability test step for the Peking Metagamelan Virtual Reality.

Table 2. Task Scenario

No.	Task Scenario
	Trying to get into a VR app and skipping the tutorial
T1	Look for the 'test-peking' application in the Oculus App Library you are currently using. Then, observe the Splash Screen that opens the application,
T2	After the splash screen display, there are three menus. Please enter the About menu to find out explanations regarding *gamelan*.
T3	Then return to the main menu scene and enter the Learning Mode scene in the VR application. (The author does not say where the learning mode is located, let the respondents explore themselves)
T4	If you successfully enter learning mode, please try playing the Peking *gamelan* according to the existing notation (grab function) and observe the surroundings (character movement)
T5	When finished, please return to the main menu scene.

	Trying to play and follow the tutorial
T6	If successful, return to the main menu. Please open the tutorial to find out how to play this VR application.
T7	When finished in the tutorial menu, return to the main menu and enter Free mode. This mode is used for users to play *peking gamelan* freely.
T8	After successfully entering, observe the difference with the previous mode (character movement) and try playing the *peking gamelan* (grab function)
T9	Once done, please exit the app, and the test is complete.

2.4. Usability Testing with Think-Aloud Method

This stage tested Peking Metagamelan Virtual Reality. Each respondent will conduct usability testing one by one at different times and places. The place used is also free from the influence of others, so it can help respondents to give their opinions on this application. The author would first ask the respondents whether they had ever played VR. If not, the author would direct them to VR, especially for press, grab, and movement. If the respondent could or had played VR before, the respondent could immediately do the task ordered by the author.

As long as the respondent was working on the task, the author would observe his behavior and interview him regarding the task. Respondents were asked to express their thoughts or opinions on the task. If the respondent was silent or could not convey his thoughts, the author had the right to intervene by asking open questions, such as "What were you thinking when you saw the UI?" to keep the conversation flowing. During the testing process, the writer recorded all conversations in the interview. The recording results were analyzed to get a UI/UX evaluation of the application.

The interview had no time limit for the response. Before ending the interview process, the author asked the respondents to review the features and asked them to say aloud what they thought about this application as a whole.

2.5. Analysis and Process of Test Result

After obtaining data and recordings, the results were analyzed by calculating successful and failed tasks. It also examined the attitude and language of the respondents during the testing process. These results were responses from respondents to the Peking Metagamelan Virtual Reality. The analysis was a reference for recommending further improvements to the Peking Metagamelan Virtual Reality. In the study, the author divided into three main topics: views on application display design elements (application aesthetics), how to deliver content (functionality), and user experience (usability) [22].

2.6. Recommendations for Improvement

This stage provides suggestions for improvement designs based on previously analyzed test results. The draft improvement recommends further improvements to Peking Metagamelan Virtual Reality.

3. Result

The required data was collected, then processed to get recommendations regarding Peking Metagamelan Virtual Reality. Table 3 is the result of working on the respondents' task scenarios. In the table is a checkmark which means the respondent succeeded in doing the task well, and a cross, if the task was executed but did not run properly.

Table 3. Task Scenario Result

Respondents	Task Scenario								
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
R01	✓	✓	✓	✓	✓	✓	✓	✓	✓
R02	✓	✓	✓	✓	✓	✓	✓	✓	✓
R03	✓	✓	✓	✓	✓	✓	✓	✓	✓
R04	✓	✓	✓	✓	✓	✓	✓	✓	✓
R05	✓	✓	✓	✓	✓	✓	✓	✓	✓

After presenting the task scenario work results, the author will also give the results of interviews while working on the task scenario. The results of the recorded interviews, which lasted around 5-15 minutes, will be grouped into three main topics: views on the application display's design elements, how to deliver the content, and user experience [21]. Each case will be explained in detail as follows.

