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RICE Journal of Creative Entrepreneurship and Management (RJCM)
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About Us

RJCM is an international journal for academics and scholars at the higher education level to communicate and share their viewpoints and academic work with fellow professionals in the areas of creative entrepreneurship and management as practiced in their fields of specializations in social sciences. Currently, it is classified as Tier 2 in Thai-Journal Citation Index (TCI).

RJCM publishes three numbers per volume annually and welcomes contributors to submit their manuscript in January, May, and September of each year. We accept both academic and research papers in social sciences from contributors. The papers are double-blind three-peer-reviewed in each volume and published online-plus-print thrice a year.

The length of the unformatted manuscript in WORD can be 15-25 pages in length including references. The contents of the manuscript should include (1) a title with the author's name, affiliate, email address and telephone contact, (2) an abstract of 150 words with 3-5 keywords, (3) an introduction, (4) a rationale and background of the study, (5) research objectives, (6) research methodology, (7) data collection procedure, (8) data analysis, (9) results and discussion, (10) research limitation (if any), (11) conclusion, (12) acknowledgement(s) (if any), (13) the author's biography of about 50-80 words, 14) references, and (15) an appendix or appendices (if any).

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Note from the Editors of *RJCM* Volume 5 Number 2

Dear *RJCM* Readers,

You are now with our second issue in Year 5 of *RICE Journal of Creative Entrepreneurship and Management* (*RJCM*). This issue contains six articles in the areas of digital marketing, organizational credit rating, human resource development, and product development.

In this issue, we have two papers on digital marketing: *"The Influencing Factors of Live Broadcast Marketing of Beauty Products on Consumers' Purchase Intention"* (Article 1), and *"Factors Affecting the Acceptance Intentions of Consuming at Unmanned Stores in Chengdu, China"* (Article 2). One paper is on organizational credit rating--*"The Influence of Environmental, Social and Governance (ESG) Ratings on Credit Ratings: A Case Study of Chinese Listed Companies"* (Article 6). Two articles are on human resource development: *"Technical and Soft Skills of University Graduates in Thailand"* (Article 3), and *"Needs Assessment of Academic Administration Development in Thai Colleges of Agriculture and Technology Based on the Concept of Smart Agripreneurial Skills"* (Article 4). There is one paper on product development--"*Managing Extended Shelf Life of Thong Yod Snacks in the Modified Condition*" (Article 5). These papers report interesting findings and current issues in the areas under study.

Our paper contributors in the second issue of 2024 are researchers from four higher education institutions in the central part of Thailand: (1) Chulalongkorn University, (2) Mahidol University, (3) Rajamangala University of Technology Phra Nakhon, and (4) Rajamangala University of Technology Rattanakosin.

The editors-in-chief hope that the research findings and current developments reported in these papers will be interesting to both researchers and practitioners in similar fields of study. The *RJCM* editorial team and the authors would appreciate our readers' comments about these articles, if possible. We always welcome contributions from those who may wish to be part of our *RJCM* network.

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Address from RICE Director

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Dear *RJCM* Readers,

We have currently witnessed more of the role of AI in the paths of work and life worldwide. Business developments and education practices rely more on AI as smart assistants to reach the ultimate goals either on sustainability or continuous growth in human abilities in all fields of work and study. However, despite the positive claim on the applications of the information technology for the great good of mankind, there has been public agitation with the ethical use of human-like devices. Business developers as well as scholars are affected by AI in its transformative ability to generate creative and academic work as desired. Cybercrimes and fraud cases are flourishing to benefit those who use AI for ill purposes. In both business and education, people need to communicate cautiously with their counterparts, colleagues, and students in new AI-oriented contexts. Such disruptions have led to new business models for entrepreneurs and new teaching-learning modes as innovations that inevitably come with necessity and time.

As new innovative developments evolving out of the huge circle of technology applications, developers, scholars and researchers have conscientiously worked toward their goals by adding new knowledge and research findings to the existing source of knowledge and specialization. In this regard, the articles contributed to *RICE Journal of Creative Entrepreneurship and Management* in the AI era will reveal new dimensions under investigation in the business/ academic communities at both the local and international levels.

I feel much obliged to all the authors for contributing the betterment of their work to academic communities. Your research in different fields of creative entrepreneurship and management certainly supports sharing and bridging academic interests of all stakeholders.

