Effects of fire fight safety education when applied metaverse in Korea: Focusing on the construction industry

Pil-Jae Moon[1]
Ha-Sung Kong[2✉]

[1]*Department of Fire Protection and Safety Engineering, Woosuk University, Korea.*
Email: yj571010@daum.net
[2]*Department of Fire and Disaster Prevention, Woosuk University, Korea.*
Email: 119wsu@naver.com

(✉ *Corresponding Author*)

Abstract

This study reviewed educational, aesthetic, entertainment and deviant experiences which are elements of the metaverse experience set them as research variables and presented the results of the study through a survey. First, it was found that the educational experience was statistically significant for safety education satisfaction and had a positive effect. In order to provide practical education, educational experiences must feel like reality and fun content must be easily delivered. Second, it was found that deviant experiences were statistically significant for safety education satisfaction and had a positive effect. This can be said to increase the prevention of safety accidents only when the deviant experience service feels like reality and interesting contents related to safety education are easily delivered. Third, it was found that the aesthetic experience was statistically significant for safety education satisfaction and had a positive effect. This can be said to increase the prevention of safety accidents only when aesthetic experiences and services feel like reality and interesting contents related to safety education are easily delivered. Fourth, it was found that the recreational experience was statistically significant for safety education satisfaction and had a positive effect. This can be said to increase the prevention of safety accidents only when entertainment and deviant experience services feel like reality and interesting contents related to safety education are easily delivered.

Keywords: Construction industry, Fire safety education, Metabus, Satisfaction, Virtual augmented reality.

Contents

Contribution of this paper to the literature
In this study, it is analyzed whether educational, deviant, aesthetic, and recreational experiences using the metaverse of construction sites, which were not covered in previous studies, affect satisfaction with fire safety education that reduces disasters at actual construction sites.

1. Introduction

According to industry statistics by industry in 2021 by the Occupational Safety and Health Agency, the number of construction workers was 2,378,751, the number of injured was 29,943 and the accident rate was 1.26, with 551 deaths and 2.32 deaths (Korea Occupational Safety & Health Agency, 2022). At this time, the government aims to reduce the number of deaths from industrial accidents by 2022 by promoting "three major projects to protect the lives of the people". In order to satisfy being intact and without contract of industrial safety education in the COVID-19 pandemic, most of them provided only education that could not be watched or experienced in real life. Therefore, it can be said that it acted as a factor that hindered the concentration and training effects of users. Hong (2022) said that COVID-19 has changed all social fields not only in Korea but also around the world. In the COVID-19 pandemic, all activities conducted face-to-face became impossible and various ways of online communication were found which has a significant impact on the education field Hong (2022). During the COVID-19 pandemic, face-to-face education was replaced by online education for safety experience education in Korea. Accordingly, it became more urgent to introduce contents for non-face-to-face fire safety education. In a previous study related to safety experience education, Shin (2017) stated that safety education is more important than theory-centered education. It is conducted in a dedicated safety education center rather than theory-centered safety education. Practical training should be provided (Shin, 2022). Shin (2020) explains that safety experience education in a virtual disaster situation enables unconscious reflex actions in emergency situations such as disasters and accidents. It suggested the importance of experiential education that can equip people with the ability to do it Shin (2020). Lim (2018) stated that firefighting tactics training has a great effect on providing additional information through virtual or augmented reality systems and can act as a solution to space and time constraints. This suggested that through education and training and the virtual reality system, it would be possible to develop teamwork among firefighters with minimal equipment and space and to strengthen individual competency (Im, 2018). Kim (2022) interpreted the metaverse as a more advanced concept than the existing virtual reality (VR) in that it interlocks with the virtual world and reality which refers to the virtual world that transcends reality (Kim, 2022). Seo (2022) predicted that the metaverse platform would be provided to users (Seo, 2022). According to Kim, Lee, and Choi (2022), presence and interest are the characteristics of virtual reality (VR) content (Kim et al., 2022).

