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A Proposal of an Educational Program Based on Case Analysis of Fashion in the Metaverse

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Abstract

Artificial intelligence(AI), virtual reality(VR), and network technology—the major technologies of the fourth industrial revolution—have ushered in the eras of metaverse of transcendent reality and big data. In these periods, training specialists through creative convergence on metaverse fashion is urgently needed. This study aims to analyze the characteristics of metaverse and cases of metaverse technology convergence in the fashion industry. Furthermore, it proposes a curriculum for fashion education programs using three-dimensional virtual content. Our findings indicate that (1) metaverse technologies, such as data technology, network technology, AI, VR, augmented reality(AR), and mixed reality(MR) technologies, are being used in various industries, including fashion, entertainment, game, electronics, and automobile industries. Hence, the market for metaverse will continue to grow (2) metaverse platforms, such as Fortnite, Minecraft, Roblox, Animal Crossing, Universe, Zepeto, and ifland, have been introducing virtual worlds, avatars, and products targeting the MZ generation(a mix of two groups—Millennials and Gen Z), their main consumer group, and are collaborating with various fashion brands. Third, the study, based on the case analysis, proposes educational programs on metaverse fashion. These are learner-centered, process-oriented, and execution-centered programs that use creative convergence education methods using design thinking at the learning, ideating, designing, making, and sharing stages. This study presents the applicability of metaverse technology as a medium for fashion education and has the potential to become basic data for creative convergence education of metaverse fashion in future.

Key words : metaverse, fashion technology, digital transformation, fashion education, online content creator

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Ⅰ. Introduction

With the acceleration of the socio-economic paradigm shift and social distancing becoming a common practice owing to the coronavirus(COVID-19) pandemic, AI and VR have become major technologies leading the fourth industrial revolution. They have the potential to start the era of metaverse of the transcendent reality of non-contact culture and big data.

The metaverse technology, mainly used in the virtual world of games, has been recently expanded and applied to other industries. Automobile manufacturer BMW uses Omniverse, a real-time three-dimensional(3D) field-work graphic simulation platform developed by NVIDIA, an American multinational technology company, to convert its automobile manufacturing system into a metaverse. Here, engineers, developers, and managers can design and simulate products while collaborating in a virtual factory in real time. Furthermore, Mercedes-Benz conducts virtual assembly education and training, and Hyundai Motors holds its car design meetings in a VR development space. Lowe's, an American interior company, provides interior experience services to customers using VR; Amazon provides an augmented reality "Room Decorator" tool to enable viewing furniture arranged in a virtual space(Lee, 2021a). Fashion brands, such as Nike, Adidas, and Kolon FnC operate showrooms in VR spaces. Lloyd's, a jewelry brand, implements an AR real-time service inside an online mall, where customers can virtually try selected products through real-time videos(Song, 2021). In the metaverse platform Zepeto, various brands, including Gucci, Ralph Lauren, Adidas, and Nike fashion brands, CU convenience store, Samsung Electronics, Hyundai Motor Company, National Museum of Korea, Ediya Coffee, and Gentle Monster have opened their online stores.

Therefore, several industrial fields have implemented marketing strategies targeting the MZ generation, major users of virtual digital services that form social relationships through social networking services(SNS) like YouTube, Facebook, and Instagram. The MZ generation includes millennials born between early 1980s and early 2000s and the Z generation born in the mid-1990s to early 2000s. The MZ generation are known to value their own styles and are the principal consumers and producers of the digital culture(Lee & Um, 2021). The metaverse enables communication with people in virtual spaces and movement between the real and the virtual world, and hence, has been receiving attention, particularly from the MZ generation.

Several studies have been conducted on these issues: One on the metaverse composition principle(Jeon, 2021); on the copyright of metaverse(Lee, 2021b); on a case of convergence of metaverse-based games and fashion(Lee & Lim, 2021); on cases of utilization of metaverse by fashion brands(Lee & Kim, 2021; Lee & Um, 2021); on ways to activate virtual spaces using metaverse(Kim & Ahn, 2021); on utilization of exhibition spaces using the metaverse technology(Kim, 2021a); on metaverse-related education(Han & Noh, 2021; Jin, 2021). However, studies on fashion education programs using metaverse are scarce.

Therefore, this study analyzes metaverse characteristics and cases of metaverse technology convergence in the fashion industry and proposed a curriculum for fashion-related education programs utilizing 3D virtual content metaverse. Furthermore, it analyzes data on fashion-brand-related cases, where 3D virtual contents and metaverse technology deployed in the fashion industry were collected from domestic and foreign academic papers, books, the Internet, and periodicals.

