Establishment of Production Standards for Web-based Metaverse Content: Focusing on Accessibility and HCI

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Received 12 October 2022; Accepted 07 December 2022;
Publication 13 March 2023

Abstract

Metaverse technology is expanding to industries in various fields, such as medical, national defense, and education, and training simulation programs have been mainstream so far.

However, there have been increasing attempts to apply metaverse content to web-based platforms linked to social media services and, as a result, we face the problem of access to web-based metaverse content. Unlike traditional content, metaverse content interacts with many users, so content accessibility is the first important part to consider. In other words, to maximize the quality of metaverse content, it is essential to pull out the optimal UX through a detailed HCI (human computer interaction) design. Metaverse content development methodologies have effective methods proposed by many researchers. However, they are limited to web-based metaverse content that limits the use of high-end hardware. They are ineffective for platforms such

Journal of Web Engineering, Vol. 21_8, 2231–2256.
doi: 10.13052/jwe1540-9589.2181

as PCs and VR devices, as most studies focus on improving the visual performance of PCs or high-performance VR devices. Therefore, unlike existing research, the key theme of our research is to study optimized development standards that can be applied to web-based metaverse content and find out their effects through experiments. We created a development standard to be applied to a Web-based platform based on the existing metaverse content development methodology. Then, we redeveloped the VR content into the metaverse content and named them the VR build and the metaverse build. We had 25 people play virtual reality builds and metaverse builds simultaneously. Then, we measured the overall experience with an evaluation tool called the Game Experience Questionnaire (GEQ); the GEQ is a proven tool for evaluating content experiences by dividing them into positive/negative scales. When comparing the results measured from the two builds, the metaverse build showed consistent results with a higher positive scale, and a lower negative scale, than the VR build. The results showed that users indeed rated metaverse content positively. The bottom line is that the web-based metaverse content development standards that we have produced are practical. However, since generalization is limited, continuous research will be needed in more experimental groups in the future.

Keywords: Web-based metaverse, Web 3.0, web application, HCI, UX/UI.

1 Introduction

Currently, the content industry centred on metaverse technology is changing practically by applying various technologies such as digital therapeutics and training simulations [1]. The metaverse refers to a three-dimensional virtual world where social, economic, and cultural activities like the real world occur. It is a platform for social, cultural, and economic activity for all ages and around the world [2]. However, older people have difficulty in using metaverse technology [3]. Intelligent devices such as high-performance HMDs and PCs are essential. However, since it is difficult for most older people to use such devices, building a UX optimized for them to use metaverse technology is essential [4]. In particular, in cognitive rehabilitation programs using digital therapeutics and metaverse technology, the older age group is often targeted, and so a serious discussion is needed in this area [5]. In this study, an experiment was conducted to record the user's feelings while playing the content of each build using GEQ-Coremodule and GEQ-Postgame Module [6, 7]. Through this study, it is worthwhile identifying the characteristics of senior users, who may be relatively challenged to adapt to the metaverse environment compared to younger users, and use them as data to build UX/UI for them in the future.

2 Background

2.1 Industrial Application of Metaverse and Web-based Platforms

The extended reality technology market, which is attracting attention as a core technology in the era of the fourth industrial revolution, is expected to proliferate from $2.7 billion in 2018 to $20.9 billion in 2022, and it is also leading the immersive content market in China, Japan, and the United Kingdom [8, 9]. Moreover, it is emerging as a next-generation core technology attracting worldwide attention, promoting a variety of policy support with domestic and foreign companies such as Google, Apple, Samsung, and KT. Extended reality technology is currently being applied to various industries such as medicine, defence, and entertainment as surgical simulation, military simulation, and next-generation content with an NUI (natural user interface) [10–12]. Unlike VR-based experiential content that is only performed, various technologies are used to transform it into immersive content that provides users with a sense of presence as if they were in the real world [13, 14].

In this rapidly changing content market, sensor-based hardware production technologies such as head-tracking and eye-tracking are continuously being developed [15–18]. Still, high-quality content that implements the environment required by users with high performance is a reality that is insufficient compared to market demand [19–21]. Therefore, it is necessary to reduce the gap between hardware production technology and software production technology, an existing problem, through research on content development methods based on VR, AR, and MR technologies [22, 23]. This process requires research to establish a standard for developing high-quality content. It is known that the metaverse was first used in the novel “snow crash” by American novelist Neil Stevenson in 1992 [24], which is a compound word of the Greek meta meaning “transcendence, more” and universe meaning “world” or “universe”. For researchers, the metaverse has emerged as a new topic in content technology. Currently, many researchers have different definitions of the metaverse [25–27].