Most of the prior studies have shown that safety education is a theoretically oriented education and that the development of customized programs considering each learner's target, situation and level and the development of content that can nurture safety educators are insufficient. With the advent of the intact era due to COVID-19, research on the virtual world is rapidly being conducted but there is a lack of research on various contents that can be applied to social, cultural and economic fields to create real value. In this study, educational, deviant, aesthetic and recreational experiences using the metaverse of construction sites have been analysed.

2. Application of Experience-Based Education in the Metaverse

2.1. Definition of Metaverse

Metaverse is a compound word of transcendence and cosmos and the term first appeared in American novelist Neal Stephenson's novel 'Snow Crash' (1992). Metaverse is "a four-dimensional virtual space-time that connects economic, social, cultural and political activities through an avatar, a virtual self." This is "not a simple three-dimensional virtual space but a space and method in which virtual space and reality actively interact. The intersection of reality and the virtual world is realized with 3D technology". Metaverse also means "an advanced internet composed of permanent three-dimensional virtual spaces connected to the perceived virtual world". In the virtual space, it shows a sense of existence similar to reality.

2.2. Composition of the Metaverse

Metaverse is an augmented service that pursues augmented reality externally. It refers to an environment in which objects expressed in 2D or 3D in real space are superimposed in virtual space and interact with each other. It has the characteristic of reducing the feeling of rejection towards the virtual world and increasing the sense of immersion. In other words, it is a technology that synthesizes external virtual information into real space based on real images or backgrounds in a computer. This technology can interact with and display the virtual world by combining it with the real world in real time. Well-known examples are the Pokemon Go and IKEA Place apps, etc. Mirror World integrates and expands external information into the virtual space and maximizes usability. The representative examples are web-based Google Earth and Airbnb (Lee, 2022). Lifelogging is an augmented service that pursues the inner and it is an activity to record, store and share experiences and information occurring in daily life as text, images and videos. It also focuses on expressing and recording the user's inclinations. Social media such as Instagram, Facebook, Kakao Story, Twitter and YouTube are representative examples of life logging which has the meaning of replicating one's life in the digital space (An, 2022).

2.3. Metaverse Experience-Based Education Platform

It is necessary to pay attention to the virtual convergence economy as an economic paradigm in the metaverse era. In experiential economy theory, the elements constituting experience can be classified into four categories: recreational experience, educational experience, aesthetic experience and deviant experience.

A recreational experience is a state of enjoyment that is interesting and appealing. A recreational experience is one that is passively absorbed through the senses such as watching a performance or listening to music. Recreational experience is the oldest and most developed form of experience. It refers to a situation in which pleasant feelings are generated and maintained by the experience. Educational experiences require physical training in order to improve abilities as well as the acquisition of knowledge, the mind and skills for intellectual

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education. An educational experience can be defined as an experience at the level of absorbing new knowledge and skills rather than being completely immersed in the experience. Aesthetic experience refers to a passive form of appreciating and accepting aesthetic elements when the environmental conditions that enable participants to immerse themselves in experiential activities are satisfied. In other words, it can be judged by the degree to which the beautiful element of the object of experience is felt by the participant.

A deviant experience reflects an individual's desire to escape from the everyday environment for a new cultural experience. An example of a deviant experience is enjoying extreme sports or participating in an orchestra. Deviant experiences have higher levels of immersion and participation than recreational and educational experiences. In this way, researchers can see that it is possible to apply the scale of the experience domain to various fields such as recreational, educational, aesthetic and deviant experiences.

3. Research Design and Data Analysis

3.1. Research Design

This study aims to analyze the effect of metaverse experience factors on the satisfaction of fire safety education for construction site workers.