Additionally, our study proposes curricula for creating virtual fashion items using Zepeto Studio. It proposes developing these items into fashion products, educational curricula, or non-curricular programs related to convergence of metaverse and fashion using design thinking. It proposes fashion education programs using metaverse, presents the possibility of using metaverse technology as a medium to educate students on fashion, and is likely to provide basic data for creative convergence education of metaverse fashion in the future.

Ⅱ. The metaverse

1. Concept of the metaverse

Metaverse is a compound word; it is made of the Greek word *meta* meaning "transcendence" and *universe* meaning the world. Therefore, it means the "virtual world that transcends the real world"(Kim, 2021a). The term 'metaverse' appeared in the science fiction novel *Snow Crash* written by Neal Stephenson published in 1992. Metaverse means the coexistence of the real world and the virtual world, where the person in the former conducts overall political, economic, social, and cultural activities through a virtual avatar, thus replacing the real person in an online-based 3D virtual world(Lee & Chang, 2021).

Additionally, metaverse is an XR+D.N.A. technology that combines eXtended Reality(XR), such as computer hardware and software, 5G mobile communication technology, VR, AR, and MR, and DNA technology like the "data technology x network technology x AI". It has been applied to various fields, such as entertainment, fashion, interior, education, shopping, medical care, and product development, and is growing at a good pace(Lee, 2021a; Park, 2021).

2. Types and characteristics of the metaverse

The Acceleration Studies Foundation classified metaverse into the following four types according to the implementation space and information type: AR, lifelogging, Mirror Worlds, and Virtual Worlds(Choi & Pyun, 2021; Lee, 2021a; Smart et al., 2007) (Figure 1). First, AR superimposes a 3D virtual image on a real image, or background shows the images as a single image. To apply AR technology, a smart environment must be constructed using location-based GPS devices, the Internet, applications, and information technology (IT) devices, and so forth. Recently, representative fields where AR technology was utilized included head-up display for vehicles, Pokemon GO, and Google Glass. Second, lifelogging can be described as the "digitalization of daily life," which records an individual's daily life inspired from hobbies, health, leisure, and so forth on the Internet or smart devices. Information regarding objects and people is automatically recorded; Cyworld, Twitter, Facebook, and Instagram are typical examples. With the spread of smart mobile devices, it is widely used in daily lives along with Mirror Worlds, created via 3D simulation of the real world. It grafts information in the real world on a digital environment, utilizing diverse technologies, such as virtual maps, virtual modeling, GPS, and lifelogging. Representative fields where the Mirror World is utilized include Google Earth—which enables people to see the topographies and buildings across the world—and Airbnb, which is a platform based on sharing economy. Fourth, in VR, a virtual space built with digital data in a computer-based simulation environment, users create their own avatars

where they project themselves to explore the virtual world, engage in activities, and communicate with others. Representative fields where VR is utilized include Fortnite, Second Life, Zepeto, and ifland.

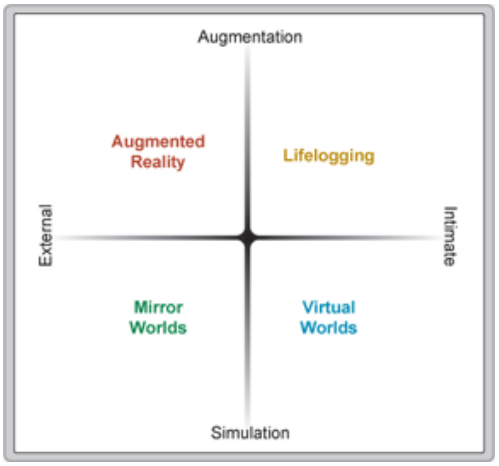

Figure 1. The metaverse roadmap: Pathways to the 3D web. From Smart et al. (2007). https://www.metaverseroadmap.org

Richman(2020) classified the metaverse into the following three types: collective virtual shared space, convergence with physical reality, and persistence. The collective virtual shared space refers to an open virtual space where everything imaginable within the metaverse is shared by everyone. Like the virtual world of massively multiplayer online role-playing games(MMORPG), the metaverse is a navigable virtual space where one can interact with others. Second, the convergence with physical reality refers to the connection between the digital world and the virtual world, and places virtual objects and events in the metaverse in the real world. Third, persistence means that the metaverse itself exists permanently regardless of whether an individual accesses it.

Ko et al.(2021) classified the metaverse into three types: game-, social-, and life/industry-based according to the purpose of expression of the metaverse and access to it. The game-based metaverse allows playing games based on Roblox, Minecraft, and Fortnite. Additionally, it provides a communication space. The social-based metaverse started from mobile apps in the form of social media such as Zepeto, Weverse, and Horizon and was developed into a metaverse, thereby enabling communication, meetings, shopping, and games. The life/industry-based metaverses graft exercise, education, simulation, and training onto game elements using a device(interface) id grafted with virtual convergence technologies like smart indoor cycling and RingFit home training.