In a study by Lee in 2021, “Metaverse is a world in which virtual and reality interact and co-evolve, and socio-economic-cultural activities are performed to create value. The post-real world is a permanent and persistent multi-user environment that merges the physical reality and the virtual digital world" [28]. Many other researchers have defined the metaverse, but they have in common that it is a space connecting the real and digital worlds [29–32]. In conclusion, this means that tasks in various fields that cannot be easily performed in the real world due to a lack of human and material resources can be utilized in the metaverse environment implemented as a content base. The advantages of this metaverse are medical, military, and educational; it has the potential to be usefully applied in the industrial field [33, 34]. As such, the concept of the metaverse connecting the virtual and real worlds is a theory that can bring innovation to our lives when fully implemented, but there are limitations in reality. That's a technical limitation.

Metaverse content aims to link the real world and the virtual world ideally. In order to express such interlocking technically, it is essential to have 4K or higher high-resolution video, various interaction methods, as well as the professional implementation of the training method to be performed in conclusion. If these factors are not considered, or there is a lack of quality, it cannot be called metaverse content [35]. For this reason, much content claims to be metaverse content in the current content market, but in reality many remain at the level of experiential content using existing VR technology. The development of metaverse content can only be made when experts from various fields gather and aggregate their capabilities. For example, assuming that metaverse content for treating mental illness is created, development experts in game design, graphics, programming, etc., medical experts, psychological counselling experts, and UX/UI experts are needed to implement user interaction [36]. Since multi-disciplinary experts are required to produce a single piece of content, it takes time and money to make existing entertainment content, and there are many factors to consider. For this reason, the current content market lacks high-quality metaverse content. However, currently, there are many cases where government and public institutions support the production of high-quality metaverse content. In this case, the shortage of human and material resources is solved to some extent, and the content developed with government support is trained on industrial sites. In some cases, it is used for programs, etc., but this form is mainly found in the defence field [37–39]. VBS3, which is currently adopted as a de facto standard in the United States and used for actual education training, is an example of using metaverse content in defence [40]. It is the result of research The US military is talking about training as "All, but war is a simulation". the US military's training system started in the early 2000s, and the US military searched for ways to use augmented reality in the early 2000s. Still, now it is paying attention to the military usefulness of all metaverse types. In the US Air Force, a small transparent display mounted on the front of the cockpit of a fighter is a cornerstone of metaverse utilization. The US Army is exploring the military use of the metaverse in combatant lethality among the six modernization strategies [41].

Combatant lethality is a modernization strategy to increase survivability while strengthening the lethality of combatants through the advancement of combatant capabilities and combat equipment across fire, manoeuvre, communication, protection, and durability. Among the lethality of combatants, the representative projects that utilize the metaverse are the integrated visual augmentation system and the synthetic training environment [42].

The integrated visual augmentation system is a project to enhance the situational awareness ability of combatants and ensure optimal combat performance by projecting and superimposing battlefield information on the actual battlefield environment transmitted through human vision by integrating VR and AR technologies [43–47]. The metaverse is being actively developed not only in the military field but also in the medical field [48]. Unlike metaverse content in the defence field, which is produced with support from the government or public institutions, the medical field is also being actively developed in the private industry. The so-called "digital therapeutics" is the content, a software medical device (SaMD) that provides evidence-based therapeutic intervention to patients to prevent, manage, and treat a medical disorder or disease. Unlike existing content, digital therapeutics require safety-efficacy verification through clinical trials and supporting literature, and specification of the purpose of specific disease treatment (indications, efficacy, and effectiveness) and the difference from existing drugs, medical devices, or other treatments. It can be used in combination or independently [49]. Types of digital treatment devices are divided into medication replacement and medication complement. Medication replacement is a type of content that has a direct therapeutic effect even when used alone instead of an existing treatment and improves the treatment effect when combined with an existing treatment. Medication complement refers to content that cannot be used alone because it has no independent therapeutic effect and can be used with existing treatments to improve the original treatment effect [50].

Digital therapeutics was first proposed as a method that could be applied to the medical field as virtual reality technology became a hot topic. Still, they failed to actively research because they did not meet the strict standards of medical device regulatory policies [51]. However, with the recent rapid rise in the value of metaverse content, regulations on digital therapeutics have been relaxed worldwide, and research has also been active in line with this (the US new medical device safety action plan-2018.04, software pre-certification program test plan announcement-2019-01 Enactment of Korea Medical Device Industry Fostering and Innovative Medical Device Support Act (Innovative medical device designation, innovative medical device software company certification, creative medical device Special exceptions such as software license certification and change simplification – 20.05.01) [52].