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The Influencing Factors of Live Broadcast Marketing of Beauty Products on Consumers' Purchase Intention

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Abstract

In recent years, e-commerce live streaming has become a strong support for China's economic development. The COVID-19 epidemic has further prompted more companies to use e-commerce live, and some problems have emerged in the industry after the epidemic. Therefore, the researchers examined the influencing factors of live broadcast marketing on consumers' purchase intention. The purposes of the study were to (1) identify the factors that affect consumers' purchase intention in e-commerce live broadcast marketing, and (2) explore the interaction mechanism between various factors. It was expected that the obtained findings would generate practical implications for practitioners in the e-commerce live broadcast industry. Beauty products were used as an example to conduct research. A questionnaire was constructed with acceptable validity and reliability through the Questionnaire Star APP, and the questionnaire was distributed to viewers of the beauty live broadcast room with the highest popularity on the live broadcast platform. A total of 403 valid responses were collected and analyzed for descriptive statistics, correlation and linear regression. The research results were (1) The six variables of anchor professionalism, high-quality content, preferential promotions, high interactivity, consumer perceived value and consumer perceived trust affect consumers' purchase intention. (2) Both consumer perceived value and consumer perceived trust have a positive impact on consumers' purchase intention; and anchor professionalism, high-quality content, preferential promotions, and high interactivity have a direct impact on consumer perceived value and consumer perception. Trust also has a positive impact. The implications of the findings for e-commerce live broadcast marketing platforms, practitioners and managers lie in the professional training of anchors, established supervision and assessment mechanism, the audience perception and interactive experience, and platforms diversified promotional activities to further attract consumers.

Keywords: *Live streaming marketing, SOR model, purchase intention, perceived value, perceived trust*

1 Introduction

1.1 Research Background

The widespread popularity of the Internet and the continuous development of digital technology have given rise to new industries and business models, prompting changes in consumer types and habits, and driving high-quality economic development. Currently, live streaming marketing has become a new business opportunity with enormous potential (Xie, Li, Gao, & Liu, 2019). Compared with traditional e-commerce, live streaming marketing satisfies consumers' purchasing and experiential needs through real-time interaction, visualization, online viewing, and online purchasing function. Influenced by the COVID-19 pandemic, e-commerce livestreaming has developed rapidly with both transaction volume and user scale increasing significantly. In 2021, China's e-commerce livestreaming market transaction volume increased from CNY 1.285 trillion in 2020 to CNY 2.36151 trillion (NetEconomics, 2023). The rapid development of e-commerce livestreaming has led various industries to accelerate their adoption of this model for online purchases, which in turn has strongly supported economic development.

As a new marketing model integrating e-commerce and live streaming, live streaming marketing in China has soared in popularity. However, due to its short development time and low industry threshold, specific problems, particularly uneven abilities of anchors, rather unstable live broadcasting systems, and homogenized marketing content have gradually emerged. At the same time, some live broadcast merchants pursue high traffic while ignoring the credit value enhancement of their content which challenges consumer trust (Wei, Li & Liu, 2022). These issues seriously hinder the development of e-commerce livestreaming. With the end of the pandemic, e-commerce livestreaming has currently faced challenges from offline physical economy competition. Therefore, it is important to examine the influencing factors and mechanisms of consumers' purchase intention toward e-commerce livestreaming so that the live streaming industry can effectively support China's economic internal circulation.

Beauty products play an important role in live streaming marketing, as consumers need to visually experience their effects due to the nature of the products. Live streaming marketing can ideally meet the demand of beauty products for makeup and skin care, including cosmetics for hair, nails and fragrances. According to data released by market research company QuestMobile, beauty products accounted for as much as 37.5% of short video live streaming in 2020. Therefore, exploring the factors that influence consumers' purchase intention in e-commerce live streaming marketing using beauty products as an example is considered worth investigating.

1.2 Research objectives

Two research objectives of the study were to (1) identify the factors that affect consumers' purchase intention in e-commerce live broadcast marketing, and (2) explore the interaction mechanism between various factors. It was expected that the obtained findings

would generate practical implications for practitioners in the e-commerce live broadcast industry order to further develop good practices for China's e-commerce live broadcast marketing.

