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User Interface Evaluation in Metaverse Gamelan Virtual Reality Using Heuristics Evaluation Method

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Abstract: The advancement of information technology in the modern era today's has increased the availability of Augmented Reality or Virtual Reality enabled devices, which can serve as a gateway to exploring various applications. For example, there is the virtual reality application of Gamelan Slenthem, which is currently being developed with the aim of making Indonesian cultural musical instruments. Even though what is developed is not an application or an ordinary website, the user interface is still one of the most important stages in the development of an augmented reality or virtual reality application. Every information technology has an interface that can be a link between the user and the technology itself. The interface is influenced by needs, and information technology has a design that makes it easy for users to operate it and can make users feel comfortable using the application or technology. In this study, we will use heuristic evaluation to evaluate the application of the virtual reality gamelan metaverse game. Heuristic evaluation itself is a method of evaluating user interfaces and usability that can be used to determine the extent to which a system is used by users to achieve certain goals effectively, efficiently, and satisfactorily. This research focuses on evaluating the use of heuristics in user interface design based on usability aspects through observation and interviews with users.

Keywords: User Interface • Heuristic Evaluation • Evaluasi Interface • Virtual Reality • Metaverse

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1. Introduction

New applications and technologies have emerged as a result of ongoing development, the advancement of the times, and the rise in virtual reality devices. New technologies and applications with greater functionality and a more contemporary look will constantly appear. As time goes on, an increasing number of people connect and generate ideas virtually in cyberspace. Rapid technological development has made it possible for people to interact with a virtual environment, often known as virtual reality, as realistically as possible [1].

A cutting-edge technology called virtual reality (VR) integrates human-machine interactions to create lifelike experiences. Virtual reality allows for unrestricted movement over the internet. In the virtual world, anyone can view an object from a variety of angles and reshape it as desired. To enter virtual worlds and travel over their data highways, virtual reality application developers require specialized abilities from a reality system. Multiple domains are supported by Real Virtual [2].

Over the past five decade, research and development in virtual reality and VR have grown to be very interesting fields. A rise in display technology has coincided with the growth and development of technology, particularly the downsizing of computer systems. In general, the user interface for virtual reality is an extension of the graphical user interfaces that users use to interact with current computer systems. In this context, virtual reality, or VR, can also be thought of as an immersive setting. Exploring various user interface model types that are appropriate for user interaction as naturally and realistically as feasible is necessary for virtual reality itself [3].

An interactive simulation of a three-dimensional environment that people may enter and engage with is referred to as virtual reality (VR). "The utility of VR has been the subject of numerous studies, but few have examined the user acceptability of VR using the Technology Acceptance Model. "Acceptance of technologies is still in the context of virtual reality. However, studies have demonstrated the applicability of these connection patterns to web encyclopedias [4].

The availability of AR and VR-enabled devices has expanded thanks to modern technological advancements, opening up new consumer-oriented options and applications outside of gaming and entertainment. Developers frequently run into a number of challenges and roadblocks while designing and building their own virtual reality applications. When creating virtual reality apps, creating and designing environments for VR itself is one of the challenges and roadblocks that are frequently encountered [5]. Up until now, the industry has begun to take VR more seriously, both in the fields of design, engineering, and construction as well as in many others. Applications

for virtual reality (VR) offer the ability to feed sensors with 3D surroundings so users can be completely submerged in them. The availability of AR and VR-enabled devices has expanded thanks to modern technological advancements, opening up new consumer-oriented options and applications outside of gaming and entertainment. Developers frequently run into a number of challenges and roadblocks while designing and building their own virtual reality applications. When creating virtual reality apps, creating and designing environments for VR itself is one of the challenges and roadblocks that are frequently encountered [6].

A good design is necessary to make it easier to provide information by enabling it to be done in a precise and understandable way. In addition, individuals will be drawn to the things offered because of its design. An interface, often known as an interface, serves as a link between the user's world and the world of a system or product. The user interface is "that element of the computer and software that can be seen, heard, talked to, and which can be directly comprehended by humans," according to Wilbert O. Galitz [7]. The approach and mechanism of the display interface that interacts with the user can be referred to as the "user interface" in an indirect manner. According to this assertion, the user interface is a component of a computer, program, or piece of software that controls how an interface is displayed for users and makes it easier for users to interact with displays in a pleasant way [8].