3.1. Views About App View Design Elements

3.1.1. Aesthetics
Aesthetics are often defined as subjective things related to beauty and visual design. In Human-Computer Interaction (HCI), user interface aesthetics or visual aesthetics are primarily referred to as the beauty or pleasant display interacting user interface of an interactive system [22]. Regarding aesthetics, respondents generally felt that the application's appearance had been well-designed. Although overall was good, respondents noted that the design could be further improved by playing with color combinations to make each feature more attractive and more prominent. There are also certain menu sections where the background color and writing collide, making it difficult to read the menu's contents. The followings are the views and results of respondents' thoughts on this VR application.

> *"Di bagian menu About antara latar belakang dengan tulisannya kurang kontras, karena gamelannya kan coklat, dan tulisannya warna hitam. Jadi, saya tidak bisa membaca tulisan tersebut. Contohnya ini, alat musik gamelan 'bla-bla-bla' itu tidak terbaca, karena latar belakangnya ada gambar gamelan sehingga tidak terlihat tulisannya dengan jelas. Mungkin bisa memilih warna yang lebih kontras."* (Responden R01)

> "On the About menu, there is less contrast between the background and the writing because the gamelan is brown, and the writing is black. So, I cannot read the text. For example, the *gamelan* musical instrument' blah-blah-blah is illegible because there is a *gamelan* image in the background, so the writing cannot be seen clearly. Maybe you can choose a more contrasting color." (Respondent R01)

> *"Di bagian About, gambar gamelannya itu malah menutupi teksnya. Jadi, kalau membaca teksnya malah jadi susah. Tulisan pengertian gamelannya juga terlalu banyak. Bisa tidak ya, jika dibuat lebih ringkas dalam bentuk gambar dan ada teks singkat, seperti poster. Bagian menu tutorial juga kurang menarik, karena hanya tulisan saja, mungkin bisa ada gambar untuk membantu penjelasannya."* (Responden R04)

> "In the About section, the *gamelan* image even covers the text. So, it is even more difficult to read the text. There are too many writings on the *gamelan*. Can you make the pictures and short text more concise, like posters? The tutorial menu section is also not interesting because it is not written. There should be pictures to help explain it." (Respondent R04)

> *"Tulisannya bisa diperjelas dan bisa memainkan warnanya agar terlihat kontras. Di dalam menu About kan banyak informasi gamelan yang diberikan. Jika memang itu penting semua, mungkin bisa menggunakan mode scroll agar tulisannya bisa diperbesar dan tidak semua langsung di satu papan. Untuk mata minus perlu effort dalam membacanya, jika terlalu kecil tulisannya."* (Responden R05)

"The fonts should be enlarged, and you can play with the colors to make it look contrasting. In the About menu, a lot of *gamelan* information is provided. If that is all that matters, maybe you can use scroll mode so that the fonts can be enlarged and not all directly on one board. For minus eye condition, the struggle is real due to small fonts." (Respondent R05*)*
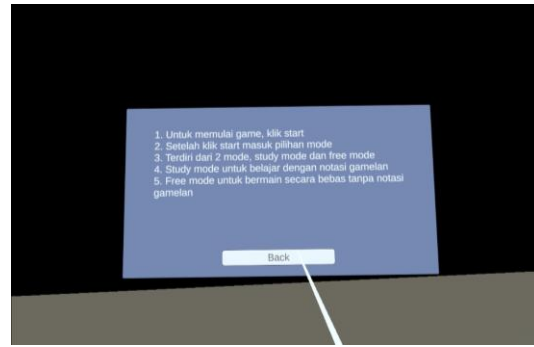

Figure 1. Screenshot on About Menu

Figure 2. Screenshot on Tutorial Menu

Apart from discussing the colors in the menu section, there is also a discussion about the appearance of the *gamelan*. The environment in the *peking gamelan* section looks hollow and unattractive.