3. Size of the metaverse market

As technologies help realize the metaverse, the demand for metaverse platforms has been gradually increasing. Additionally, as lack of physical contact has become routine due to the COVID-19 pandemic, people's interest in the virtual world and demand for metaverse technologies have risen. Following such a trend, global companies have been jumping on the bandwagon of the metaverse business. Microsoft(MS) and NVIDIA have introduced metaverse-related technologies while taking in metaverse as the next-generation core business. Social media company Facebook changed its company name to Meta, stating "Metaverse is a stage next to the Internet." It also plans to introduce Horizon, a metaverse social platform. Bloomberg Intelligence predicted that the size of the metaverse market would grow from US$478.7 billion(about 564 trillion won) last year to US783.3 billion dollars(about 923 trillion won) in 2024(Shin, 2021) (Figure 2). As the development and demand for metaverse increases, the market size has been on the rise.

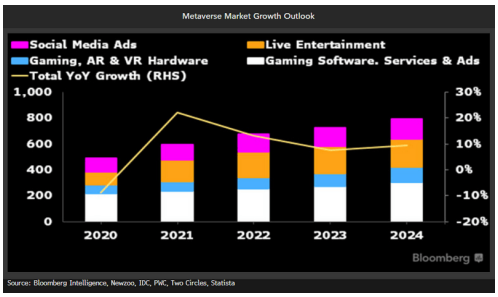

Figure 2. The size of the metaverse market.
From Bloomberg Intelligence. (2021).
https://www.bloomberg.com

Ⅲ. Cases of convergence of fashion and the metaverse

Fashion companies have been using metaverse to compete with each other. Kolon FnC has opened a showroom and a flagship store in the VR space; jewelry brand Lloyd's has carried out an AR real-time service at an online mall where customers can try on products virtually through a real-time video(Song, 2021). Metaverse platforms such as Formite, Minecraft, Roblox, Animalcrossing, Universe, Zepeto, and ifland have been presenting virtual worlds, avatars, and products to their customers.

Global fashion brands sell virtual fashion products made using digital graphics on the metaverse platform Zepeto, an augmented reality service operated by Naver Z, and provide consumers with various experiences as a strategy for effective communication between fashion brands and consumers(Choi & Suk, 2021). Virtual characters in Fortnite wear Nike products and wander around, thereby stimulating a desire to purchase similar products among other players. Luxury brand Valentino held a fashion show for its newly launched products in the Nintendo game Animal Forest, wherein virtual characters live with their neighbors in a virtual village. Luxury brand Gucci opened a virtual store in Zepeto where it sells real clothes in online shopping malls. It also promotes sales of virtual game players in collaboration with Tennis Clash developed by the game company Wildlife Studios(Lee, 2021a). In the case of Streetify, a British virtual shopping platform, users can walk through virtual streets, enter stores of interest, and do virtual shopping as if they were shopping in a real offline store. They can create their own shopping streets and share them on social media(Lee, 2021a). Users of ifland, a service operated by SK Telecom that targets the MZ generation, can create their own sub-character(another character other than the original character) in the virtual world and interact with people through social activities such as SNS within the metaverse while going about their daily lives(SKtelecom, 2021).

A virtual influencer, Shudu, worked as the first digital fashion model for global brands such as Cosmopolitan, Vogue, and Balmain. Virtual male and female characters, named Seo Hae-ju and San Ji-su of LF Hazzys, created an official Instagram account as virtual influencers. Virtual human Lil Miquela, introduced by Brud, an American AI start-up company, is a model for Chanel and Prada. It is also a musician that recently released its single album(Kim, 2022; Lee, 2021a).

As interest in sustainable fashion rises, brands such as The Fabricant, which designs virtual clothing items utilizing 3D CLO software and block chain technology, enable consumers to dress their avatars in the virtual worlds and provide services through smartphones equipped with an AR player and VR headsets. This is quite unlike the existing fashion brands that simply release fashion products on the metaverse. Iridescence, the world's first digital-only dress, produced by The Fabricant in 2019, was auctioned at $9,500. In 2020, Leela, a virtual costume platform, was launched to

enable users to create their own virtual avatars and select virtual costumes, thereby providing the MZ generation with opportunities to experience and enjoy virtual digital fashion(Park, 2021). Additionally, Fapik provides a variety of 3D content production services: converting 2D objects to 3D, 3D scanning, 3D avatar and dummy production, 3D costume production, 3D image production, digital look book production, fashion show video production, and virtual showroom production. The 3D virtual try-on systems, such as CLO, enable working on part of clothing product development processes that range from the creation of a virtual fitting model to pattern production, design development, textile design, color combination, artwork image mapping, sample production, and so forth in virtual spaces. Furthermore, they provide diverse services such as VR stores, AR showrooms, and holograms(Oh & Ryu, 2015; Yoo, 2021).