Jakob Nielsen says that "software design must be user-friendly," and that "how comfortable the user is and how easy it is for the user to use the tool" are just as important as the software's level of sophistication. "Every action and response from people, systems, and products can all be fully translated by the interface itself. Visitors and users will want to stay and use the developed application if the interface is well-crafted. Conversely, an interface design would be deemed poor and a failure if it causes users to abandon an application rapidly simply because it is made ugly [9].

One of the crucial steps in creating metaverse games is interface design, also known as user interface design, particularly in the virtual environment (VE) sector. User experience, commonly referred to as "user interaction," is impacted by this [10]. The user interface can facilitate users' exploration of a website or game. In addition to serving as a decorative feature or source of sweetness or visual appeal. The user interface has so far grown to be one of the most crucial components and needs to be thoroughly examined during the software development phase [11].

The success or failure of a system is considered to be dependent on the user interface, which is why it is thought to be so crucial in systems. Users will be perplexed when utilizing the system we create if the user interface is overly complex. Factor analysis for ease of use is simple to learn, simple to set up, simple to grasp, and flexible to learn and apply using Fred Davis' (1989) research methodology. In the meantime, according to Segars and Grover (1993), there

are three elements that determine ease of use: easy to learn, easy to become proficient, and easy to use. This component influences ease of use when utilizing the confirmatory factor analysis approach [12].

When creating a website or application for the virtual world, user experience (UX) and user interface (UI) are two crucial factors that must be taken into account. Because UI/UX can influence how successfully a software application or website is produced, it is said to be crucial. This is influenced by a successful website or software application's appealing UI and UX design. Many well-known organizations have to suffer significant losses simply because customers refuse to use a system's services due to a subpar user interface [13].

Up until now, methods requiring user interface knowledge have been used to criticize the majority of user interfaces, or what is known as the user interface. The attributes of the interface will be examined by UI specialists when they evaluate it using the heuristic evaluation method to determine whether it will have usability issues. This heuristic evaluation method uses usability testing, where the interface is examined in real-world or controlled settings between reviewers to gather information about the issues that users encounter. By employing this heuristic evaluation method, it is also possible to see how effectively a practical interface enhances the user experience when using the developed virtual reality application [14].

The phrase "a generic name for a group of procedures based on the fact that the evaluator checks or validates the usability features connected to the user interface" refers to the heuristic evaluation test method. The ideas of virtual reality design and Nielsen's (1994) heuristic evaluation method were both applied in this study [15]. The foundation for creating a direct mapping, VR-specific heuristic approach is Nielsen's (1993) heuristic evaluation method. The system and the real world can be used as examples of this mapping [15].

Research frequently uses the heuristic evaluation method Utilizing a set of criteria, this approach gauges usability (best practices). These techniques are essentially suggestions rather than in-depth usability standards. Jakob Nielsen is a significant innovator as well as the best-known and most significant author on this topic. Ten usability heuristics for user interface design were proposed by Jakob Nielsen. In a study based on an extensive and universal taxonomy, an alternative technique to the Nielsen heuristic evaluation method was adopted [16].

Heuristic evaluation has been utilized extensively in the past to test the results of research. It is still uncommon to test virtual reality applications using this heuristic evaluation method, however. Heuristics evaluation, according to Nielsen, is a technique for usability engineering that identifies usability issues with the user interface so that they can be addressed throughout the redesign process [17]. This technique can aid in obtaining evaluation outcomes and identifying usability errors in the Gamelan virtual reality metaverse application. The heuristic evaluation

approach is used to assess usability flaws and faults using Nielsen's heuristic concepts. These features provide for a clear description of the Gamelan virtual reality metaverse application's use without the requirement for memorability or error on the part of the user, who only makes judgments based on presentation and information [18].

Based on the description provided above, the authors are interested in using the heuristic evaluation method as an analysis for evaluating the user interface in the Gamelan virtual reality metaverse application based on the description provided above. It is envisaged that the findings of the study "User Interface Evaluation on Metaverse Gamelan Virtual Reality Games Using the Heuristic Evaluation Method" will serve as a guide for designing better Gamelan virtual reality metaverse games so that players will feel at ease playing them.