"Untuk tampilan gamelan Peking sudah lumayan menyerupai wujud aslinya. Memang sih Peking itu ramping dan kecil, tetapi tidak seramping dan kecil ini, khususnya untuk jarak bilahnya masih terlalu berdekatan. Pada tampilan notasi sudah pas ukuran jaraknya antara notasi gamelan dengan pandangan. Namun dari segi environmentnya masih kurang unsur Jawanya dan terlalu sepi. Mungkin bisa bermain tekstur untuk tampilan pendoponya dan tiang pendoponya tampak kecil. Lantainya juga bisa menggunakan Tegel Kunci, seperti di Kraton Jogja. Luas pendoponya juga terlalu sempit ya, mungkin empat tiang yang ada di dekat Peking bisa dimundurkan ke dekat pojok agar terkesan lebih luas." (Responden R03)

"For the appearance of the *Peking gamelan* is quite similar to its original form. Indeed, the *Peking* is slim and small, but not this slim and small, especially since the blades are still too close together. In the notation display, the size of the distance between the *gamelan* notation and the sight is right. However, regarding the environment, it still lacks Javanese elements and is too quiet. Maybe it can be textured for the pavilion's appearance, and the pillars of the pavilion look small. The floor can also use key tiles, like in the Kraton Jogja. The pavilion area is also too narrow. The four pillars near *Peking* could be pushed back near the corners to give a wider impression." (Respondent R03)

"Suasana ruangnya mungkin bisa dibuat lebih mirip pendopo ya untuk warnanya. Orang melihat pendopo itu warnanya kalau tidak merah ya keemasan, seperti di Festival Gamelan. Yang saya lihat tadi di aplikasi VR, pendoponya berwarna abu dan coklat, mungkin bisa diperbaiki komposisi warnanya. Menurut saya, orang di pendoponya tidak berfungsi dan kita tidak bisa interaksi dengan orang tersebut. Mungkin sebaiknya dihapus saja.." (Responden R02)

"Maybe the room's atmosphere could be made more like a pavilion, yes, for the color. People see that the color of the *pendopo* is either red or golden, like at the *Gamelan* Festival. In the VR application, I saw that the pavilion is gray and brown. Maybe the color composition can be improved. I think the people in the pavilion are not functioning, and we cannot interact with these people. Maybe it should just be removed." (Respondent R02)

"Orang di pendoponya mungkin bisa diganti pakaiannya menjadi pakaian adat Jawa dan diletakkan di dekat pintu gerbang, seperti penjaga gerbang. Cahaya di tiang pendoponya memang dibuat seperti ini ya,

yang di Free mode? Bercahaya tetapi tidak ada lampunya. Masih kurang warna, jadi tampak sepi, mungkin bisa tambah tanaman untuk penambah warna". (Responden R04)

"Perhaps people in the *pendopo* can be changed into traditional Javanese clothes and placed near the gate, like a gatekeeper. The light on the *pendopo* pole is made like this. Isn't it in Free mode? Glowing but no light. There is still a lack of color, so it looks deserted. Maybe you can add plants to add color." (Respondent R04)

Figure 3. Screenshot on Study Mode
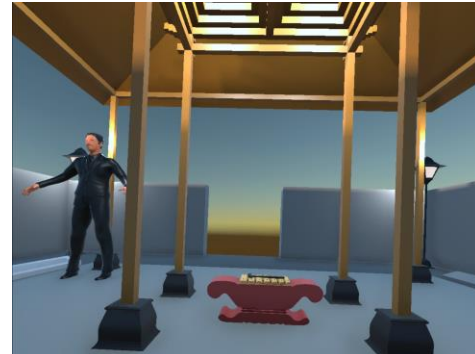
Figure 4. Screenshot on Free Mode

3.1.2. Navigation

Navigation in UI design is the process of guiding users through an interface by providing a path from one point to another [22]. Most respondents felt that operating the application was easy in testing it. The writing on the menu button was clear enough but not attractive to the eye. The followings are the views and results of respondents' thoughts on this VR application.