1. Zepeto

Zepeto, an augmented reality metaverse platform, was launched in August 2018. It is functional in more than 200 countries, including Korea, China, Japan, and the United States. It is popular among the Z generation that enjoys communication, collaboration, and creation. Zepeto's global cumulative number of subscribers exceeded 300 million and its cumulative item sales reached 2.3 billion pieces in 2022, indicating its rapid growth into being the Asia's No. 1 metaverse platform (Hwang, 2022). On this platform, users can play games and participate in activities with other users in a virtual space with their own avatars customized firsthand. Users can meet their friends from all over the world on the 3D world map and use photo and video booths, where they can enjoy K-pop dances among other things. Moreover, unlike the existing SNS like Instagram and Facebook, where users can express themselves, users can carry out SNS activities to upload virtual characters on their feed and communicate with their offline friends or those they met on Zepeto.

Zepeto has established itself as a platform where users can enjoy more diverse global intellectual property rights(IP) through partnerships with entertainment companies like Hybe Co., Ltd(a South Korean multinational entertainment company), JYP Entertainment Corporation(a South Korean multinational entertainment and record label conglomerate), and YG Entertainment Inc(a South Korean multinational entertainment agency). Fashion brands that operate collaboration shops in Zepeto include companies such as Gucci, Dior, DKNY, Ralph Lauren, MCM, Nike, Adidas, Puma, MLB, and Tonymoly. Zepeto users can purchase branded clothes, shoes, hats, and accessories, and put them on their avatars using Zem or coin obtained via cash payment. The Z generation, the main users of Zepeto, are emerging as the main customer base; luxury brand products, difficult to purchase in the real world, can be bought at lower prices at Zepeto. Fashion companies have been analyzing Generation Z's consumption trends, for they are the future consumers, have a higher potential purchasing power, harbor interest in fashion, and are competitively advancing into Zepeto to secure future consumer groups(Hwang, 2022; Lee, 2022a).

Luxury fashion brand Gucci provides a 3D world map, Gucci Villa, on Zepeto. In this virtual space, users can try on Gucci fashion items and communicate with users from other countries while walking through the European-style buildings and beautiful gardens that embody the brand's unique colors and patterns against the backdrop of Firenze(Figure 3). This is used to sell relevant products through virtual collection items that

Figure 3. Gucci x Zepeto.
From Gucci×Zepeto. (n.d.).
https://www.gucci.com

Figure 4. Ralph Lauren x Zepeto.
From Choi. (2021b).
http://tnnews.co.kr

Figure 5. MCM x Zepeto.
From Choi. (2022).
https://www.meconomynews.com

Figure 6. Covernat x Zepeto.
From Choi. (2022).
https://www.meconomynews.com

embody the actual products as they are. This helps the brand implement a marketing strategy for the Z generation(Lee & Chang, 2021). In the Loubiworld, created by luxury brand Christian Louboutin inside Zepeto, users naturally acquire that brand image by wearing Christian Louboutin clothes, and clicking and uploading selfies. Fashion brand Ralph Lauren offers a service that enables customers to decorate their 3D avatars with his products at the Ralph Lauren World, including Madison Avenue flagship store in New York, Ralph's Coffee, and Central Park(Figure 4). Global fashion brand MCM Worldwide launched MCM Cubic Map as a utopian world where reality and fantasy coexist in Zepeto. This was done to strengthen brand awareness not only among consumers in their 20s and 30s, but also among those in their teens. It displays virtual fashion items such as branded clothes, bags, hats, accessories, and so forth(Figure 5). Barrels' casual brand Covernat has also opened a brand hall that offers a variety of attractions and unique experiences in Zepeto. Consumers who visit the Covernat Brand Hall can appreciate Covernat's popular items such as C logo knit and sweatshirt in the metaverse space(Figure 6). Cosmetic brand Hera and Etude of Amore Pacific have been conducting active marketing, such as operating a pop-up space where Zepeto users can virtually experience makeup zones, photo zones, and new collection products. Tonymoly opened Hongdae Tonymoly World, especially designed for taking proof shots. On Zepeto, users can travel by car across the virtual Hongdae street comprising the Tony Street Zone, Jump Map Zone, Busking Zone, Driving Zone, and Graffiti Zone. It was organized as a space where users could meet the virtual influencer character Tony. The companion animal character, Moly, was used to push sales by promoting the brand to the MZ generation(Choi, 2021a; Choi, 2022).

