Journal of the Korean Applied Science and Technology
Vol. 41, No. 3. June, 2024. 771~783
ISSN 1225-9098 (Print)
ISSN 2288-1069 (Online)
http://dx.doi.org/10.12925/jkocs.2024.41.3.771

Analysis of Acceptance Intentions for Digital Technology Education among Beauty Industry Learners

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(Received May 30, 2024; Revised June 23, 2024; Accepted June 25, 2024)

뷰티분야 학습자의 디지털 기술 관련 교육에 대한 수용 의도 분석

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(2024년 5월 30일 접수; 2024년 6월 23일 수정; 2024년 6월 25일 채택)

Abstract : The analysis of beauty major students' acceptance intentions for digital new technologies revealed that subjective norms and self-efficacy significantly impact ease of use as mediating variables, and willingness to innovate and self-efficacy significantly impact usefulness as mediating variables. However, willingness to innovate did not significantly impact ease of use, and subjective norms did not significantly impact usefulness. Ease of use and usefulness significantly impacted acceptance attitude, and acceptance attitude significantly impacted acceptance intention. These results suggest that while beauty major students recognize the positive necessity of new technology application in the beauty field, they may feel somewhat burdened by learning and utilizing new technologies. Learners' fear of applying new technologies could result in a reluctance to take courses necessary for understanding and acquiring digital new technologies. To address this, it is necessary to analyze the basic knowledge level of digital technology among beauty major students and develop lower-level related courses and programs to help them easily understand digital new technologies.

Keywords : Beauty care, Digital new technology, Acceptance Attitude, Acceptance intention, beauty field, Innovation willingness, Subjective norm, Self efficacy

요 약 : 본 연구는 뷰티 분야에서 디지털 기술 적용 및 혁신수용으로 나타나는 변화에 대한 인식개선 및 해결방안으로 뷰티관련 전공 학습자들의 신기술 수용의도를 분석하여 뷰티산업을 이끌어 갈 예비 뷰티 서비스 전문가들에게 필요한 전문적인 디지털 관련 기술 교과목을 개설하여 교육하고, 신기술을 적용할 수 있는 능력을 배양하여 디지털 기술에 대한 인식도가 높은 뷰티 전문가 배출의 가능성을 알아보고자 하였다.

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뷰티전공 학습자의 디지털 신기술 수용의도를 분석한 결과 신기술에 대한 주관적 규범, 자기효능감은 매개변수인 용이성에 유의미한 영향을 미치는 것으로 나타났으며, 혁신의지와 자기효능감은 매개변수인 유용성에 유의미한 영향을 미치는 것으로 나타났다. 그러나 혁신의지는 용이성에 유의미한 영향을 미치지 않는 것으로 나타났다. 또한 용이성과 유용성은 수용태도에 유의미한 영향을 미치는 것으로 나타났으며, 수용태도는 신기술 수용의도에 유의미한 영향을 미치는 것으로 나타났다. 이러한 결과를 종합하여 볼 때 뷰티전공 학습자들의 디지털 기술 관련 기초지식 수준을 분석하고, 디지털 신기술과 관련한 기초지식을 습득할 수 있도록 비교적 낮은 수준의 관련 교과목 개발 및 프로그램을 활용하여 뷰티전공 학습자들이 디지털 신기술을 쉽게 인식할 수 있는 변화의 계기가 마련될 필요가 있다.