3.2. Research Subjects and Data Collection

This study conducted an online and offline questionnaire survey from April 1 to April 30, 2022 for construction site workers of J construction companies in Daegu, Gyeongbuk, Gyeongnam, and Chungbuk. For the questionnaire survey, 290 copies were collected by distributing a total of 300 copies and 280 copies of the collected questionnaires were analyzed except for insincere responses.

3.3. Hypothesis Setting

This research is to analyze the effect of metaverse experience factors on the satisfaction of fire safety education for construction site workers. Hypotheses are established as follows:

Hypothesis 1: Educational experience will have a positive effect on satisfaction with safety education.
Hypothesis 2: Deviant experiences will have a positive effect on satisfaction with safety education.
Hypothesis 3: Aesthetic experience will have a positive effect on satisfaction with safety education.
Hypothesis 4: Recreational experience will have a positive (+) effect on satisfaction with safety education.

3.4. Measuring Tool

The questionnaire used in this study included gender, age, educational background, experience, occupation and position. As for the major variables, educational, deviant, aesthetic and recreational experiences were used as measurement tools for experience factors.

3.4.1. Educational Experience

Educational experience was defined as something that can improve knowledge and ability by acquiring information or perceiving technological improvement through experience. The measuring tool used in the previous study of Bae (2022) was modified. The sub-factors of the educational experience measurement consisted of 5 items of safety knowledge in the industrial site, fire safety accident prevention education, accident risk understanding, safety management understanding and on-site situational factors. On a 4-point Likert scale (1 = 'not at all' ~ 4 = 'very much'), the higher the score, the higher the educational experience. In this study, the overall point is shown as Cronbach's alpha = 0.870 (Bae, 2022).

3.4.2. Deviant Experience

 Deviant behavior is defined as behaviors, emotions   or thoughts that are contrary to the standards of behavior of a specific group or society and social expectations. The measuring tool used in the previous study of the Moon (2021) was modified and used for the study. The sub-factors of the measurement of deviant experience consisted of 5 items: importance of safety activity, appearance of experience, feeling out of reality, stress relief and new experience. This was measured on a 4-point Likert scale (1 = 'not at all' ~ 4 = 'strongly agree'), the higher the score, the higher the deviant experience (Moon, 2021).

3.4.3. Aesthetic Experience

The purpose of the aesthetic experience is to determine   whether the real life or field environment is realistic and lively.

The measuring tool used in the previous study by Kim (2021) was modified and used. The sub-factors of the aesthetic experience measurement consisted of five items: attractive atmosphere, lively, harmonious with the environment, realistic   and fall accident experience. This was measured on a 4-point Likert scale (1 = 'not at all' ~ 4 = 'strongly agree') the higher the score, the higher the aesthetic experience (Kim, 2021).

3.4.4. Recreational Experience

Recreational experience refers to anything that stimulates, promotes   and creates a state of hedonistic and pleasurable emotions through experience. According to the purpose and method of this study, the measurement tool used in the previous studies of Kim (2022) was modified and consisted of 5 items: interest , diversion, event, fun and feedback. This was measured on a 4-point Likert scale (1 = 'not at all' ~ 4 = 'strongly agree'), the higher the score, the better the entertainment experience (Kim, 2019).

3.5. Satisfaction with Fire Safety Education

Satisfaction with education was defined as examining the subjective responses of learners to education. The definition of education satisfaction is the subjective satisfaction of the participants who experienced the VR

education process and contents. The measurement tool used in the previous studies by Moon (2021) and Kim (2022) was modified to suit the purpose and method of this study. The sub-factors consisted of 5 items: understanding, importance of safety education, securing safety, risk factors and organizational satisfaction. This was measured on a 4-point Likert scale (1 = 'not at all' to 4 = 'strongly agree') and a higher score means higher education satisfaction (Kim, 2020).

3.6. Analysis Method

The data collected in this study was analysed by IBM SPSS (Statistical Package for Social Science). Currently, it is used in all fields such as medicine, experimentation and quality control and the WIN 25 program is the latest version used in this study. The detailed data analysis procedure is as follows:

First, the demographic and participation characteristics of the subjects were analyzed by calculating frequency and percentage, mean and standard deviation.