2. Literature Review

2.1 Livestream Marketing

Live marketing is a form of marketing based on consumer usage and satisfaction. It utilizes modern technology and social media platforms to provide real-time video content, visually showcasing products to consumers, interacting with them, and ultimately promoting purchase behavior (Zhai, 2017). Live marketing relies on the real-time interaction, open visibility, strong entertainment value and other characteristics provided by online live streaming. Through hosts explaining and demonstrating products to audiences during live broadcasts, marketing can be conducted effectively.

As an emerging marketing model, e-commerce live streaming has developed rapidly in recent years and has been extensively studied by scholars. The convenience, richness of content, low threshold for participation and wide audience characteristics of live streaming marketing have brought huge traffic economy benefits. Live streaming marketing has advantages, such as lower marketing costs, faster coverage, direct sales effects and effective marketing feedback. Live streaming marketing is still in its infancy stage; the audit standards for live stream merchants on e-commerce platforms are not standardized enough; the degree of industry specialization is relatively low; some merchants engage in false advertising which leads to a decrease in consumer trust and affects their willingness to purchase. Zhao & Wang (2021) confirmed that the professionalism of anchors and other characteristics can affect consumers' purchase intention by influencing their perceived function and emotion. Scholar Cai (2021) asserted that the interactive behavior in the live broadcast room can form a two-way transmission of information, affect consumer perceived value, and enhance trust. Chen (2020) proposed that the degree of price discounts will have a positive impact on consumers' purchase intention by influencing their perception of value. Jiang (2019) pointed out in his research that high-quality content in live marketing not only includes diversified products but also comprehensive product displays and quality assurance by anchors.

2.2 Consumers' Purchase Intention

Consumers' purchase intention refers to the probability of consumers willing to take specific purchasing actions; consumer willingness represents the likelihood of consumers buying products (Feng, Mu & Fu, 2006). In this study, consumers' purchase intention refers to the possibility of consumers purchasing products and services during live streaming.

A large number of scholars have conducted research on consumers' purchase intention. Huang (2021) found through empirical research on consumers' purchase intention for agricultural specialty products in live marketing that cognition and trust have

a positive impact on purchasing willingness. Yang (2021) explained that merchants' preferential promotions and product information have a significant positive effect on consumer perceived value, thereby affecting purchase intention. Wang et al. (2017) found that consumer perceived value has a positive effect on purchase intention. In the context of live streaming e-commerce, consumer trust is the foundation and goal of development, as well as a rare resource and asset. The development of live streaming economy needs to be supported by consumer trust (Xiong, 2022). Li (2014) confirmed that trust can increase consumers' willingness to buy goods, and then make them generate purchase intention through perceived value. The greater the perceived value, the stronger the purchase intention as consumers pursue maximizing perceived value. Trust as an important factor can affect consumers' purchase intention. From the previous studies by these scholars, we can see that various factors influence consumers' purchase intention, among which consumer perception of value and trust have a greater impact on consumption behavior.

2.3 S-O-R Theory Model

The S-O-R theory model (Stimulating-Organism-Response) was proposed by Mehrabian & Russell in 1974 to explain and predict the impact of environmental stimuli on individual cognition, emotion, and behavior. The model suggests that external stimuli can affect an individual's psychological state, which in turn affects their behavior. The model considers stimulus, organism, and response as independent variables, mediating variables, and dependent variables, respectively (Zhai, 2017; Yang 2021).

The S-O-R theory model has been widely used in the study of consumers' purchase intention. The S-O-R model investigates the impact of lenient online return policies on consumers' perceived product quality and purchase intention. The consumer purchasing decision-making model based on the S-O-R model explores factors influencing consumers' purchase intention in e-commerce live streaming scenarios. It can be seen that the S-O-R theory model has good applicability for studying consumers' purchase intention (Zhai, 2017; Yang 2021). As described so far, the researchers of the present study reviewed previous research results, the S-O-R model as a research framework, the characteristics of e-commerce live marketing as external stimuli factors, and perceived consumer values and trust as internal psychological factors. This is to examine and identify the influencing factors and mechanisms of consumers' purchase intention in e-commerce live streaming.