주제어 : 뷰티케어, 디지털 신기술, 수용태도, 수용의도, 뷰티산업, 혁신기술, 주관적 규범, 자기 효능감

1. Introduction

The Fourth Industrial Revolution, first introduced by Schwab (2016) at the World Economic Forum Annual Meeting in Davos, Switzerland, is expected to bring about various socio-economic changes due to technological changes at an unprecedented level compared to previous industrial revolutions. The Fourth Industrial Revolution predicts significant changes in our daily lives, ways of working, and existing business methods, particularly forecasting revolutionary changes in consumer trends [1]. With the development of science and technology due to the technological revolution and the prolonged experience of Covid-19, the shift in consumption towards contactless services and the acceleration of consumer demand to meet individual preferences and lifestyles are evident[2]. Various forms of digital technologies, known as core technologies of the Fourth Industrial Revolution, such as artificial intelligence, the Internet of Things, virtual reality, augmented reality, robotics, and big data, can all be actively utilized in contactless services. These digital technologies fundamentally replace human interaction and can perform tasks traditionally done offline through online platforms, enabling digital methods for various socio-economic activities[3]. However, these digital technologies are not applicable to all industrial fields. For example, jobs requiring relationship-building and emotional skills through direct human interaction or jobs where the systematization of non-standardized skills is crucial are challenging to replace with digital technology[4]. The beauty industry, previously considered unrelated to digital technology, has seen the development of various personalized service devices by experts in new technologies. Nevertheless, beauty industry workers still perceive their industry as one relying solely on human senses. There is also a prevalent stereotype that the beauty industry is unrelated to the digital revolution, with concerns that digital technology may negatively impact job opportunities[5]. E.H. Park(2021) revealed that beauty industry workers' awareness of digital new technologies in the Fourth Industrial Revolution era is low. Beauty tech, developed using technologies like artificial intelligence and big data analysis, is predominantly driven by large corporations, with limited opportunities for small business owners and beauty workers to engage with these technologies, resulting in a general lack of understanding and utilization[6]. The evolution of the beauty industry is mainly driven by large companies willing to invest boldly to quickly adopt and apply changes, continually advancing through the integration of IT technology. BeautyTech, a fusion of beauty and technology, is also known as Smart Beauty. It is widely applied in the cosmetics industry, offering consumers new

experiences such as personalized cosmetic manufacturing[7]. BeautyTech uses algorithms and AI technology to precisely analyze consumers' skin conditions and employs experiential technologies like AR and VR to enhance customer convenience and provide new experiences through mobile apps, actively utilized in marketing[8]. The issue with the application of these positively impactful digital technologies is the low awareness among beauty service workers. The beauty service industry has traditionally evolved based on human service and technical sensibility, with a significant emphasis on the role of human resources directly providing services. However, despite being a crucial human service industry, high labor intensity leads to high turnover rates and persistent issues of declining service quality[9].

Recent studies on the application of digital technology in the beauty field have shown that the convergence of beauty and digital technology has positive impacts. However, the reluctance of beauty service workers to embrace digital technology might be a reason for the low direct utilization of such technology in the beauty industry. Therefore, there is a need to improve the awareness of digital technology among beauty major students at universities, who will become experts in the beauty industry, and beauty workers in the industry. This study aims to analyze the acceptance intentions of beauty-related major students for new technologies to establish and apply specialized digital-related technology courses necessary for future beauty service experts, thereby enhancing the possibility of producing beauty experts with high awareness of digital technology. The purpose is to present measures for activating education related to new technologies in the beauty field by analyzing how variables like learners' willingness to innovate, subjective norms, and self-efficacy, as independent variables, affect acceptance attitudes, ease of use, and usefulness as mediating variables and subsequently impact technology acceptance intentions.

2. Research method

2.1. Research Model

The structural equation model consists of three parts: independent variables, mediating variables, and dependent variables. Independent variables are set as willingness to innovate, subjective norms, and self-efficacy. Mediating variables are set as acceptance attitude, ease of use, and usefulness, and the dependent variable is technology acceptance intention. The research model is based on Y.H. Yoo's (2019) study on the "intention to use drone logistics services using the Technology Acceptance Model (TAM)" and J.S. Kim's (2004) study on "the impact of perceived security on the intention to use online shopping malls"[10,11]. The relationships among these variables are shown in Fig. 1.

2.2. Research Procedure and Statistical Analysis

The subjects of this study were 300 university students majoring in beauty-related departments at junior colleges or general universities (four-year colleges). A self-administered questionnaire survey was conducted from April 1 to April 15, 2024. The willingness to innovate, subjective norms, and self-efficacy, selected as independent variables, were measured on a five-point scale with items adapted and supplemented from scales used in studies by S.H. Park (2016) [12], Y.H. Yoo (2019) [10], S.Y. Yoo (2014), A.R. Kwon (2012), I.Y. Lee (2017)[13,14,15] [10]. Acceptance attitude, ease of use, and usefulness, selected as mediating variables, were measured on a five-point scale with items adapted and supplemented from scales used in studies by Y.H. Yoo (2019), J.S. Kim (2004)[10,11], S.K. Lee (2011), N.Y. Lim (2023)[16,17] and B.N. Son (2010)[18]. The intention to accept technology, the dependent