The global digital therapeutics market is expected to grow to $9.64 billion in 2022, and the US market is expected to grow to $4.42 billion in 2023. In line with this, “reSET”, a form of smart app for drug use disorder treatment, was first approved by the FDA in the United States, and 12 digital therapeutic products have been approved by the FDA so far [53]. The FDA-approved digital treatment has proven effective in many diseases, from alcohol and drug addiction to diabetes, cancer, schizophrenia, mania, bipolar disorder, depression, PTSD, and ADHD. In addition, it has had an innovative effect on the existing medical system, and active research is expected to proceed in the future. Based on the literature and research results, the concept of the current metaverse and the content market trends and application fields using it have been summarized.

So far, from the results of previous studies, we can see that metaverse content is applied to various industries. However, as mentioned earlier, the lack of accessibility due to the need for high-end hardware devices for existing metaverse content is a problem that needs to be addressed in the future. We thought that grafting metaverse content of web-based platforms through existing research and market analysis would be a great alternative to addressing the lack of accessibility. So, we want to create a clear metaverse content development standard that can be applied to web-based platforms. In conclusion, to support our research, we thought it was necessary to understand the characteristics of web-based platforms and metaverses. Therefore, the next section will discuss their characteristics and development standards.

2.2 Web 3.0 and the Metaverse

Web 3.0 is defined as a user-centred Internet environment that can read, write, and own content (data). It can also be a provider that creates and distributes. However, the ownership of the profits and content generated in this process belongs to the company. On the other hand, the distinguishing feature of Web

3.0 is that users can also earn revenue and secure content ownership through these activities [54–58].

In addition, Web 3.0 sees the liberalization of data operation, user data ownership, and high security as crucial elements [59–61]. This element is equally applied to the metaverse. Because, due to the nature of metaverse content, where various users access and interact, users can freely access it, the expansion of ownership and security of data is a crucial factor in providing services. Many researchers have defined the concept of Web 3.0 to include the metaverse because of the similar characteristics described above. We see this definition in terms of web platform-based metaverse content creation (Figure 1). It can be guessed that high-quality metaverse content created by considering various criteria will be compatible with web-based platforms because they have similar characteristics. Therefore, we concluded that if we establish a standard for creating high-quality metaverse content, we can see a practical transfer effect when ported to a web-based platform. Furthermore, we think this suggests a significant potential for the future scalability of metaverse content. Therefore, in the next section, we intend to establish a new standard by examining and organizing research on the standards for creating metaverse content.

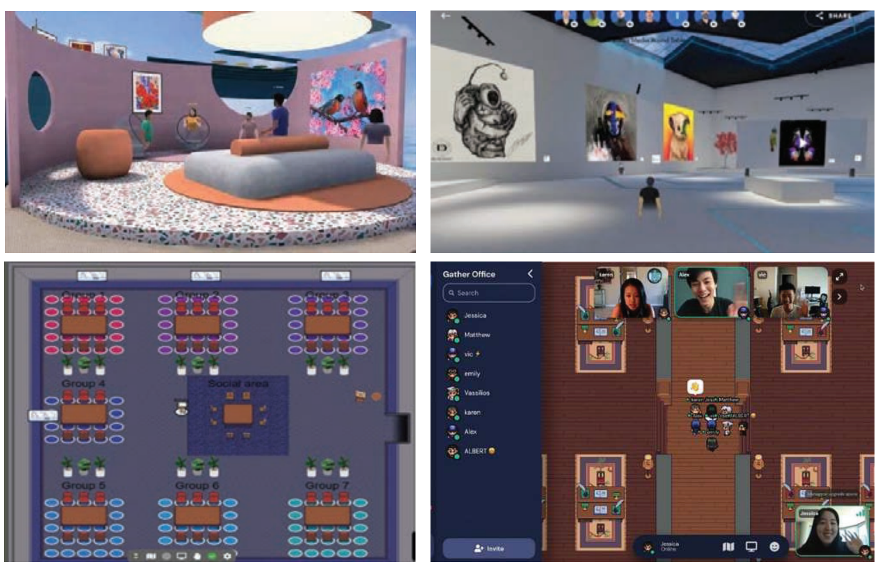

Figure 1 Web-based metaverse content development case.

2.3 Web-based Metaverse Content Development Direction

According to a study examining the current status and future potential of the 3D virtual world and metaverse, four areas of metaverse content are key: realism, accessibility, interoperability, and scalability [62]. In addition, a study on the social benefits of the metaverse suggests that high-quality products could be made only when content is produced in consideration of social values such as "accessibility", "diversity", "equality", and "humanity" [63].