Beyond enjoying virtual content, Zepeto users and creators firsthand produce and sell items such as avatar costumes and 3D worlds in their Studio. Along with the user-generated content(UGC), Zepeto is establishing itself as a new SNS genre with focus on Z generation. Influencers and creators on Zepeto are gradually becoming as active as influencers on YouTube and TikTok.

2. Fortnite

Fortnite is a free-to-play battle game produced by Epic Games, consisting of four types: “Fortnite Save the World,” a competition among computers, “Fortnite Battle Royale,” a competition among users, “Forkley,” where users build their island, and “Party Royale,” a space for communication between users. At Party Royale, users can enjoy concerts, parties, and film festivals. They can live their daily lives in the virtual world and experience live events related to the real world.

Fortnite also collaborated with luxury fashion brand Balenciaga and was produced in the form of non-fungible token(NFT) game items and actual clothes. NFT products produced by Balenciaga include hats, T-shirts, and hood T-shirts, which were applied to four popular characters in Fortnite: Doggo, Ramirez, Knight, and Banshee. Simultaneously, actual clothes with the logos of Fortnite and Balenciaga were sold on Balenciaga’s website(Suh, 2021) (Figure 7).

3. Roblox

Roblox is an online game-based 3D virtual platform, a metaverse platform where users can program games in the Roblox Studio and enjoy those created by other users. In Roblox, virtual currency called Robux can be used to buy, trade, sell, and create virtual items to decorate virtual characters.

Figure 7. Balenciaga x Fortnite.
From Suh. (2021).
https://gametoc.hankyung.com

Figure 8. Tommy Hilfiger x Roblox.
From Lee. (2022b).
https://fpost.co.kr

Figure 9. Gucci x Roblox.
From Kim. (2021b).
http://www.atlasreview.co.kr

Global fashion brand Nike introduced Nike LAND, a digital showroom space where Nike products can be worn and purchased by virtual avatars on Roblox. Fashion brand Forever 21 has enabled users to not only buy and sell Forever 21 products in the virtual world Forever 21 Shop City, but also create their own store and manage all aspects of game play. Ralph Lauren

also launched a virtual digital fashion line on Roblox, and Tommy Hilfiger provided a service targeting the MZ generation through virtual clothing collections for which Roblox platform users firsthand create their own styles (Figure 8). Gucci provides a service to sell its bags in the Gucci Garden Archetypes virtual garden based on the Firenze Palace(Kim, 2021b; Lee, 2022b) (Figure 9).

Ⅳ. Design thinking and digital virtual fashion education program

1. Design thinking education program

Several universities have recently provided students with opportunities to experience an education curriculum based on design thinking(Chon & Hwang, 2019; Lee & Lee, 2018; Lim et al., 2021). Design thinking aims to improve users' experiences with the designers' creative problem-solving methods. It seeks to look at problems from the same perspective as that of the users, empathize with them about their problems, and provide solutions for them. Among design thinking processes, the "empathize, define, ideate, prototype, and test" stages, proposed by Stanford Design School, are the most widely recognized. In the empathize stage, designers are inspired to first understand people before they begin designing in earnest. In the define stage, problems that need to be solved are defined while organizing and analyzing the numerous data obtained at the empathy stage. In the Ideate stage, free ideas are derived through brainstorming and the most appropriate idea determined. Prototype stage involves making a prototype based on the decided idea. The test stage involves reviewing the produced prototype and collecting user opinions to revise and supplement the prototype(Lim et al., 2021). The double diamond model 4D of the Design Council encompasses repetitive thinking, termed converge and diverge, via feedback between the diamond-shaped stages that comprise "discovery, definition, develop, and deliver"(Nam, 2022). The design thinking process suggested by Woo(2017) consists of "understand, empathize, ideate, and prototype" stages. The understand stage encompasses understanding the design thinking guide and problem situations, seeking solutions, and understanding the knowledge related to problems. The empathize stage requires empathizing with users through interviews and questionnaire surveys, collecting data, and sharing results. The ideate stage is where a problem is defined and an idea generated to clarify the topic and set concrete directions. Finally, the prototype stage is where a prototype is completed through visualization and testing(Yu & Lee, 2021).

Studies on the development of education programs using the design thinking process include: On development of a design thinking education program for creative problem solving(Nam, 2022); on the development of middle school home economics classes using design thinking techniques(Yu & Lee, 2021); on the development of an extracurricular design thinking program as a creative convergence competency education model(Lim et al., 2021); on the design thinking process for university classes(Lim & Kim, 2021). In this study, referring to the design thinking process models of previous studies, a program on metaverse fashion program developed in the following five stages: learn, ideate, design, make, and share. The learning stage encompassed empathizing with users and collecting and analyzing data; the ideate stage was used to set concrete

directions of the brand concept and identity and decide ideas. The design stage was where a design was made on the decided idea; the make stage encompassed producing a prototype; and the share stage was where a user test was carried out for the produced prototype to evaluate it.