2. Methodology

The theory of "Heuristics Evaluation" by Jakob Nielsen and Ralf Molich was employed as the methodology in this investigation. In the Gamelan virtual reality metaverse application, user interface design evaluations are conducted using the heuristics evaluation technique as a guide. A test expert must review and comment on the user interface using a set of heuristics or recommendations as part of the heuristic evaluation process. [19].

2.1. Research Sample

Purposive sampling was used to choose the sample for this study. The purposive sampling method is a non-probability sampling technique in which components of the target population are chosen based on their suitability for the study's goals and a set of inclusion (open approach) and exclusion criteria [20]. To enable people to fully participate in decision-making, inclusion is the process of establishing social connections and recognizing the diversity of people and communities. Exclusion, on the other hand, is a process that prevents people or groups from having access to, control over, and involvement in the resources they need [21].

2.2. Research Stage

The research flow is a sequence of research steps carried out, starting with problem identification, literature study, the development and preparation of instruments, data collection, data analysis, and the preparation of recommendations. The research stage flowchart can be seen in Figure 1.

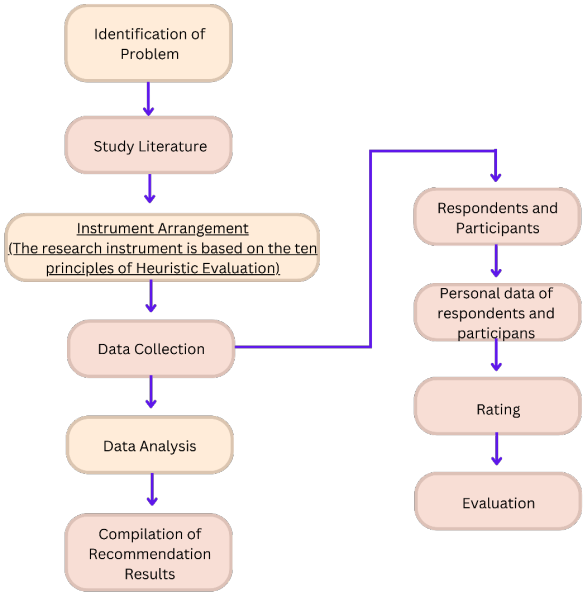

Figure 1. **Research Stage Flowchart**

2.3. Identification of Problem

The process of problem identification entails determining the research topic and the reasons why the chosen topic needs to be researched. The problem identification stage is conducted to gather data for the discussion of earlier heuristic evaluation research.

2.4. Study Literature

A study of literature is a data collection approach that entails reading and analyzing numerous research-related books, articles, notes, and reports [6]. Here, the author cites a number of sources to back up the investigation.

2.5. Instrument Arrangement

The development of this research tool was guided by Jacob Nielsen's 10 heuristic evaluation principles. A questionnaire-styled set of questions serves as the study instrument. Jacob Nielsen's ten guiding principles for heuristic evaluation are as follows: Visibility of System Status, Match Between System and The Real World, User Control and Freedom, Consistency and Standards, Error Prevention, Recognition rather than retail, Flexibility and efficiency of use, Aesthetic and minimalist design, Helping users recognize, diagnose, and recovers from errors, and also helping with documentation.

2.6. Data Collection

To collect the data required for this study, a data collection approach was used. Observation, interviews, and doing specific activities were employed as qualitative data gathering techniques in this study. The information for this study was gathered from a number of subject-matter specialists. user interface, Human Computer Interaction, and Designer Interior/Building.

2.6.1. Respondents and Participants

A number of testing phases are carried out throughout the use of virtual reality to obtain an evaluation and the best recommendations for enhancing the appearance of a good, accurate, and appealing user interface. Five respondents were used in this study by the authors, who interviewed them and had them do the activity in accordance with the instructions they intended to test specifically. Even though there weren't many participants or responses in this study, it was claimed that this was enough to comprehend user behavior in a selection of task scenarios [22]. This is because the respondents who agreed to participate in the study were professionals who fit the description of user interface and display experts. In order for the study's participants to have a better understanding of user characteristics and acceptable user interface design [23].

2.6.2. Personal data of respondents and participants

Several experts who are knowledgeable and have years of experience in their respective industries are consulted during this study procedure. Five respondents are utilized as samples in this analysis, which is sufficient for the tests to run, as previously indicated, if experts are employed as respondents or participants in this study [24]. Following are some personal data from a sample of respondents as well as participants who are experts in their respective fields, which can be seen in Table 1.