As seen from the above studies, the absolute standard is not currently generalized to define "metaverse content", but they are pursuing both "technical value" and "social value" in common. In conclusion, the metaverse world, linked with the real world, must be pursued for values similar to the real world. In other words, just as we constitute society in the real world, make laws for the public good, and obey them, we must pursue such values in the metaverse environment, a virtual world that represents the real world. Therefore, to build a proper metaverse environment, technological and social values that protect the norms within the environment must be met simultaneously. Based on the previous research above, the elements the metaverse environment must satisfy are summarized in the Table 1.

Whether the elements in the table have been met will be our criterion for dividing the existing experiential virtual reality content and the immersive technology applied to metaverse content.

3 Method

To examine the validity of the metaverse content production standards presented in this study, we produced two different versions of one piece of

Table 1 Requirements for metaverse content

Variables	Description
Realism	How realistic the objects in the content are • Object, resources and environment
Accessibility	How easily multiple users can access the metaverse environment
Interoperability	Compatibility with other devices and environments
Scalability	Whether users can create new content through exchanges within metaverse content
Diversity	Whether the metaverse content can be extended to various cultures
Equality	Ability to provide content to all users without discrimination
Humanity	Whether there are common goals and moral norms such as humanity within the metaverse environment

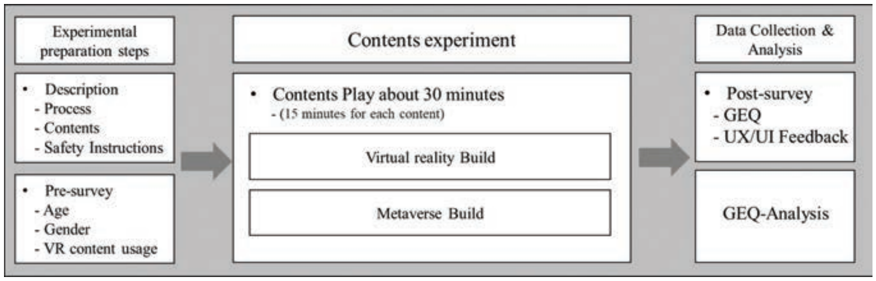

Figure 2 Experimental process.

content. One of these two builds is the existing experiential virtual reality content, and the other is a build that applies the metaverse content production standards we have proposed. We divided these two builds into "virtual reality build" and "metaverse build", respectively.

After we played two different builds of content to the same group of users, we used a GEQ survey to record the user's experience with the content. Through this, we want to differentiate the difference in user experience between each build and take a parsimonious approach to how valid our production standards are.

3.1 Demographic Characteristics

The experiment was conducted on 25 men and women who experienced VR and metaverse content less than once or twice. The experiment was conducted by dividing the 25 subjects into a group in their 20s and a group in their 50s After playing two cognitive rehabilitation content builds (virtual reality build and metaverse build), users used the GEQ-Coremodule and GEQ-Postgame Module to quantify the experience they gained while playing the content of each build. Experiments were conducted in a controlled environment with two assistants. In addition, when using virtual reality/metaverse contents, the safety rules and primary health status were checked by the experimental team.

3.2 Content

We used content designed to recover users' daily lives with mild cognitive impairment. As mentioned earlier, we divided one piece of content into two builds and used it for the experiment. The first is a build made with experiential virtual reality content, and the second is a build that applies the metaverse content standards. Compared to virtual reality content, metaverse content has

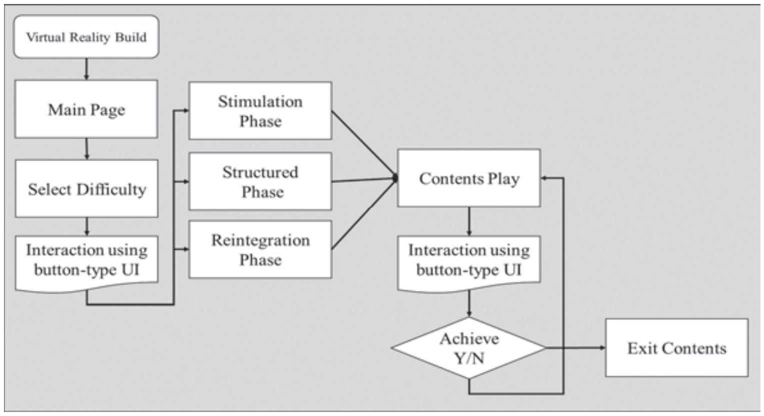

Figure 3 Content flow – virtual reality build.