"Seharusnya sehabis belajar langsung praktek, tetapi tadi terkesan dari Study mode ke Free mode adalah dua mode yang berbeda, seperti tidak nyambung. Biasanya kalau kita bermain game diberikan pengarahan terlebih dahulu, baru bermain gamenya. Jadi, game itu lebih berkesinambungan. Bukan seperti tadi, selesai Study mode harus back to Main Menu. Kemudian masuk ke Free mode sehingga membutuhkan proses yang lama." (Responden R04)

"After learning, we should move to practice, but I feel Study mode and Free mode are two different modes as if they were not connected. When we play games, we are supposed to get the instructions first; then, we play the game. So, the game feels more continuous. Unlike this game, when Study mode was over, we must return to the Main Menu, then we could go to Free mode, which required a long process." (Respondent R04)

"Penempatan buttonnya tidak ada masalah, hanya saja kurang berwarna sehingga tidak terlalu mencolok. Sebaiknya warna buttonnya dibedakan sesuai fungsi button tersebut, hal itu dapat mempermudah pengguna ketika mencari button menu tertentu, karena ada pembeda." (Responden R01)

"There is no problem with the placement of the buttons, it is just that they are less colorful, so they do not stand out too much. It is better if the color of the button is distinguished according to the function of the button. It is easier for users when looking for a certain menu button because there is a difference." (Respondent R01)

"Bisa ditambahkan icon di button menunya agar mempermudah pengguna. Khususnya bagi pengguna yang kesulitan untuk membaca tulisan, dapat terbantu dengan penambahan icon tersebut. Bisa juga untuk memainkan warna pada buttonnya." (Responden R02)

"An icon can be added to the menu button to make it easier for users, especially those who have difficulty reading text. The addition of this icon can help. You can also play the color on the button." (Respondent R02)
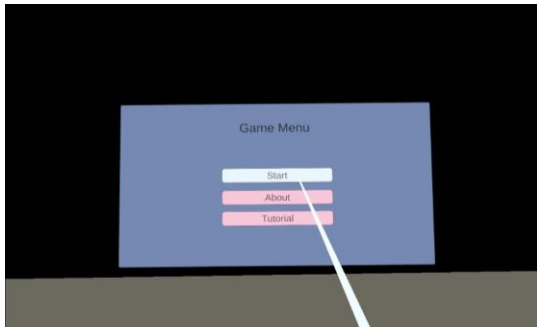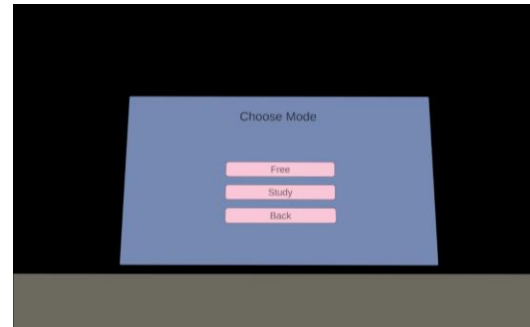

Figure 5. Screenshot on Main Menu

Figure 6. Screenshot on Choose Mode

3.2. How to Submit Application Content

3.2.1. Functionality

Functionality indicates whether a design helps users achieve their goals and needs [22]. Respondents said this VR application was interactive and offered many features. Overall, the features offered could also work well. The followings are the views and results of respondents' thoughts on this VR application.

> *"Fiturnya cukup menarik, suara gamelannya sudah mirip dengan suara peking asli hanya kurang bergema saja dan suaranya juga tidak delay. Ada fitur notasinya juga sudah tertampil dengan baik. Fungsi untuk memegang pemukul juga tidak ada masalah dan cukup pas di tangan." (Responden R03)*

> "The feature is quite interesting. The sound is similar to the original *peking* sound; it is less resonant and does not delay either. There is a notation feature that is also well displayed. Holding the bat is also no problem; it fits quite well in hand." (Respondent R03)