2. Digital virtual fashion education program

The processes of clothing planning, production, sales, and distribution are being digitized in the apparel and fashion industries. The CAD/CAM technologies, which began to be introduced into the domestic fashion industry in 1970, have been introduced in earnest from the early 1980s. Clothing and fashion-related departments of domestic universities have developed and applied CAD education programs to cultivate apparel CAD specialists. Additionally, from the end of the 1990s, 3D virtual clothing programs, such as Lectra, OptiTex, V-Stitcher, i-Designer, DC Suite, and CLO 3D, began to be universalized worldwide. These focused on 3D CAD development firms; virtual fashion education programs using 3D virtual clothing programs were gradually developed and run(Lee & Sohn, 2011). Examples of domestic and foreign education programs include an online distance education program implemented by the Fashion Institute of Technology(FIT) in New York, USA, and Simon Fraser University(SFU) in Vancouver, Canada, in 2004. A project was implemented wherein a 2D fashion design was carried out by the FIT, and 3D virtual clothing was produced by the SFU using Adobe Atmosphere program. The University at Buffalo implemented the Virtual Fashion(VF) project titled SLCC 2007 “Educational Simulations in Second Life for Fashion Technology Students” at the virtual campus named Second Life. This digital virtual fashion education was carried out as a 15-week educational curriculum in which the processes of fashion design, product development, presentation, marketing, promotion, and virtual fashion show were implemented using computer graphic programs and 3D apparel CAD programs. This curriculum consists of the following five stages: Stage 1 “Second life sign on,” Stage 2 “Create avatar,” Stage 3 “First T-shirt project in Second Life,” Stage 4 “Fashion collection presentation package,” and Stage 5 “Prepare for the virtual fashion show.” The first stage “Second life sign on” was where students logged in Second Life, an online multimedia platform that allows people to create an avatar for themselves, and virtual fashion education on basic tools was implemented. The second stage, “Create avatar,” was where students created their own various virtual avatar characters in the Second Life menu. The third stage, “First T-shirt project in Second Life,” was where students created virtual clothes of various designs such as T-shirts using the Second Life template and upload image files to put them on the virtual avatar. The fourth stage, “Fashion collection presentation package,” was where students produced virtual clothes using the 3D apparel CAD system through virtual clothing pattern production, virtual sewing, textile design, and 3D simulation, and made virtual fashion collections and portfolios. The fifth stage, “Prepare for virtual fashion show,” comprised a virtual fashion show where students’ virtual clothes outcomes were evaluated as the last stage of the curriculum. In South Korea, the Digital Fashion Center at Silla University has implemented practitioner-centered training programs, such as practical pattern making, 3D virtual costume simulation, and textile design for incumbents of textile and fashion companies since 2010. Additionally, almost all apparel and fashion-related departments of domestic universities have developed and implemented

3D virtual clothing education programs. Renowned overseas fashion schools such as FIT, Parsons School of Design, Central Saint Martins, London College of Fashion, and many universities in South Korea actively implemented 3D virtual clothing education(Lee & Sohn, 2011; Pak & Lee, 2022).

Ⅴ. Proposal of education programs for convergence between fashion and the metaverse

In the era of digital transformation triggered by the fourth industrial revolution, technologies such as the Internet of Things(IoT), cloud computing, AI, and big data solutions are converging with various industrial fields to create information and communication technology(ICT)-based metaverse platforms. Looking at the cases of metaverse in the field of education, the University of California, Berkeley opened a virtual campus in Minecraft and held a graduation ceremony. The Pennsylvania State University opened a classroom in Minecraft as an alternative to offline classroom lessons and conducted classes to provide an educational environment wherein learners could interact with each other.

Among domestic universities, Soonchunhyang University held a no-contact entrance ceremony in 2021 using the ifland Jump app of SKT, as part of which freshmen entered a virtual entrance ceremony space with their virtual avatars wearing the department jumper. Konkuk University collaborated with Playpark, a VR game company, to hold a university art festival with a metaverse in the virtual campus space Konkuk Universe. In the virtual space that looks like a reproduction of the Konkuk University campus, students can create their own avatars and purchase clothes with the money obtained through virtual campus activities(Han & Noh, 2021). Sookmyung Women's University held a school festival on the virtual campus Snowverse, wherein the Sookmyung Women's University campus was brought together with Mammosix. In this virtual space, students created their own characters and participated in guerrilla events and running competitions(Han, 2021). Sungkyunkwan University held the Sungkyun Hangeul Essay Contest using metaverse platforms like ifland, Zoom, and eX-campus. As such, metaverse technology is still being used as an auxiliary function for school events or curriculum activities in education; going forward, metaverse would be utilized for concrete and actual curriculum activities and as curricula for training professional human resources in diverse major fields.