2.4 Research Hypotheses and Research Framework

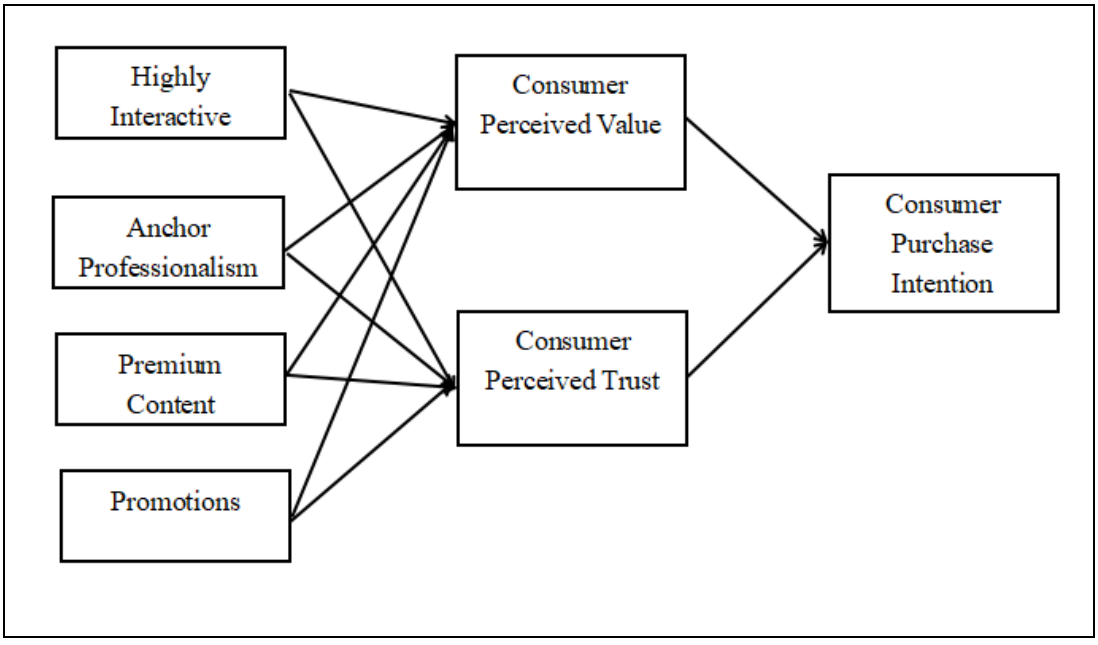
Based on the above-mentioned review of previous studies, the researchers of the present study put forward ten research hypotheses as shown in Table 1 below:

Table 1: Research Hypotheses

Summary of Assumptions	
NO.	**Research Hypotheses**
H1a	High interactivity has a significant positive impact on perceived value.
H1b	High interactivity has a significant positive impact on perceived trust.
H2a	Anchors' professionalism has a significant positive impact on perceived value.
H2b	Anchors' professionalism has a significant positive impact on perceived trust.
H3a	Promotions have a significant positive impact on perceived value.
H3b	Promotions have a significant positive impact on perceived trust.
H4a	Premium content has a significant positive impact on perceived value.
H4b	Premium content has a significant positive impact on perceived trust.
H5	Perceived value has a significant positive impact on consumers' purchase intention.
H6	Perceived trust has a significant positive impact on consumers' purchase intention.

The empirical framework in this study is shown in Figure 1 below:

Figure 1: Empirical Framework of Study



3. Research Methodology

3.1 The Respondents

The respondents in this study were to give data on influencing factors and the mechanism of interaction between consumers' purchase intention in e-commerce live broadcast marketing. They belonged to the watching group of the live broadcast of beauty

products in China. The data, as of June 2022, reported the total number of e-commerce live broadcast users in China at 469 million. The calculation formula: n=N/(1+N*e2) (e takes 0.05) resulted in 399.99 and rounded as 400 as the number of respondents to respond to the questionnaire. To ensure the needed number of returned responses in the data collection process, the researchers planned to contact 450 respondents.

3.2 The Instrument

The researchers designed a questionnaire to collect needed data. The questionnaire has three parts: (1) the screening questions on the survey participants. (2) demographic information on the respondents' gender, age and occupation, and (3) a 7-point Likert scale to assess seven variables: (i) anchor professionalism, (ii) preferential promotions, (iii) high-quality content, (iv) highly interactive, (v) perceived value, (vi) perceived trust, and (vii) consumers' purchase intention.