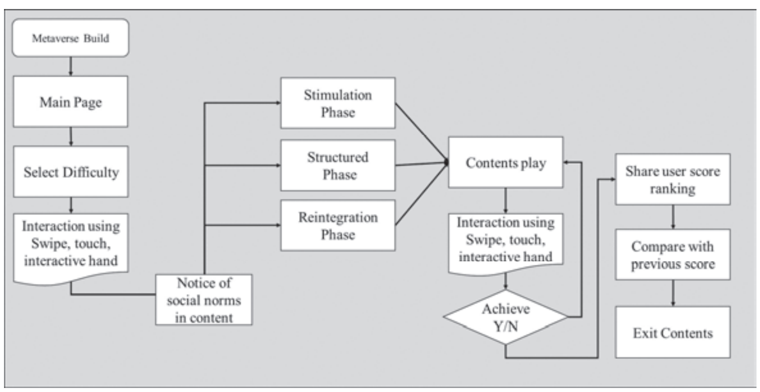

Figure 4 Content flow – metaverse build.

improved interaction, accessibility, UX/UI, and optimization technology, and the flow chart of each content is shown in Figures 3 and 4.

"Virtual reality build" and "metaverse build" proceed in the flow, as shown in Figure 5. Content is played after setting the difficulty on the Main Page. In this process, the game ends when the user achieves the goal set for each difficulty level. In this process, the interaction is the difference between the metaverse build and the virtual reality build. The virtual reality build uses a button-type UI for the interaction elements in the content. Still, unlike the existing build, the metaverse build uses swipe and touch using interactive hands. The interaction element between the user and the content has been improved. In addition, the metaverse build also includes social

Figure 5 Button type UI(L), interactive hand type UI(R).

interaction-based technology that allows users to compare and share their previous scores with those of other users, which was improved in line with the metaverse content criteria described above.

3.3 Game Experience Questionnaire

In the metaverse UX/UI design, it is very important to know the UX/UI of user content. A representative tool for this is GEQ. GEQ is a survey to find out the overall satisfaction with game content. IJsselsteijn et al. and Johnson et al. suggested [64, 65] that the GEQ is divided into three parts. Part 1 is the core part of the GEQ. It assesses game experience as scores on seven components: immersion, flow, competence, positive and negative affect, tension, and challenge. For a robust measure, we need five items per component. As the translation of questionnaire items, no matter how carefully performed, sometimes results in suboptimal scoring patterns, we have added a spare item to all components. After the first use of the translated GEQs, scale analyses will be performed to check whether any item should be discarded or replaced. Part 2, the social presence module, investigates the psychological and behavioural involvement of the player with other social entities, be they virtual (i.e., in-game characters), mediated (e.g., others playing online), or co-located. This module should only be administered when at least one co-player is involved in the game. Part 3, the post-game module, assesses how players felt after they had stopped playing. Again, this is a relevant module for assessing naturalistic gaming (i.e., when gamers have voluntarily decided to play), but it may also be relevant in experimental research.

3.4 Experiment Space

In the experimental space, it was necessary to experience virtual reality content in the same environment to control the experimental environment.

Figure 6 Experiment location and progress.

Therefore, all experiments were conducted in the "Virtual Reality Content Lab" at Gachon University's IT Convergence College. The "Virtual Reality Content Lab" is a 22 m^2 soundproofed space, with a virtual reality content experience space of 2.5 m $\times$ 2.5 m and the remaining space for research data collection and analysis. In addition, a separate space for monitoring characterizes it.

These features are designed so that subjects can conduct virtual reality content experiments in a smooth and consistent environment. The detailed configuration of the clinical trial environment and the actual clinical trial environment are shown in Figure 6.

4 Results

4.1 Data Description – Virtual Reality Build

We found the results from two experimental groups of people in their twenties and fifties. On a five-point GEQ, the highest ratings given by users were less than three. This result suggests that since the experimental content is a functional game made for cognitive rehabilitation, there is a part that falls in the fun aspect. The GEQs we focused on are "competence," "sensory and imaginative immersion," "flow," "tension/annoyance," "challenge," "negative affect," "positive affect" of the CORE-module, and "positive experience," "negative experience," "tiredness," "returning to reality" of the post-game module. The abbreviations of Table 2 are as follows COM (competence), SAI (sensory and imaginative immersion), Flow, TA (tension/annoyance), CHA

Table 2 GEQ-Result (virtual reality build)