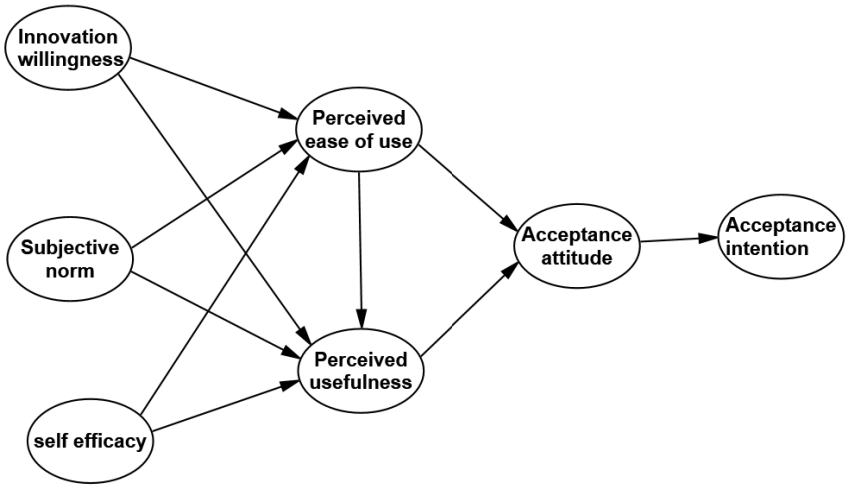

Fig. 1. Analytical model.

variable, was measured on a five-point scale with items adapted and supplemented from scales used in studies by J.S. Kim (2004)[11] and A.R. Hong (2018)[19]. The questionnaire was revised after reflecting the opinions of six professors to verify the content validity of each item, and a preliminary test was conducted to finalize the survey content. The analysis tools used were IBM SPSS Statistics 25 and IBM AMOS 25 programs.

The analysis methods were as follows: first, frequency analysis was conducted to understand the demographic characteristics. Second, Cronbach's α was calculated, and exploratory factor analysis was performed to confirm the reliability and validity of the measurement tools. Third, correlations were calculated to understand the relationships between variables, and means, standard deviations, skewness, and kurtosis were calculated to assess normality. Fourth, confirmatory factor analysis was conducted by constructing a measurement model to understand the factor structure, and model fit was assessed by calculating composite reliability(C.R.) and average variance extracted(AVE) to verify construct reliability and discriminant/convergent validity. Fifth, a structural regression model was constructed to test the hypotheses and investigate the influence of variables.

3. Results and discussion

3.1. Characteristics of Research Subjects

The demographic characteristics of the study subjects were analyzed using frequency analysis. The majority of the study subjects were female(276, 90.8%), with over 90% being 22 years old or younger. The most common year in school was the first year, with 129 students(42.4%). The majority of the subjects were in the arts and physical education field(299, 98.4%).

3.2. Reliability and Validity

The reliability and validity of the scales were confirmed by calculating Cronbach's α and performing exploratory factor analysis. The principal component analysis method was used for factor extraction, and varimax rotation was applied to clarify the factor structure. Factor coefficients above 0.4 were considered

Table 1. Demographic Characteristics

		Frequency	Percentage
Gender	Male	28	9.2
	Female	276	90.8
Age	under 20	126	41.4
	21~22	160	52.6
	23~24	13	4.3
	25~30	5	1.6
Grade	1	129	42.4
	2	99	32.6
	3	66	21.7
	4	10	3.3
Major	Fine Arts	299	98.4
	Science and Technology	5	1.6
Region	Gyeonggi-do	56	18.4
	Other	248	81.6

suitable for the respective factors. The suitability of the correlation matrix for factor analysis was verified using KMO and Bartlett tests, with KMO being above 0.7 and Bartlett test being significant, indicating suitability ($p<.001$). The factor coefficients for willingness to innovate, subjective norms, self-efficacy, ease of use, usefulness, acceptance attitude, and acceptance intention ranged from 0.455 to 0.9702, indicating validity for all factors. The cumulative variance was 69.690% for willingness to innovate, subjective norms, and self-efficacy, and 79.668% for ease of use, usefulness, acceptance attitude, and acceptance intention, which were sufficient. Cronbach's α ranged from 0.765 to 0.919, indicating stability.