Table 1. Personal data of respondents and participants

Code	Name	Work	Gender	Highest Education	Specialists	Understand BasicConcepts of User Interface	Experience & Publications
RSP1	Yonathan Dri Handarkho, S.T., M.Eng., Ph.D.	Lecturer at FTI UAJY	Male	S3 Doctorate Degree at Assumption University Thailand	• Information Technologi • UI-UX Specialist	Very Undertanding	• UI/UX Analyst • Developer of Student Relationship Management (SRM) system at Universities in Indonesia • Second Author Jurnal of Scopus Indexed International Journals (Q1) • Author of Internasional Scopus Journals (Q2)
RSP2	Ambar Setyawan	Arutala Teams	Male	D3	• Product Quality • Business Management • Virtual Interface & Virtual Experiences Analyst	Very Undertanding	• Presiden Director of PT Arutala Digital Inovasi Metaverse Evangelist
RSP3	Kurnia Febriansyah	Arutala Teams	Male	Vocational High School	• 3D Artist Generalist	Undertanding	• Junior 3D Generalist Artist in Arutala at asset creatin and animatin section • Virtual Reality Game Maker
RSP4	Mutiara Cininta, S.T., M.Arch.	Lecturer at FT UAJY	Female	S2 Master at University of Sydney	• Digital Illustration • Virtual Environment Designer • Several Creative Arts	Undertanding	• Bilateral professional placement program at ACICIS
RSP5	Herlina, S.Kom, M.Eng.	Lecturer at FTI UAJY	Female	S2 Master Degree at UGM	• Data Analytics • Human Interaction • Gaze-based Interaction	Very Undertanding	• Author of the journal Object Selectin Algorithms in Eye Point-Based Interface Interactions • Author of the Internasional Journal Conference on Information and Communications Technology (ICOIACT)

2.6.3. Rating

In this research process, respondents were assigned to give a rating or ranking of problems based on the severity of the problems found [25]. The evaluator's task at this stage is to determine the severity of the problem based on Table 2.

Table 2. Nielsen's Severity Ratings

Rating	Definisi
0	**Don't Agree** : I don't agree that this is a usability problem at all (There are no problems with usability)
1	**Cosmetic** : Need not to be fixed unless extra time is available on project (There is time, an aesthetic issue that only has yo be fixed briefly exists)
2	**Minor** : Fixing this should be given low priority (A low priority for a minor usability problem)
3	**Mayor** : Important to fixing, so should be given high priority (Major..usability problems must be fixed right away)
4	**Catastrophic** : Imperatice to fix this before product can be released (Before releasing a product, the usability crisis must be fixed)

2.6.4. Data Analysis or Ratings Analysis

Respondents are questioned at this point in the evaluation process in accordance with heuristic principles in order to find and define specific problems, which are then reviewed by offering recommendations and suggestions for improvement. The 10 principles of heuristic evaluation created by Nielsen serve as the rules for heuristic evaluation. Decisions in this study will be based on problems that respondents or evaluators will identify and record in the evaluation formula.

2.7. Data Analysis

The heuristic evaluation approach and ten heuristic evaluation variables were employed for the data analysis in this study. The analysis was conducted based on the responses from the interview findings as well as the priority level of the problems discovered, which would affect the importance of the improvements that need to be made. Improvement suggestions will be based on the outcomes of the severity ratings. The information gathered during this review process is qualitativeiables were employed for the data analysis in this. The analysis was conducted based on the responses from the interview findings as well as the priority level of the problems discovered, which would affect the importance of the improvements that need to be made. Improvement suggestions will be based on the outcomes of the severity ratings. The information gathered during this review process is qualitative. This qualitative data is presented as a heuristic evaluation and is derived from a list of interface-based issues that the evaluator believes violate certain heuristic principles. The assessment findings are then The evaluation findings are then condensed into a table that offers a thorough explanation of the issue and

suggestions.

3. Results And Discussion

No representation of the population is necessary for heuristic evaluation. The combined knowledge of the three usability experts, according to Nielsen, is adequate to recognize the great majority of usability problems with user interfaces. However, finding seasoned experts in this industry is challenging. Usability experts in this study are those who have a postgraduate degree or at least 1.5 years of experience in a related sector. Three participants who work as lecturers and two participants with over 1.5 years of experience in related professions conducted the evaluation.