No	Age	Sex	COM	SAI	FLOW	TA	CHA	NEA	POA	POE	NEE	TIR	RTR
1	50s	F	0.6	1.5	2.6	0.7	1.8	1	0.8	0.3	0.5	2	0.7
2	50s	M	1	0.8	2.4	2.7	3.2	2	0	1.2	2	2.5	0.7
3	50s	M	1.8	3	2.4	0	2	0	3	2.2	0.5	0	1.3
4	50s	F	1.4	0.8	1.2	1.3	1.2	1.5	0.4	0.2	0.5	1	0
5	50s	F	0.4	1	0.8	2	1.8	2.3	0.2	0.2	1	2.5	0.3
6	50s	F	1.8	1.2	1	0	0.6	1.5	1.6	0.7	0	0	0.3
7	50s	M	1.8	1.2	1.2	2	2.4	2.8	1	0.5	1.7	3	0.7
8	50s	M	2.4	0.5	0.4	2.3	0	4	0.2	0	2	3	0
9	50s	F	1.2	0.8	1	1	1.2	1.5	1.2	0	2	0	0.3
10	50s	F	2.8	2.5	2.8	2	2	1.3	2.6	0	2	1.5	2.3
11	20s	M	2.8	1.7	0.6	1.3	0.6	2.5	2	0.5	0.3	0	0
12	20s	M	2	2.3	0.8	1.3	1.2	2.5	2	0.2	0.8	0	0
13	20s	F	0	1	2.6	2	3.4	0.8	0.2	0.5	1.3	2.5	1
14	20s	F	1.4	1	0.6	0.3	1.4	1.8	0.4	0.3	0.5	1	0.3
15	20s	F	1.2	1.5	1.4	2.3	1.6	0.8	1	1	2	2	1
16	20s	F	0.4	0.3	0	0.7	0	1.5	0	0	1	1.5	1
17	20s	M	1.4	2	2.2	0	1	0.5	2.2	1.8	0.3	0	1
18	20s	F	0.8	0.5	1	1.7	2.4	1.8	0.2	0.2	0.8	2	0.3
19	20s	M	0	0.8	1	1.3	2.6	0.5	0.2	0.2	1.2	1	0.3
20	20s	M	0.4	0.8	0.4	2	1	2	0.4	0	0.7	2	0.3
21	20s	M	1.8	1.5	1	1.3	1	2	2.2	0	0.5	0	0
22	20s	F	2.6	2	2	0	0.4	0	2.4	1.7	0.3	0	0.7
23	20s	M	1	0	0	0	1.6	4	0	0	2	4	0
24	20s	M	1	2.3	2.6	2	2.8	1.5	1.6	0	2	2	1.3
25	20s	M	1.4	1	1	2.7	1.4	3	1	0	2	1.5	0

(challenge), NOA (negative affect), POA (positive affect), POE (positive experience), NEE (negative experience), TIR (Tiredness), RTR (returning to reality).

4.2 Data Description – Metaverse Build

We can look at the results of the experimental groups who played the metaverse build. The metaverse build has improved interaction compared to the existing virtual reality build. The metaverse build adds behavioural guidelines within the content based on the criteria we created and various interactions, such as swipes and touches through the interactive hand. According to the GEQ results, the UX/UI evaluation of the metaverse build was significantly higher than that of the virtual reality build. In addition, the intuitively crafted

Table 3 GEQ-Result (metaverse build)

No	Age	Sex	COM	SAI	FLOW	TA	CHA	NEA	POA	POE	NEE	TIR	RTR
1	50s	F	2	2.2	2.6	0.7	2	1	2	1.7	0.7	1	0.7
2	50s	M	2.2	2.5	3.4	0.3	2	0	3	1.7	0.3	0	0.7
3	50s	M	2.2	1.5	2.4	0	0.6	1.3	1.6	0.8	0.3	0.5	0
4	50s	F	2.4	1	1.6	0	0.6	1.3	1.8	0.7	0.5	1	0.3
5	50s	F	2	2.3	2.4	0	1	0	2.6	1.7	0.3	0	0.7
6	50s	F	1.2	2.5	2.4	1	1	0	3	2.2	0.5	0	1
7	50s	M	3	2.2	1.8	0	0.8	0.5	2.2	1.5	0.2	0.5	0.3
8	50s	M	3.4	2.3	3	0	1	1	3.2	0	2	0	0.7
9	50s	F	3	3	3.6	0.3	1.6	0	3.4	0	2	1	1
10	50s	F	2.6	2.8	3.2	0	0.8	0	3	0	2	0	1
11	20s	M	2.8	1.7	0.6	1.3	0.6	2.5	2	0.5	0.3	0	0
12	20s	M	1	1	1.8	1.3	2.8	0.8	2.2	0.3	0.7	1	0.7
13	20s	F	3	2.8	2.6	0	1.2	0	3.2	2.3	0.5	0	0.3
14	20s	F	3.2	2.8	2.2	0	0.8	1.5	2.6	1.8	0.8	1	0.3
15	20s	F	2.6	3	2	0	1.2	0	3.4	2.7	0.5	0	1
16	20s	F	1.6	0.5	1	0	0.6	0.8	1.2	0.5	0.5	2	0.3
17	20s	M	2.2	0.7	2.6	0.7	1.2	0	2.4	2	0.3	1	0.7
18	20s	F	2	2.2	1.6	0	0.6	0	1.8	0.2	0	1	0
19	20s	M	1.4	0	1	0.3	0.4	1.8	0.6	0	0.2	1	0
20	20s	M	3	1.7	1.2	0.7	1.4	1.5	2	0.2	0.5	1.5	0.3
21	20s	M	4	3	2.6	0	2.4	0.5	2.8	2	0.3	1.5	1.3
22	20s	F	2.8	2.7	2.4	0	0.6	0	2.8	1.5	0.5	2	0
23	20s	M	3.8	2	2.6	0	1.2	1	2.8	0	2	2	0.7
24	20s	M	2.4	2.3	2	2	2	3	1.2	0	2	2	2
25	20s	M	3.6	2.2	1.2	0	1.2	0.8	3	0	2	3	0