From enjoying blockbuster games and consuming items once upon a time, we are now on to creating and selling games, YouTube video content, and virtual content on an online platform. Professional makers, who are online content creators in the metaverse era, develop and sell online content products, while simultaneously playing the roles of imaginers, manufacturers, producers, and consumers who utilize the cutting-edge technology in the online space. Creators of Zepeto firsthand produce and sell virtual content items such as virtual items and 3D worlds in Zepeto Studio. In line with a rapidly changing environment, changes such as curriculum development for nurturing fashion-related online content creators should be attempted in fashion major education as well.

This study proposes a curriculum for creating virtual digital fashion content using metaverse for subjects in fashion majors and developing content into products. This educational curriculum will be applied to three

credit subjects related to bachelor and master for fourth-grade undergraduate students and graduate students who have completed 3D modeling-related subjects such as Maya, AutoCAD, and 3ds Max. Additionally, this study aimed to structure an educational curriculum using design thinking among creative convergence educational methods for learner-, process-, and practice-centered project learning and creative production. In this study, referring to digital fashion education program and design thinking process models of previous studies, a metaverse fashion education program was developed in five stages: learn, ideate, design, make, and share(Figure 10). The educational goals and practice plans for each step are as follows.

Stage 1 [Learn]

- *Trend research and market survey (weeks 1)*

As the first stage of the project, 'trend research and market survey' should be conducted. Various environmental information across society is collected and information on domestic and oversea fashion markets and related industries, cases where the metaverse was used in the fashion industry, information on fashion brands and consumers and lifestyles on metaverse platforms, fashion trends and virtual content product trends are analyzed.

Stage 2 [Ideate]

- *Brand identity & Concept (week 2)*

Through fashion brand analysis, consumer analysis, and product analysis of the metaverse platform, target consumers of this project and the brand identity and concept differentiated from other brands for product development are set.

Stage 3 [Design]

- *Development of virtual content fashion product design (weeks 3)*

A design concept is set, and designs of colors, textiles, silhouettes, details, items, and accessories are planned. Design ideas are created and developed, and styling is developed through design sketches and coordination between items.

Stage 4 [Make]

- *Production of content items using the template editor (weeks 4-5)*

A Zepeto account is made on the Zepeto Studio homepage, and the program is downloaded and installed. Using the template editor to make customized items by modifying the 2D graphic image of the texture file included in the template.

The list of templates supported by Zepeto Studio is checked, and the template of the item to be made is selected from the list of templates and downloaded. A texture graphic is designed based on the UV grid image and texture graphic image of the item utilizing an image editing program such as Adobe Photoshop. This texture file is uploaded, and the item design worked is checked using the Zepeto preview function.

- *Content item production using 3D Modeling (weeks 6-13)*

Using 3D modeling software such as Maya, 3ds Max, AutoCAD 3D, etc., 3D works such as modeling and rigging is performed to produce virtual content fashion items. The list of item categories supported by Zepeto Studio is checked, and modeling files for tops and bottoms, shoes, hair, headwear, bag, gloves, and glasses suitable for the design concept and the design worked are downloaded. After performing 3D modeling, mapping, and rigging work on the downloaded item file, the item file is converted into a Zepeto extension

file with Unity.

- *Thumbnail production and submission for examination (week 14)*

If a content item has been produced using the template editor or 3D Modeling, whether the item was produced well will be checked with the item preview function of the Zepeto app. Item thumbnails are made to effectively promote the items produced to Zepeto users. The items through this process are submitted by clicking 'Submit for Examination'.

Stage 5 [Share]

- *User test and prototype evaluation (weeks 15)*

User tests are conducted on the results of Zepeto virtual content items produced for Zepeto users, and creativity, practicality, product value, and improvement points are evaluated.

Ⅵ. Conclusion

Metaverse technology convergence in the fashion industry has been on the rise, and to respond to the foregoing, the development of related education programs is crucial to foster creative convergence talents in education. This study analyzed metaverse characteristics and cases of metaverse technology convergence in the fashion industry and proposed a curriculum for fashion-related education programs using 3D virtual content metaverse.

The findings of this study are as follows.

First, as metaverse technologies such as data, network, AI, VR, AR, and MR technologies have been developed by the fourth industrial revolution, such technologies are utilized in various industrial fields such as fashion, entertainment, games, electronics, and automobile industries, and the metaverse market size will also continue to grow.