3.1. Anaysis Results

3.1.1. Visibility of System Status

The Gamelan virtual reality metaverse application's game system must be able to clearly tell the user what is happening in this area. To test the system status's visibility in this instance, questions were posed to respondents or participants. The severity grade is 0 or "don't agree" if there are no issues and it is easy to use. One query concerns the situation where the homepage feature is present but the display is empty. The severity level for issues like that is 1, or "cosmetic problem."

3.1.2. Match Between System and The Real World

The game system for the Gamelan virtual reality metaverse application must employ language that is familiar to users in this part. In this instance, namely the match between the system and the real world, the Gamelan virtual reality metaverse program can be considered to be good. Users have reported that there are no issues with the product, claiming that the language and other icons are simple enough for them to grasp with a 0 severity grade or 1 disapproval.

3.1.3. User Control and Freedom

Respondents or participants are free to select or carry out tasks in this section as they see fit when using the Gamelan virtual reality Metaverse application game. The Gamelan virtual reality metaverse program can be considered to be good with queries in this situation, namely user control and freedom, noting that there are no issues because users can access tutorials and information about the Gamelan virtual reality metaverse application readily. Therefore, this item has no issues and is convenient to use, earning a severity rating of 0 or Don't Agree.

3.1.4. Consistency and Standards

In order to prevent users from becoming perplexed by the situation that arises, the standards employed in the Gamelan virtual reality metaverse application game system must be consistent in terms of playing Gamelan virtual reality games. In this instance, it can be said that the consistency and standards of the game application's metaverse Gamelan virtual reality are good, with inquiries noting that there are no issues. Therefore, this item has no issues and is convenient to use, earning a severity rating of 0 or Don't Agree.

3.1.5. Error Prevention

This section describes how the Metaverse Gamelan virtual reality application's gaming system is built to reduce and prevent user errors. A score of 0 denotes disagreement with the study's focus on error prevention. The respondent or participant will then be prompted with questions using the back button and other Gamelan virtual reality metaverse application buttons. Severity ratings are 2 or a Minor Usability Problem if the back button and other buttons in the Gamelan virtual reality metaverse program do not work properly, confusing the user, because certain users are having difficulty performing their tasks in this situation.

3.1.6. Recognition Rather than Retail

In this part, the Gamelan virtual reality metaverse application's game system must aid users in identifying, analyzing, and resolving issues. The Gamelan virtual reality metaverse application game can be said to be effective with questions in this instance of recognition rather than recall, stating that there is no issue because the user feels that the steps in the Gamelan virtual reality metaverse application game are clear and simple to implement. With a severity rating value of 0 or Don't Agree, the item has no issues in this part and is thus comfortable.

3.1.7. Flexibility and Efficiency of Use

This section describes how the game system in the Gamelan virtual reality metaverse application should be simple for both new and seasoned users to feel at ease using. By asking responders or participants if there were any issues with the Gamelan virtual reality metaverse gaming application, it may be concluded that it is good in this situation of recognition rather than recall. Therefore, this item has no issues and is convenient to use, earning a severity rating of 0 or Don't Agree.

3.1.8. Aesthetic and Minimalist Design

The gaming system in the Gamelan virtual reality metaverse application must be user-friendly in this area so that both novice and expert players can feel at ease using it. By polling respondents or participants and finding out that there were no issues, it can be said that the Gamelan virtual reality metaverse game application is effective in this instance of recognition

rather than recall. With a severity rating of 0 or Don't Agree, this item therefore has no issues and is comfortable to use.

3.1.9. Help Users Recognize, Diagnose and Recovers from Errors

The game system in the Gamelan virtual reality metaverse application must be able to clearly communicate error messages that arise in order for users to understand them. There is a difficulty with the play button click in this instance, namely Helping Users Recognize, Dialogue, and Recover from Errors: the user cannot begin the Gamelan virtual reality metaverse application game but must first exit the game before re-entering the game numerous times. The user cannot access the Gamelan virtual reality metaverse application game while utilizing the play button; instead, they must exit the game and then re-enter it numerous times. It is utterly useless if applied to these problems. The severity grade for issues like these is 2 Minor Usability Problem.