Second, correlation analysis was performed to analyze the relationship between educational experience, deviant experience, aesthetic experience, recreational experience and educational satisfaction which are all experiential factors.

Third, the experience factors such as educational, deviant, aesthetic, recreational experiences and education satisfaction were analysed using ANOVA (Analysis of Variance) verification, percentage, mean and standard deviation.

Fourth, multiple regression analysis was conducted to examine the effects of educational experience, deviant experience, aesthetic experience and recreational experience which are all experiential factors.

4. Analysis of the Findings of the Study

4.1. Demographic and Sociological Characteristics

Looking at the demographic and sociological characteristics of the study subjects as shown in Table 1, the gender of the study participants was 232 males (83%) and 48 females (17%). 121 people aged 50 to 70 years (43%) 72 people were 40 to less than 50 years old (26%), 48 people were 30 to less than 40 years old (17%) and 39 people were 20 to 30 years old (14%). Educational background: 116 people (41%) with a high school diploma or less, 98 people with a junior college degree or less (35%) 64 people with a university degree or less (23.3%) 2 people with a graduate school degree or higher (0.7%) and 70 people (25%) in the construction industry), 70 people (25%) from the electrical industry, 70 people from the facilities business (25%) and 70 people from the firefighting industry (25%). Their work experience appeared to be 95 (34%) with 10 or more and less than 20 years, 87 (31) with 5 or more and less than 10 years, 64 (23%) with 20 or more years, 34 (12%) with less than 5 years. By rank, 124 staff (44%) were employed with 103 assistant managers (37 people), 47 managers (16.9%) and 6 assistant directors (2.1%).

4.2. Correlation Analysis of Experience Factors and Education Satisfaction

Looking at the correlation analysis as shown in Table 2 , the relationship between variables, the educational experience (0.476) showed a rather high correlation for the metaverse experience and the satisfaction with fire safety education was a result of a recreational experience (0.614), an aesthetic experience (0.531), an educational experience (0.483) and a deviant experience (0.185) which showed a correlation.

Table 1. Frequency analysis of general characteristics of study subjects.

Category	Content	N	%
Sexuality	Male	232	83
	Female	48	17
Age	20- 30	39	14
	30- 40	48	17
	40- 50	72	26
	50- 70	121	43
Academic background	High school or less	116	41
	Community college	98	35
	University	64	23.3
	Graduate school	2	0.7
Occupation	Construction industry	70	25
	Electricity industry	70	25
	Facility industry	70	25
	Firefighting industry	70	25
Work experience	Less than 5 years	34	12
	5-10 Years	87	31
	10-20 Years	95	34
	Over than 20 years	64	23
Rank	Staff	124	44
	Assistant manager	103	37
	Manager	47	16.9
	Assistant director	6	2.1

Table 2. Correlation analysis of experience factors and fire safety education satisfaction.

Variable	Educational experience	Deviant experience	Aesthetic experience	Recreational experience	Firefighting safety education satisfaction
Educational experience	1				
Deviant experience	0.356**	1			
Aesthetic experience	0.294**	0.281**	1		
Recreational experience	0.269**	0.153**	0.192**	1	
Metaverse experience	0.476**	0.037**	0.142**	0.289**	
Satisfaction with fire safety education	0.483**	0.185**	0.531**	0.614**	1

Note: **$p < .01$.

4.3. Analysis of Differences in Satisfaction with Experience Factors and Fire Safety Education (ANOVA Analysis)
4.3.1. Analysis of the Sexuality Gap

According to gender, looking at the analysis of differences as a result of Scheffe's ex post verification of the metaverse's experiential factors, education satisfaction and fire safety education satisfaction, educational experience $p<0.000$, deviant experience $p<0.000$, aesthetic experience $p <0.01$, recreational experience $p<.01$ and the level of fire safety education satisfaction $p<0.01$ is statistically significant between groups. Males showed high levels of educational, deviant, aesthetic, recreational and fire safety education experiences in the metaverse.