3.3. Confirmatory Factor Analysis

To verify if the theoretical model assumed and the research model obtained from the sample differed, maximum likelihood estimation was used to estimate parameters and check the significance of the chi-square value for model fit. If not significant, the null hypothesis is not rejected, indicating the research model follows the theoretical model. However, since the chi-square value is sensitive to sample size, additional fit indices calculated using the chi-square value and degrees of freedom are considered. Fit indices include absolute fit indices showing overall model fit and model explanatory power, such as RMSEA (Root Mean Square Error of Approximation) and RMR (Root Mean Square Residual), and GFI (Goodness of Fit Index), which show the model improvement from the worst independent model. Incremental fit indices include NFI (Normed Fit Index), IFI (Incremental Fit Index), RFI (Relative Fit Index), TLI (Tucker and Lewis Index), and CFI (Comparative Fit Index). The suitability of the measurement model was evaluated by applying RMSEA, IFI, TLI, and CFI values.

The initial confirmatory factor analysis results for the measurement model were as follows: $\chi 2 = 1382.784$ (df=384), $\chi 2/df = 3.601$. The overall fit indices were IFI = 0.769, TLI = 0.723, and CFI = 0.767, not meeting the

Table 2. Exploratory Factorial Analysis and Reliability

	factor coefficient				factor coefficient			
Innovation technology1	0.526	0.301	0.211	Perceived usefulness1	0.845	0.289	−0.013	0.135
Innovation technology2	0.508	0.218	0.262	Perceived usefulness2	0.857	0.123	0.179	0.144
Innovation technology3	0.851	0.456	0.423	Perceived usefulness3	0.619	0.179	0.363	0.280
Innovation technology4	0.572	0.340	0.211	Perceived usefulness4	0.782	0.245	0.498	0.346
Innovation technology5	0.615	0.305	0.346	Perceived ease of use1	0.352	0.788	0.139	0.051
Subjective norm1	0.465	0.786	0.469	Perceived ease of use2	0.316	0.689	0.343	0.043
Subjective norm2	0.522	0.902	0.498	Perceived ease of use3	0.237	0.550	0.240	0.266
Subjective norm3	0.410	0.603	−0.389	Perceived ease of use4	0.381	0.600	0.253	0.228
Subjective norm4	0.411	0.726	0.398	Acceptance attitude1	0.368	0.360	0.619	0.348
Self efficacy1	0.356	0.345	0.753	Acceptance attitude2	0.204	0.395	0.793	0.196
Self efficacy2	0.311	0.236	0.557	Acceptance attitude3	0.447	0.375	0.673	0.086
Self efficacy3	0.401	0.379	0.755	Acceptance attitude4	0.376	0.127	0.589	0.260
Self efficacy4	0.51	0.478	0.848	Acceptance attitude5	0.158	0.318	0.455	0.202
				Acceptance intention1	0.304	0.161	0.194	0.795
				Acceptance intention2	0.295	0.480	0.208	0.663
				Acceptance intention3	0.296	0.218	0.256	0.791
				Acceptance intention4	0.353	0.262	0.154	0.750
eigenvalue	3.409	3.059	2.592	eigenvalue	4.335	3.644	3.130	2.435
% variance	26.222	23.532	19.935	% variance	25.500	21.438	18.409	14.322
Accumulated %	26.222	49.755	69.690	Accumulated %	25.500	46.937	65.346	79.668
Cronbach's α	.868	.765	.849	Cronbach's α	.815	.880	.916	.919
KMO=.828, Bartlett's test $x2$=2514.358, p<.001				KMO=.887, Bartlett's test $x2$=5230.395, p<.001				