> *"Fitur untuk memainkan gamelan pekingnya sudah berfungsi dengan baik. Namun, jika meletakkan pemukulnya di bagian kayu badan Peking, pemukul tersebut tembus ke dalam. Hal tersebut menyulitkan pengguna, khususnya untuk mengambil kembali pemukul tersebut. Lalu bisa juga menambahkan fitur jika memukul dengan kencang volume suaranya dapat berbeda dengan yang memukul lebih pelan. Jadi terkesan lebih nyata." (Responden R05)*

> "The feature for playing the Peking *gamelan* is functioning properly. However, the bat penetrates inside if you put the bat on the wooden part of the Peking body. It makes it difficult for the user to retrieve the bat. Then you can also add a feature that if you hit hard, the volume of the sound can be different from those who hit more slowly. So, it seems more real." (Respondent R05)

> *"Secara keseluruhan, semua fiturnya sudah berjalan dengan baik. Hanya saja untuk sensitivitas ketika memukul bilahnya bisa dikurangi, karena jika tersentuh pemukul sedikit saja sudah langsung berbunyi. gamelan Peking yang asli sepertinya tidak demikian." (Responden R01)*

> "Overall, all the features are running well. It is just that the sensitivity when hitting the blade can be reduced because if you touch the beat just a little, it immediately sounds. The original Peking *gamelan* does not seem like that." (Respondent R01)

3.2.2. Availability of Teaching Materials

A good learning application provides complete learning material and helps explain the learning material under discussion. Respondents in this study said it was important for the Peking Metagamelan Virtual

Reality to provide material related to *gamelan* in more detail. If it is later used for learning methods, complete material is needed to understand it. The followings are the views and results of respondents' thoughts on this VR application.

> *"Untuk Peking sendiri cara bermainnya kan dipukul dua kali setiap bilahnya, kemudian di pathet untuk memberhentikan suaranya. Di aplikasi ini belum diajarkan bagaimana cara bermain Peking yang benar. Biasanya juga, jika untuk pembelajaran pada bilah Peking ditulis laras atau nadanya menggunakan spidol sehingga mempermudah dalam membaca notasi teks lagunya." (Responden R03)*

> "For Peking itself, the way to play it is to hit it twice for each blade, then to the *pathet* to stop the sound. This application has not taught me how to play Peking correctly. Usually, also, if for learning on the Peking bar, the barrel or the tone is written using a marker to make it easier to read the notation of the text of the song. (Respondent R03)

> *"Ditambahkan petunjuk mungkin, jika notasinya menunjukkan angka 3, bilah mana yang harus di pukul, dsb. Untuk tampilan notasi lagunya mungkin bisa lebih dirapikan aja, sebaiknya jangan menggunakan tulisan tangan. Jika memungkinkan bisa dibuat seperti papan tulis atau diketik ulang saja, jadi notasinya tidak mengambang seperti itu." (Responden R05)*

> "Added a hint, maybe, if the notation shows the number 3, which bar to hit. To display the song notation, maybe it could be tidied up more. It is best not to use handwriting. It can be made like a blackboard or typed back, so the notes do not float like that." (Respondent R05)

> *"Inikan aplikasi pembelajaran, alangkah baiknya untuk ditampilkan nama alatnya dan penjelasan sekilas mengenai alat tersebut, seperti cara memainkannya, dll. Penjelasan tersebut bisa ditaruh di di dalam Menu About atau Tutorial." (Responden R02)*

> "This is a learning application. It would be nice to display the tool's name and a brief explanation, such as how to play it. This explanation can be placed in the About or Tutorial menu." (Respondent R02)

3.3. User Experience with the Application

3.3.1. Application Usability

Application usability measures whether a given user can use a product or design in each context to effectively, efficiently, and satisfactorily achieve a defined goal. Generally, respondents felt this application helped assist learning. This application can also be another alternative to learning gamelan, so it is exciting and interesting. Overall, this application also provides a brief understanding of the gamelan itself. The followings are the views and results of respondents' thoughts on this VR application.