A sexuality difference analysis is given in Table 3.

4.3.2. Age Difference Analysis

According to age, the analysis of differences is a result of Scheffe's follow-up verification of the metaverse's experiential factors, education satisfaction, and safety accident prevention, metaverse's experiential factors were $p<.000$, fire safety education satisfaction was $p<0.000$. These levels were statistically significant between groups. The metaverse experience factor was the highest over 50 and over 70 followed by 40 and over 50, 30 and under 40 and 20 and over 20. For education satisfaction, those in their 50s and over 70s showed the highest level followed by those in their 40s and older, less than 50s, 30s and younger and those in their 20s and older.

Age difference analysis is given in Table 4.

4.3.3. Analysis of Differences in Academic Background

According to educational background, the analysis of differences is the result of Scheffe's post-test verification of the experiential factors of the metaverse and satisfaction with fire safety education. The results are as follows: Metaverse's experiential factors and firefighting education satisfaction were both statistically significant between groups at the level of $p<.000$. That is, university graduates showed the highest percentage followed by graduate school, community college and high school.

Analysis of differences in academic background is given Table 5.

Table 3. Analysis on gender difference.

Category	Sexuality	N	Average	Standard deviation	F	t	Significance level
Educational experience	Male	232	3.22	1.07	5.9	6.7	0.000**
	Female	48	1.65	0.47			
Deviant experience	Male	232	3.14	1.02	11.8	8.14	0.000***
	Female	48	1.94	0.42			
Aesthetic experience	Male	232	3.41	1.31	7.23	6.84	0.004**
	Female	48	2.38	0.623			
Recreational experience	Male	232	3.23	1.23	13.4	7.16	0.002
	Female	48	1.84	0.62			
Satisfaction with fire safety education	Male	232	3.36	1.24	8.45	7.61	0.001
	Female	48	1.94	0.47			

Note: **$p<0.01$, ***$p<0.001$.

Table 4. Analysis on age difference.

Category	Age	N	Average	Standard deviation	f	Significant
Metaverse experience factor	20~29	39	1.13	0.172	525.21	0.000***
	30~39	48	1.74	0.421		
	40~49	72	3.23	0.274		
	50~70	121	3.98	0.436		
Satisfaction with fire safety education	20~29	39	1.12	0.326	474.12	0.000***
	30~39	48	2.14	0.358		
	40~49	72	3.41	0.478		
	50~70	121	3.58	0.469		

Note: ***$p<0.001$.

Table 5. Analysis on academic record difference.

Category	Academic background	N	Average	Standard deviation	f	Significant
Metaverse experience factor	High school or less	116	1.37	0.214	372.24	0.000***
	Community college	98	2.92	0.423		
	University	64	4.34	0.424		
	Graduate school	2	4.27	0.034		
Satisfaction with fire safety education	Highschool or less	116	1.31	0.324	309.21	0.000***
	Community college	98	3.15	0.432		
	University	64	4.64	0.426		
	Graduate school	2	4.34	0.034		

Note: ***p<0.001.

4.3.4. Analysis of Differences in Occupations

The analysis of differences by job as shown in Table 6 and the results of ex post verification of metaverse experience factors, fire safety education satisfaction, and Scheffe are as follows: Metaverse's experiential factors and fire safety education satisfaction were all statistically significant between groups at the level of p<.000. The construction industry showed the highest number followed by the manufacturing industry, the service industry, and others.

Analysis of occupational differences is given in Table 6.