Table 3. Confirmatory Factorial Parameters Estimate and AVE, CR

		B	β	S.E.	t	CR	AVE
Innovation willingness	Innovation willingness 1	1	0.863			.886	.660
Innovation willingness	Innovation willingness 2	1.133	0.829	0.064	17.823***		
Innovation willingness	Innovation willingness 4	1.18	0.786	0.072	16.406***		
Innovation willingness	Innovation willingness 5	1.099	0.749	0.072	15.256***		
Subjective norm	Subjective norm1	1	0.795			.845	.645
Subjective norm	Subjective norm2	0.881	0.833	0.063	13.935***		
Subjective norm	Subjective norm4	0.858	0.699	0.072	11.947***		
Self efficacy	Self efficacy1	1	0.673			.887	.727
Self efficacy	Self efficacy3	1.37	0.897	0.1	13.664***		
Self efficacy	Self efficacy4	1.618	0.923	0.117	13.87***		
Perceived ease of use	Perceived ease of use1	1	0.673			.895	.741
Perceived ease of use	Perceived ease of use3	0.992	0.84	0.08	12.4***		
Perceived ease of use	Perceived ease of use4	1.067	0.841	0.105	10.129***		
Perceived usefulness	Perceived usefulness1	1	0.727			.886	.722
Perceived usefulness	Perceived usefulness2	1.041	0.744	0.082	12.682***		
Perceived usefulness	Perceived usefulness3	1.077	0.854	0.074	14.592***		
Acceptance attitude	Acceptance attitude1	1	0.874			.959	.854
Acceptance attitude	Acceptance attitude2	0.955	0.81	0.053	17.958***		
Acceptance attitude	Acceptance attitude3	0.97	0.851	0.05	19.57***		
Acceptance attitude	Acceptance attitude4	0.902	0.762	0.056	16.228***		
Acceptance intention	Acceptance intention1	1	0.834			.928	.810
Acceptance intention	Acceptance intention3	0.974	0.876	0.052	18.778***		
Acceptance intention	Acceptance intention4	1.009	0.877	0.054	18.826***		
x^2=728.208, df=208, CMIN/DF=3.501, IFI=.901, TLI=.900, CFI=.901, RMSEA=.080							

recommended threshold of 0.9, while RMSEA was 0.093, above the recommended threshold of 0.08. To improve the model, items with factor loadings below 0.5, high error variances, and high modification indices between errors were reviewed. Items 3 from willingness to innovate, 3 from subjective norms, 2 from self-efficacy, 2 from ease of use, 4 from usefulness, 5 from acceptance attitude, and 2 from acceptance intention were deleted to improve model fit. The modified model results were $x2$ = 728.208 (df=208), $x2/df$ = 3.501, with overall fit indices IFI = 0.900, TLI = 0.901, CFI = 0.901 meeting the recommended threshold of 0.9, and RMSEA = 0.080, near the recommended threshold of 0.08. All factor loadings were significant, ranging from 0.673 to 0.923($p<.001$).

The reliability and validity of the factor structure were confirmed by assessing reliability and discriminant/convergent validity. Based on Fornell and Larcker's criteria (1981)[20], and Fornell et al. (1982)[21], the following steps were taken:

First, check the significance of each unstandardized coefficient.

Second, ensure the standardized coefficient of the latent variable's influence on the observed variable is above 0.7.

Third, demonstrate reliability with composite reliability above 0.7.

$$Conceptual\,Reliability\,C.R = \frac{(\Sigma Standardization)^2}{(\Sigma Standardization)^2 + \Sigma Factor\,Error}$$

Fourth, demonstrate convergent validity with AVE above 0.5.

$$AVE = \frac{(\Sigma Standardization)^2}{(\Sigma Standardization)^2 + \Sigma Factor\,Error}$$

Fifth, confirm discriminant validity by ensuring the correlation coefficient between factors is lower than the square root of AVE.

Correlation coefficients between factors, composite reliability(C.R.), and the square root of AVE were calculated and presented in 〈Table 4〉. Composite reliability (C.R.) ranged from 0.884 to 0.985, above 0.7, and AVE ranged from 0.660 to 0.956, above 0.5, indicating reliability and convergent validity. Discriminant validity was confirmed as the square root of AVE was higher than the highest correlation coefficient(0.750 between acceptance attitude and acceptance intention). The results for means, standard deviations, skewness, and kurtosis, shown in 〈Table 4〉, indicated all variables met the normality assumption, with skewness below an absolute value of 3 and kurtosis below an absolute value of 10[22-24].

3.4. Hypothesis testing

A structural regression model was constructed to test the hypotheses and investigate model fit. $x2$ = 713.448 (df=216), $x2/df$ = 3.303, with overall fit indices IFI = .901, TLI = 0.900, CFI = .901 meeting the recommended threshold of 0.9, and RMSEA = 0.081, near the recommended threshold of 0.08, indicating the structural regression model is suitable for hypothesis testing.

The paths from subjective norms(β=.346, $p<.001$) and self-efficacy(β=.528, $p<.001$) to ease of use were significant, excluding willingness to innovate. The paths from willingness to innovate(β=.263, $p<.05$) and self-efficacy(β=.360, $p<.001$) to usefulness were significant, excluding subjective norms. The path from ease of use(β=.986, $p<.001$) to usefulness was also significant. The paths from usefulness(β=.312, $p<.001$) and ease of use(β=.631, $p<.001$) to acceptance attitude, and from acceptance attitude (β=.866, $p<.001$) to acceptance intention were significant.