metaverse build UX worked efficiently for all age groups. In conclusion, the users preferred the metaverse build over the virtual reality build, as the results showed that the score of the virtual reality build exceeded the score on the positive scale.

4.3 Comparison of GEQ Scores by Age Group

For users in their 50s, the metaverse build scored higher than the virtual reality build in competence, sensory and imaginative immersion, flow, positive affect, and positive experience (Figure 7). On the other hand, in tension/annoyance, challenge, negative affect, negative experience, tiredness, and returning to reality, the virtual reality build showed higher scores than the metaverse build. In the case of users in their 20s, the metaverse build

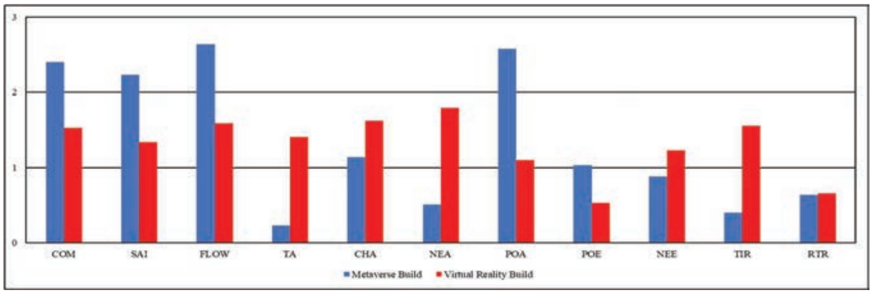

Figure 7 Comparison of GEQ scores of users in their 50s (metaverse build, virtual reality build).

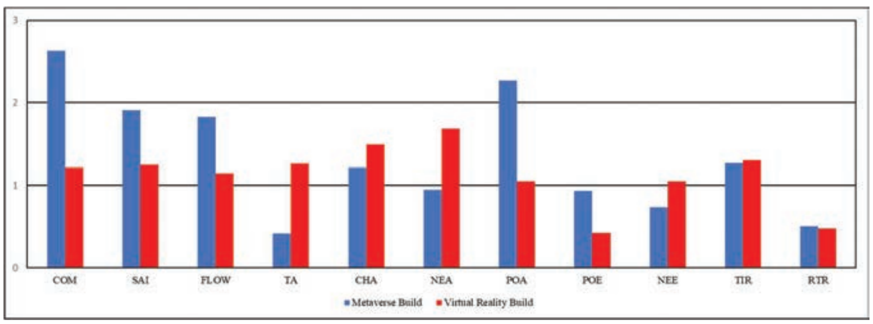

Figure 8 Comparison of GEQ scores of users in their 20s (metaverse build, virtual reality build).

responded with a higher number than the virtual reality build in the items of competence, sensory and imaginative immersion, flow, positive affect, and positive experience (Figure 8). On the other hand, in tension/annoyance, challenge, negative affect, negative experience, tiredness, and returning to reality, the virtual reality builds scored higher than the metaverse build. When users compared the metaverse content to virtual reality content:

1. UX aspect: intuitive, familiar, and proficient in operation
2. Content play: I was able to enjoy a positive impact and a high quality of immersion
3. Content usage fatigue: I was able to play content more comfortably.

However, on the “challenge” scale, which indicates the content achievement level, the VR build was rated higher than the metaverse build. We are cautiously predicting this because the level of control difficulty of metaverse content has been lowered due to intuitive interaction technology.

5 Discussion

5.1 Limitation of the Research

As a result of the experiment, metaverse content obtained high values in the positive items competence, sensory and imaginative immersion, flow, positive affect, and positive experience in the 20s and 50s groups. In contrast, for the negative things, such as tension/annoyance, challenges, negative effect, negative experiences in, tiredness, and returning to reality, it can be seen that virtual reality content obtained high figures. The content used in this study is the application of our proposed metaverse content production standards to the existing virtual reality content. The basic process of both contents is the same.