4.3.5. Analysis of Differences in Work Experience

Looking at the analysis of differences according to work experience as shown in Table 7, the results of Scheffe's ex post verification of the metaverse's experiential elements and fire safety education satisfaction were p<0.000 found to be statistically significant between groups. With more than 5 years and less than 10 years of work experience, the highest level was shown followed by more than 10 years and less than 20 years, less than 5 years and more than 20 years.

Analysis of differences in work experience is given in Table 7.

4.3.6. Analysis of the Difference in Rank

Looking at the analysis of differences according to rank as shown in Table 8, the metaverse experiential factors, fire safety education satisfaction and Scheffe post-test results showed that all the metaverse experiential factors and fire safety education satisfaction levels were p<0.000 which was found to be statistically significant. In other words, the lower the rank, the higher the overall score.

Analysis of the difference in rank is given in Table 8.

Table 6. Analysis of occupational difference.

Category	Occupation	N	Average	Standard deviation	f	Significance level
Metaverse experience factor	Construction industry	70	3.27	0.465	374.17	0.000***
	Electricity industry	70	3.35	0.524		
	Facility industry	70	2.37	0.358		
	Firefighting industry	70	1.78	0.266		
Satisfaction with fire safety education	Construction industry	70	3.17	0.356	336.24	0.000***
	Electricity industry	70	3.38	0.486		
	Facility industry	70	2.49	0.265		
	Firefighting industry	70	1.86	0.189		

Note: Analysis on job difference.
***p<0.001.

Table 7. Analysis on difference of employment history.

Category	Work experience	N	Average	Standard deviation	f	Significant
Metaverse experience factor	Less than 5 years	34	2.71	0.107	462.23	0.000***
	5 to less than 10 years	87	3.45	0.471		
	10 to less than 20 years	95	3.37	0.361		
	Over than 20 years	64	2.37	0.271		
Satisfaction with fire safety education	Less than 5 years	34	2.38	0.12.3	474.21	0.000***
	5 to less than 10 years	87	3.94	0.67.3		
	10 to less than 20 years	95	3.52	0.392		
	Over than 20 years	64	2.74	0.294		

Note: ***p<0.001.

Table 8. Analysis on position difference

Category	Rank	N	Average	Standard deviation	f	Significance level
Metaverse experience factor	Staff	124	3.67	0.421	567.25	0.000***
	Agent	103	3.154	0.267		
	Manager	47	2.331	0.314		
	Director	6	1.665	0.0365		
Satisfaction with fire safety education	Staff	124	3.541	0.656	317.62	0.000***
	Agent	103	3.621	0.234		
	Manager	47	2.422	0.321		
	Director	6	1.365	0.541		

Note: ***p<0.001.

4.4. Effect of Experience Factors on Education Satisfaction (Multiple Regression Analysis)

In this study, multiple regression analysis was performed to verify and analyze the effect of metaverse experience factors on fire safety education satisfaction.

Looking at the regression analysis as shown in Table 9, the variable among the experiential factors had the greatest effect on satisfaction with fire safety education.

Multiple regression analysis was performed on the effect of the metaverse experience factors on educational satisfaction. As a result of regression analysis, the explanatory power of the metaverse experience factor was about 31.1% and it was statistically significant in the relationship of satisfaction with safety education (F=25.562, p<0.01). Since the Durbin-Watson statistic is 1.471 which is close to the reference value of 2, it was judged that there is no multicollinearity. As a result of testing, the significance of the regression coefficient was found that metaverse educational experience had a significant positive effect on satisfaction with fire safety education (β= 0.594, p<.01).

Metaverse deviant experience, metaverse aesthetic experience and metaverse recreational experience have a positive effect on the relationship between safety education and satisfaction.

Comparing the size of the standardization coefficient, the metaverse educational experience had the largest effect on satisfaction with fire safety education (β = 0.594) followed by the deviant experience (β = 0.514) and entertainment experience. It was verified to have an effect on the satisfaction of safety education in the order of the physical experience (β = 0.025) and the aesthetic experience (β = 0.014). The analysis results are shown in Table 9. The effect of experience factors on satisfaction with firefighting safety education is given in Table 9.