Table 4. Correlation between variables, AVE square root, descriptive statistics

	Innovation willingness	Subjective norm	Self efficacy	Perceived usefulness	Perceived ease of use	Acceptance attitude	Acceptance intention
Innovation willingness	.813						
Subjective norm	.629**	.803					
Self efficacy	.689**	.386**	.853				
Perceived usefulness	.540**	.443**	.614**	.861			
Perceived ease of use	.344**	.303**	.351**	.679**	.850		
Acceptance attitude	.456**	.335**	.457**	.711**	.745**	.924	
Acceptance intention	.347**	.285**	.418**	.657**	.734**	.750**	.900
Mean	3.08	3.19	3.15	3.70	3.75	3.87	3.85
standard deviation	0.82	0.77	0.86	0.60	0.66	0.61	0.61
skewness	−0.04	−0.17	−0.19	−0.28	−0.23	−0.53	−0.54
Kurtosis	−0.08	−0.69	−0.26	2.04	1.23	2.24	2.43

***p<.001, the diagonal is AVE square root.

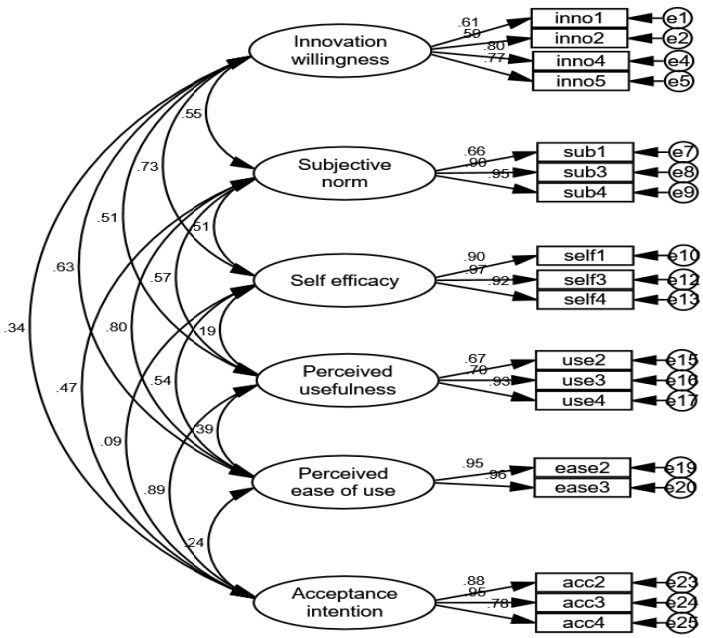

Fig. 2. Confirmatory Factor Analysis Parameter Estimates(Standardization Coefficients).

Table 5. Path parameter estimates and significance

		B	β	S.E.	t
Innovation willingness	Perceived ease of use	−0.058	−0.073	0.103	−0.568
Subjective norm	Perceived ease of use	0.255	0.346	0.07	3.663***
Self efficacy	Perceived ease of use	0.488	0.528	0.094	5.178***
Innovation willingness	Perceived usefulness	0.217	0.263	0.094	2.311*
Subjective norm	Perceived usefulness	−0.111	−0.147	0.066	−1.7
Self efficacy	Perceived usefulness	0.342	0.36	0.092	3.723***
Perceived ease of use	Perceived usefulness	1.013	0.986	0.111	9.163***
Perceived usefulness	Acceptance attitude	0.327	0.312	0.094	3.487***
Perceived ease of use	Acceptance attitude	0.646	0.631	0.099	6.535***
Acceptance attitude	Acceptance attitude	0.846	0.866	0.056	15.059***
χ^2=713.448, df=216, CMIN/DF=3.303, IFI=.901, TLI=.900, CFI=.901, RMSEA=.081					