3.1.10. Help and Documentation

In order to assist users in using the metaverse Gamelan virtual reality application game on the system, the system for the Gamelan virtual reality metaverse application game must contain pertinent documentation and strong support features. The lack of a help menu in this instance, specifically Help and Documentation, makes it harder for users to get assistance when they run into problems. The severity level for issues like that is 3, which stands for "serious usability concern."

The results of the analysis using Nielsen's heuristics evaluation method can be seen in Table 3.

4. Discussion

Authors should discuss the results and how they can be interpreted in perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

Table 3. Results of analysis with Nielsesn's Heuristics Evaluations

No	Nielsen's Heuristic Principal	Nielsen's Severity Rating					total
		Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	
1	Visibility of System Status (Feedback)	1	0	0	0	1	2
2	Match Between System and Thereal World	0	1	0	0	0	1
3	Use Control and Freedom	1	0	0	0	0	1
4	Consistency and Standards	1	0	0	0	0	1
5	Error Prevention	0	0	1	0	0	1
6	Recognition and Efficient of Use	0	0	0	0	1	1
7	Flexibility and Efficient of Use	0	0	0	0	0	0
8	Aesthetic and Minimalist Design	1	0	0	0	0	1
9	Help users Recognize, Dialogue, and Recovers	2	2	0	1	1	6
10	Help and Documentation	4	4	4	4	4	20
	Total Problems Found	10	7	5	5	7	34

Based on the results of the research in Table 3, a classification of problems can be made based on the severity rating listed in Table 4.

Table 4. Classification of problems with severity ratings

Nielsen's Heuristics Principal	Problem Descriptions	Problem Ratings	Total Severity Ratings	Index SR(Severity Ratings)
Visibility of System Status (Feedback)	The system for the Gamelan virtual reality metaverse application still does not have clear information regarding the application	Minor irritations that can be overlooked	2	0.4
Help users Recognize, Dialogue, and Recovers	The system is unable to clearly convey the impression of an error that has occurred, even though in the application of virtual reality there must be someone to accompany it	Minor Annoyance	6	1.2
Help and Documentation	There is no relevant documentation system, such as a help feature, to help users in a confused state	Big Disruption	20	4

4.1. Development Recommendations

Overall, the study's findings indicate that the severity rating based on Nielsen's heuristics evaluation principal indicates that the metaverse gamelan virtual reality application receives

positive evaluation values from respondents or participants whom we consider to be users on the principal of "help and documentation." A score between -0.8 and 0.8 is regarded as a neutral assessment of the relevant dimension in the usual interpretation. The scale's range is +3 (very positive) to -3, with a score of 0.8 representing a poor evaluation (extremely negative). Scores between 1.5 and 2 already suggest very good quality due to the typical response tendency in such assessments (people typically avoid extreme answer categories).Considering the analysis' findings and [26]. The recommendations for further development are derived based on the findings of the analysis and the problem classification table with a severity rating, which are shown in Table 5.

Table 5. Development Recommendations

No	Prinsip Heuristic Evaluation	Development Recommendations
1	Help and Documentation	There needs to be an additional "help and ask" menu.

5. Conclusions

The Nielsen heuristic assessment method analysis and testing results indicate that the Gamelan virtual reality metaverse application already has very favorable user interface conditions. The virtual reality metaverse game application, which already has a very attractive atmosphere, serves as evidence for this. The heuristic evaluation approach, which passed the investigation with a good severity rating, demonstrates all of this. In this study, the improvement of a virtual reality metaverse game system's performance was determined according to the priority of the problems uncovered by applying the heuristic evaluation approach with severity ratings. Nine of the 10 heuristic evaluation concepts that were applied in this study's application of the method to the metaverse gamelan virtual reality game system produced results that did not reveal any user interface or interface issues. These nine principles include: visibility of system status, match between system and the real world, user control and freedom, consistency and standards, error prevention, recognition rather than recall, flexibility and efficiency of use, aesthetic and minimalist design, and helping users recognize dialogue and recovers from errors. Then there is another principle, which is discovered to be a user interface issue that will effect the usability of gamelan virtual reality metaverse applications and result in recommendations for improvement for subsequent metaverse gamelan virtual reality applications development. Recommendations are based on the "help and documentation" premise and call for the necessary adjustments.

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