Table 9. Effects of experience factors on satisfaction of the fire fight safety education.

Category	B	B	S. E	t	p	VIF
Educational experience	0.358	0.594	0.026	13.92	0.002	1.345
Deviant experience	0.436	0.514	0.032	14.25	0.000	1.365
Aesthetic experience	0.001	0.014	0.025	0.032	0.000	1.425
Recreational experience	0.002	0.025	0.036	0.025	0.001	1.471
F=25.562 P<.000b) R = 0.578a, R^2 = 0.311 Adjusted R^2 = 0.308, D-W=1.47						

4.5. Validation of the Research Hypothesis

In this study, a research model was established based on research questions to verify the relationship between metaverse utilization experience factors and fire safety education satisfaction and the research hypothesis was verified as follows:

4.5.1. Research Hypothesis 1 Verification

Hypothesis 1: Educational experience will have a positive effect on satisfaction with safety education.

The analysis of this study shows that metaverse educational experience (β= 0.594 p<0.001) had a positive effect on fire safety education satisfaction and the significance level had a statistically significant effect.
Hypothesis 2: Deviant experience will have a positive effect on satisfaction with safety education.

The analysis of this study shows that metaverse deviant experience (β= 0.514 p<0.001) had a positive effect on fire safety education satisfaction   and the significance level had a statistically significant effect.
Hypothesis 3: Aesthetic experience will have a positive effect on satisfaction with safety education.

The analysis of this study shows that metaverse aesthetic experience (β= 0.014 p<0.001) had a positive effect on fire safety education satisfaction and the significance level had a statistically significant effect.
Hypothesis 4: Recreational experience will have a positive effect on satisfaction with safety education.

The analysis of this study shows that metaverse recreational experience (β= 0.025 p<0.001) had a positive effect on   fire safety education and the significance level indicates a statistically significant effect.

5. Conclusion

This study reviewed educational, aesthetic, entertainment and deviant experiences   which are elements of the metaverse experience set them as research variables and presented the results of the study through a survey.

First, educational experience was found to be statistically significant in the relationship of satisfaction with fire safety education (F=25.562, p<0.01). The explanatory power of the regression model was about 31.1%. Therefore, in order to conduct experiential education, it can be said that the satisfaction of fire safety education increases with

the educational experience which is an element of the metaverse experience. If the content of safety education is easily understood and its three-dimensional effect and presence are additionally delivered through education to find and prevent dangerous elements in the event of an accident, it can be said that the educator positively increases the satisfaction of safety education.

Second, deviant experience was found to be statistically significant in the relationship of satisfaction with fire safety education (β= 0.514 p<0.001). Therefore, in order to conduct experiential education, it can be said that satisfaction with fire safety education increases only when a sense of immersion in the deviant experience is present. It is necessary to activate the community that can share experiences and knowledge with other users by improving the satisfaction of safety education through a sense of realism that is felt in the field.

Third, aesthetic experience was found to be statistically significant in the relationship of satisfaction with fire safety education (β= 0.014 p<0.001). Therefore, in order to implement experiential education, it can be said that the satisfaction of safety education increases when the aesthetic experience service is configured to have a three-dimensional effect.

Fourth, recreational experience was found to be statistically significant in the relationship of satisfaction with fire safety education (β= 0.025 p<0.001). In other words, it can be said that the satisfaction of safety education increases when the metaverse entertainment experience service is easily delivered in an entertaining way to the participants. It should provide interesting content, then develop recreational content and equip it with various types of content suitable for members of different ages.

This study was conducted to improve the satisfaction of fire safety education by adding realism and a three-dimensional effect through experiential contents using the metaverse to increase satisfaction with educational contents and prevent safety accidents in industrial sites.

As a future research project, continuous research is needed to strengthen various experiential educational contents based on the metaverse.

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