Second, metaverse platforms such as Fortnite, Minecraft, Roblox, Animalcrossing, Universe, Zepeto, and ifland are presenting virtual worlds, avatars, and products, and are carrying out collaborations with various fashion brands. Zepeto is running collaboration shops with fashion brands such as Gucci, Dior, DKNY, Ralph Lauren, MCM, Nike, Adidas, Puma, MLB, and Tonymoly. Furthermore, Fortnite collaborated with luxury fashion brand Balenciaga, and Roblox with Nike, Forever 21, Ralph Lauren, Tommy Hilfiger, and Gucci fashion brands.

Third, based on the case analysis, this study proposed metaverse fashion education programs using creative convergence education methods. It proposed education curricula that progress in the stages of trend research and market survey, brand identity and concept, virtual content fashion product design development, content item production using the template editor, content item production using 3D modeling, thumbnail production and submission for examination, user test and prototype evaluation in order of precedence.

Information, network, computer graphics, VR, AR, MR, XR, and AI technologies have brought digitization and metaverse convergence to the apparel and fashion industry. While apparel CAD technology has made a part of the clothing production process convenient and faster, 3D virtual clothing technologies, including pattern design, textile mapping, and 3D clothing simulation, have changed the industry's communication method and production process. Both apparel export vendors and domestic brands have introduced 3D virtual clothing systems and are actively hiring

manpower for 3D virtual fashion designing jobs, where one can design traditional fashion as well as 3D virtual fashion. The 3D virtual fashion design job, which uses 3D virtual clothing programs to design and produce virtual clothing, is new and promising. As sales networks using social media were formed, the phenomenon where anyone could produce and share various contents became a culture. Creative content is emerging as a new occupation. Additionally, newer jobs that have stemmed from the metaverse craze include virtual fashion content designers and creators on metaverse platforms such as Zepeto and Roblox. Global fashion brands are entering metaverse platforms, launching fashion items, and conducting marketing. They continue to actively develop virtual content fashion products and hire professional manpower in related fields.

In response to these changes, departments related to clothing and fashion should develop and apply metaverse fashion convergence education programs. With the metaverse fashion convergence education program developed in this study, it is expected that clothing and fashion majors will be hired by fashion companies as competitive, talented people who can not only do fashion design and 3D virtual clothing design work, but also engage with fashion design production work using 3D modeling technology on metaverse.

The findings of this study can be utilized not only as educational programs for nurturing professional human resources in higher education college courses, but also in secondary and high school non-curricular programs and in other educational institutions. Furthermore, this study presented the possibility of using metaverse technology as a fashion education medium and is expected to become basic data for creative convergence education of metaverse fashion hereafter. Studies that apply metaverse fashion education curriculums, as proposed in this study, and those on metaverse and fashion utilizing big data analysis should be conducted in future.

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패션과 메타버스의 융합 사례 분석 및 교육 프로그램 제안

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요 약

4차 산업혁명시대의 인공지능, 가상현실, 네트워크 기술은 초월현실의 메타버스 시대와 빅데이터 시대를 열어나가고 있다. 이러한 시대에 메타버스 패션의 창의융합 교육을 통한 전문인 양성이 시급한 실정이다. 본 연구의 목적은 메타버스 특성, 패션산업에서의 메타버스의 기술 융합 사례들을 분석하고 3D가상콘텐츠 메타버스를 활용한 패션 관련 교육 프로그램을 위한 커리큘럼을 제안하는 것이다. 연구 결과는 다음과 같다. 첫째, 4차 산업혁명으로 데이터 기술, 네트워크 기술, 인공지능 기술, 가상현실 기술, 증강현실 기술, 혼합현실 기술 등의 메타버스 기술의 발전으로 패션, 엔터테인먼트, 게임, 전자, 자동차 산업 등 다양한 산업분야에서 활용되고 있으며 메타버스의 시장규모도 지속적으로 성장할 것이다. 둘째, 포트나이트, 마인크래프트, 로블로스, 동물의 숲, 유니버스, 제페토, 이프랜드 등의 메타버스 플랫폼에서 주 소비자층인 MZ세대를 타켓으로 한 가상 세계, 가상 아바타, 가상 제품들을 선보이고 있고 있으며 다양한 패션 브랜드와의 콜라보레이션을 진행하고 있다. 셋째, 이러한 사례 분석을 토대로 디자인씽킹 창의융합 교육방법을 활용하여 학습자 중심, 과정 중심, 실행 중심을 기반으로 한 교과 또는 비교과 프로그램의 메타버스 패션 교육 프로그램을 제안하였다. 본 연구는 패션 교육 매체로서의 메타버스 기술의 활용 가능성을 제시하고 향후 메타버스 패션 창의융합 교육을 위한 기초 자료가 될 것으로 기대된다.

주제어 : 메타버스, 패션 테크놀로지, 디지털 전환, 패션 교육, 온라인 콘텐츠 크리에이터