> *"Suatu hal baru yang pernah saya coba sebelumnya. Sebelumnya saya belum pernah main gamelan. Bisa tidak ya, jika dibuat ada tutornya? Mungkin seperti bilahnya berwarna jika menunjukkan suatu not atau ada lagunya biar bisa mengikuti ketukannya." (Responden R04)*

> "A new thing that I have never tried before. Previously I had never played *gamelan*. Is it possible to have a tutor? Maybe it is like the bar's color if it shows a note or there is a song so you can follow the beat. (Respondent R04)

> *"Secara keseluruhan aplikasi ini sudah berjalan dengan baik. Aplikasi ini bisa jadi cara baru untuk belajar gamelan. Mungkin kedepannya bisa diberikan efek getar jika sedang memukul bilahnya, sehingga pengguna bisa merasakan bahwa pemukul sudah menyentuh bilah atau menyentuh objek lain". (Responden R01)*

> "Overall, this application has been running well. This application can be a new way to learn *gamelan*. Maybe in the future, a vibrating effect can be given when hitting the blade so the user can feel that the paddle has touched or touched another object." (Respondent R01)

3.3.2. User Convenience

UI/UX plays an essential role in improving user convenience. A good UI/UX design makes an excellent first impression and keeps users interested in using the application. Most of the respondents felt comfortable using this application because, for them, Peking Metagamelan Virtual Reality was the new experience they had ever tried. However, some felt a little dizzy after using this VR, especially those who wore glasses. The followings are the views and results of respondents' thoughts on this VR application.

"Sebelumnya saya belum pernah bermain VR sehingga saya merasa pusing setelah bermain. Dalam menggunakan VR, saya juga tidak melepas kacamata karena minus saya cukup besar sehingga jadi berembun dan terlihat blur. Hal tersebut membuat saya merasa tidak nyaman. Namun dari segi pencahayaan menurut saya sudah cukup pas, tidak silau dimata dan tidak membuat mata sakit." (Responden R04)

"I had never played VR before, so I felt dizzy after playing. When using VR, I also did not take off my glasses because my minus is big enough to get dewy and look blurry. It made me feel uncomfortable. However, I think lighting is quite suitable, not dazzling in the eyes, and does not hurt the eyes." (Respondent R04)

4. Discussion

This research provides insight into the user experience of the Peking Metagamelan Virtual Reality. Based on the study's results, the five respondents completed the nine tasks smoothly and as expected. Respondents can also provide feedback to the application directly according to what they think regarding design elements, the way the application content is delivered, and the user experience.

4.1. Views about App View Design Elements

Overall, the five respondents stated that the Peking Metagamelan Virtual Reality display was good and comfortable. Good application design can make users understand what goals the application wants to convey. Users can also easily memorize the layout and contents of the application interface. A good application design, according to users, may need improvement according to artists or designers [25].

Based on the results, the respondents argued that the interface design of this application should have paid more attention to choosing the background color with the color of the text, especially on the About menu. The layout placement between the pictures and the writing must also look neater and more comfortable. In addition, using and selecting contrasting colors help users distinguish certain functions in the VR application, such as using different colors on each menu button. Contrasting color differences can make it easier for users to obtain information because these differences can convey to users that these elements have different functions from other elements [26]; for example, blue for the About menu button, green for the Tutorial button, and yellow for the Start button.

Some respondents thought the flow from Study Mode to Free Mode should be changed to make the flow more visible. After users learn Peking *gamelan*, they can immediately practice without returning to the main menu. Even though the user already understands the purpose of the menu. Therefore, replacing the back button in Study Mode with the Free mode button is recommended so that after the user has finished studying, he can immediately practice in the Free mode scene. Several respondents also said that the environment was hollow and lacked Javanese elements. This application will be used as *gamelan* learning media. Therefore, the design of the environment and its main object (*Peking gamelan*) must support each other to create interesting and informative learning. Suppose the environment's appearance is not attractive and does not display the atmosphere in the original environment. In that case, the user will quickly get bored with learning, and this application is considered less informative. The environment should also not be more prominent than the object of the *gamelan* because it can change the focus of learning toward the environment around the *gamelan*.