*p<.05, ***p<.001

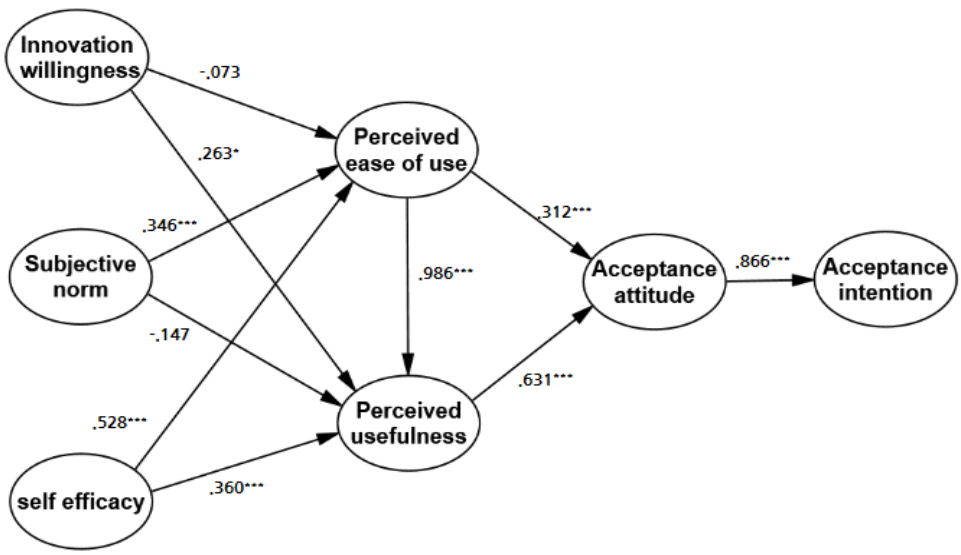

Fig. 3. Hypothesis testing results(Standardization Coefficients).

Table 5. Hypothesis Testing Results

Hypothesis		Acceptance
Hypothesis1	Willingness to innovate will positively affect ease of use.	Rejected
Hypothesis2	Willingness to innovate will positively affect ease of use.	Supported
Hypothesis3	Self-efficacy will positively affect ease of use.	Supported
Hypothesis4	Willingness to innovate will positively affect usefulness.	Supported
Hypothesis5	Subjective norms will positively affect usefulness.	Rejected
Hypothesis6	Self-efficacy will positively affect usefulness.	Supported
Hypothesis7	Ease of use will positively affect usefulness.	Supported
Hypothesis8	Ease of use will positively affect acceptance attitude.	Supported
Hypothesis9	Usefulness will positively affect acceptance attitude.	Supported
Hypothesis10	Acceptance attitude will positively affect acceptance intention.	Supported

As a result of hypothesis testing, hypotheses 2, 3, 4, 6, 7, 8, 9, and 10 were supported, while hypotheses 1 and 5 were rejected.

4. Conclusions

This study aimed to analyze the acceptance intentions of beauty major students regarding new technologies as a solution to improve awareness and address changes resulting from digital technology application and innovation acceptance in the beauty field. The goal was to establish and educate specialized digital-related technology courses necessary for future beauty service experts, cultivating the ability to apply new technologies and enhancing the possibility of producing beauty experts with high awareness of digital technology.

The analysis of beauty major students' acceptance intentions for digital new technologies revealed that subjective norms and self-efficacy significantly impact ease of use as mediating variables, and willingness to innovate and self-efficacy significantly impact usefulness as mediating variables. However, willingness to innovate did not significantly impact ease of use, and subjective norms did not significantly impact usefulness. Ease of use and usefulness significantly impacted acceptance attitude, and acceptance attitude significantly impacted acceptance intention. These results suggest that while beauty major students recognize the positive necessity of new technology application in the beauty field, they may feel somewhat burdened by learning and utilizing new technologies. Learners' fear of applying new technologies could result in a reluctance to take courses necessary for understanding and acquiring digital new technologies. Despite many universities designating IT and SW-related courses as mandatory for students, beauty major students find these courses challenging, making meaningful learning difficult. Additionally, as beauty majors are mostly in the arts and physical education fields, students aspiring for these majors often lack the basic learning ability for courses involving engineering knowledge. To address this, it is necessary to analyze the basic knowledge level of digital technology among beauty major students and develop lower-level related courses and programs to help them easily understand digital new technologies. Moreover, by collecting and providing IT-

related materials through external institutions and educational organizations conducting digital new technology support projects, and establishing a cooperative system among beauty major universities to build beauty and digital technology convergence models and offer various experiential programs, the awareness of digital technology among beauty major students can be improved, positively impacting the development of customized digital new technology education in the beauty field.

Acknowledgement

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea(NRF-2022S1A5A2A01047098)

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