We note that the metaverse build scored well on the positives of the GEQ. We could carefully guess that this resulted from the effective action of the criteria for the metaverse content we added. However, since our current study was conducted with 25 subjects, it cannot be generalized. It is necessary to conduct additional research by recruiting a more significant number of subjects in the future.

5.2 Accessibility of Web-based Metaverse Content and Senior Population

Currently, the incidence of geriatric diseases is increasing with aging, and the "corona blue" phenomenon, such as extreme stress, depression, and lethargy, is occurring due to the prolonged pandemic of COVID-19 [66]. In addition, the excessive stress and anxiety felt in face-to-face reality and the increasingly fierce competition environment stimulates and overuses the brain, leading to the acceleration of various mental disorders.

The academic community confirmed the need for research on serious games as an alternative tool to prevent the acceleration and aggravation of related diseases through early diagnosis and prevention of geriatric diseases due to the degeneration of mental and sensory organs. Due to the entry into an aging society, the content industry must also seek ways to utilize the silver industry for seniors and public welfare. As an alternative tool, we need to expand to a digital convergence therapy that combines medicine and entertainment. The metaverse presents a new phase in expanding existing content with digital therapeutics. The high-quality metaverse content can be trained realistically, and social norms to be observed within the environment are also presented. As the demand for cognitive rehabilitation treatment of the senior population increases, there is also a high interest in developing a digital treatment for the senior population.

However, digital therapeutics for the senior population is still challenging. In this study, the experimental data were analyzed by dividing the 20s and 50s groups to confirm the accessibility of the elderly population when playing metaverse content in the future. Research shows high-quality metaverse content emphasizes accessibility for all users to access the content easily. Before researching these fields, we thought playing metaverse content for the elderly population unfamiliar with digital culture would be challenging [67]. Therefore, the UI/UX section of the group's GEQ results represents its behaviour.

In conclusion, our study revealed that the usability of metaverse content is not a matter of the user's age but is strongly related to intuitive UI and UX design, and intuitive and interactive UI/UX design significantly impacts the overall experience of the game.

6 Conclusion and Future Works

We experimented with an experimental group of 25 people to create a development standard for scalability and quality control of metaverse technology extended to various industries and to verify its effectiveness. The experiment divided one type of cognitive rehabilitation content into a virtual reality build and a metaverse build. In addition, it measured overall content experience with a proven tool for evaluating the expertise of an entertainment game and content experience called the Game Experience Questionnaire (GEQ).

As a result of the experiment, in the user group of all age groups, positive experience values such as competence, sensory and imaginative immersion, flow, positive affect, and positive experience were measured with higher metaverse builds. On the other hand, negative experiences. tension/ annoyance, challenge, negative affect, negative experience, tiredness, and returning to reality were rated higher by virtual reality builds. These results can be seen that the criteria for creating metaverse content that we produced significantly affected user experience. Still, it is difficult to generalize this because it resulted from a limited experimental group of 25 people.

As such, although there are limitations in the study, we found that older people who are not accustomed to digital life make good use of the intuitive design of the metaverse build UI. These results are for researchers who are skeptical about creating metaverse content for the elderly because they are not used to digital life. We would like to carefully assert that using metaverse content is more critical to intuitive and interactive UX/UI design, not age. Due to the increasing mental burden on the entire population due to the pandemic, social phenomena such as "Covid Blue" are emerging.

Because the socially marginalized elderly age group is constantly exposed to these threats. The use of metaverse by the senior population is becoming a significant issue in academia. We could see that the quality of content released with the tag "metaverse content" in the content market is no different from that of existing experience-based virtual reality content. Functional content should consist of content that users can train or educate, and entertainment content should include elements that users can enjoy.

Unlike explicit functional content or entertainment content that needs to be made, metaverse content does not have a standard of what elements must be included, so we think the previous problem occurred. We wanted to prevent these problems and establish, experiment, and verify standards for creating metaverse content. Many researchers are skeptical about the concept of the metaverse. We believe that one of the reasons for this is the problem pointed out earlier. The problem is that most of the "metaverse content" released is no different from the existing "virtual reality content". We hope that our research will help clarify the metaverse content development standards and be used as valuable data when development technology develops in the future.

Acknowledgments

This research was supported by the MSIT (Ministry of Science and ICT), Korea, under the ITRC (Information Technology Research Center) support program (IITP-2022-2020-0-01846) supervised by the IITP (Institute for Information & communications Technology Promotion) and this work was supported by the Gachon University research fund of 2022. (GCU-202208870001).

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