Thus, the author can recommend colors that should be contrasted, a neater visual layout, a simplified application flow, and an environmental design that must support learning material.

4.2. How to Submit Application Content

According to the book by Alan Dix et al., one of the usability principles is Effectiveness (Robustness) or the level of application support, including features to users that support goals and an assessment of system behavior based on the goals [25].

Several respondents said that the Peking Metagamelan Virtual Reality features were running as expected. For example, like the feature, users felt that *gamelan* objects were almost like their original size, but the blades were still too close to each other. Respondents also thought that the functionality for Grab the beater also felt comfortable when holding the beater and playing the *gamelan*. However, there were several criticisms and suggestions for improvement from the respondents, such that the bat could still penetrate the *Peking* body when the respondent placed the paddle on the wooden part of the *Peking* body. Therefore, the developer can pay more attention to this by adding a collider [27] to the *Peking* body to detect collisions between the beater and the *Peking* body.

Some respondents said that the sensitivity of the blades should be reduced to make it look like a real *gamelan*. Therefore, reducing the blade collider's size can be suggested, or the distance between the blades can be widened, so they are not too close. Regarding the delivery of the teaching material, several evaluations still need to be completed regarding how to play *Peking*, how to read *gamelan* notation, and a brief explanation of the *Peking gamelan* instruments. In addition, some respondents suggested that the note can be typed and made like a blackboard so that the text of the notation does not seem to float.

Thus, the author can recommend regarding the content to add a collider to the *Peking* body, the distance between the blades can be widened, the teaching materials provided can be completed, especially how to play *Peking*, and the text of the song notation can be made neater and made as realistic as possible.

4.3. User Experience with the Application

Based on the results, most respondents stated they were comfortable and had no complaints. However, some argued that people with nearsightedness or minus eyes felt dizzier and looked a little blurry when using VR for too long. Feelings of dizziness, nausea, vomiting, and even cold sweat after playing VR for a long time are normal for the first timers. This condition is often called cybersickness [28]. Cybersickness occurs when the user sees movement on the display screen but does not feel the movement.

Several studies stated that the effects of cybersickness are more pronounced for users who are less experienced in the virtual world or are using Virtual Reality for the first time. Gender also affects the level of cybersickness in a person. Women can experience cybersickness more easily than men [29], [30]. According to Thomas Stoffregen, a professor from the University of Minnesota, the more realistic the appearance of objects in VR, the easier it will be for users to get cybersickness [31].

Thus, to overcome cybersickness in VR, the author can recommend reducing the movement speed of the characters in VR. In addition, a distinction is made between the real and virtual worlds. If it looks the same as the real world, the user will quickly get dizzy because, in the virtual world, the user's movements are limited and move only through the controller. In the real world, users can move freely because they still need to get used to VR, especially for movement.

5. Conclusion

Based on this research, the Think-aloud method analyzed the Peking Metagamelan Virtual Reality's usability to let the author know the user's assessment. In this research, nine task scenarios must be done by five respondents. The task execution results stated that all tasks could be done properly and smoothly.

The five respondents could also provide direct feedback on what they thought of the Peking Metagamelan Virtual Reality.

All respondents agreed that the Metagamelan VR application worked fine without errors or delays and achieved the desired goals for all features. However, a few things need to be fixed to create a user-friendly application. The author advises the developer to improve the appearance of your application interface to make it look cleaner and convey the information it provides. You can add a vibration effect when the bat and Peking blade collide. In addition, it offers different volume levels based on the strength of the hit, provides a more detailed teaching method, slows down the character's movement, and distinguishes between the natural and virtual worlds to reduce dizziness. Thus, all recommendations from this research can help evaluate Metagamelan Peking in the future.

Acknowledgment

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