4. Data Collection and Data Analysis

The electronic questionnaire was produced through the Questionnaire Star APP and distributed/ collected in the live broadcast rooms of beauty anchors with the largest number of fans among the two largest live broadcast platforms in China, Douyin and Taobao.

The collected data were then analyzed by a computer statistical software for descriptive statistics, correlation and linear regression.

5. Results of the Study

The total of 403 valid responses were obtained—meeting the target number of 400. All of the results are reported in this section.

5.1 The Respondents' Demographic Variables

Table 2 reports consumers who watched live streaming of beauty products on e-commerce platforms, with more females (51.86%) than males (48.14%). This is natural that women have a higher interest in beauty products and prefer online live shopping They are between the ages of 18-35 (54.59%), indicating that young people are the main audience of e-commerce live streaming and have a strong acceptance toward new types of online shopping methods. In terms of occupation, corporate employees (60.55%) are the main audience group, followed by freelancers (24.07%). Most viewers have an undergraduate degree (43.18%), which corresponds to the audience profile of e-commerce live streaming being young people with higher education. As for monthly disposable income, viewers of 40.69% have a monthly disposable income at RMB5001-8000 (approximately USD770-1230), while 30.52% at RMB2001-5000 (approximately USD310-770). The results reveal that the audience watching live marketing has certain purchasing power. The obtained data show consumers on live broadcasts of beauty products as relatively balanced in gender, aged between 18-35 years old, with higher education and certain purchasing power.

Table 2: The Respondents' Demographic Variables

Demographic variables	Items	Frequency	Percentage
Gender	Male	194	48.14
	Female	209	51.86
Age	18~35 years old	220	54.59
	36~50 years old	134	33.25
	Over 50 years old	49	12.16
Profession	Student	24	5.96
	Business unit staff	38	9.43
	Corporate employees	244	60.55
	Freelancer	97	24.07
Education Level	High school and below	36	8.93
	Junior college	132	32.75
	Undergraduate	174	43.18
	Postgraduate	61	15.14
Monthly Disposable Amount	Below RMB 2000	17	4.22
	2001~5000 yuan	123	30.52
	5001~8000 yuan	164	40.69
	More than 8001 yuan	99	24.57
Total		403	100.0

5.2 Reliability and Validity

5.2.1 Reliability Analysis

The researchers conducted a reliability test on the sample data to measure the degree of reliability and stability between different variables in the questionnaire. The most commonly used Cronbach's α coefficient was used to test the reliability of the questionnaire content categories in this study. Generally, if the α value is greater than 0.7, it indicates good reliability.

Table 3: Results of the Reliability Test

Title	Cronbach's alpha
Anchor Professionalism	0.838
Promotions	0.819
Premium Content	0.815
Highly Interactive	0.805
Perceived Value	0.856
Perceived Trust	0.853
Purchase Intention	0.826

As shown in Table 3, the reliability coefficients of all variables are greater than 0.7, indicating that the quality of research data is highly reliable and can be used for further analysis.

5.2.2 Validity Analysis

Validity refers to the effectiveness of the sample data, which reflects the accuracy level of the research questions measured by the questionnaire. The method for testing validity is to first use KMO value and Bartlett's sphericity test to check whether the sample data meet the requirements for factor analysis to proceed to exploratory factor analysis through principal component analysis and cumulative variance rotation method. In validity testing, a KMO value greater than 0.8 and a significance index p value less than 0.05 in Bartlett's sphericity test are generally selected as standards for testing. When the sample data meet these standards, it indicates that the sample data are suitable for information extraction and meet the requirements of factor analysis.

Table 4: KMO and Bartlett's Test

KMO Value		0.899
Bartlett's Sphericity Test	Approximate Chi-Square	4344.860
	df	253
	p	0.000

According to Table 4, the KMO value of the variables in this study is 0.899, which is higher than 0.8. The significance index p value of Bartlett's sphericity test is 0.000, less than 0.05. This indicates that the seven variable items in the study are suitable for information extraction, with good validity and suitable for factor analysis. Subsequently, an exploratory factor analysis was conducted on the sample data.

Table 5: Validity Analysis Results

Item	Factor loading coefficient							Common variance (common factor variance)
	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**	**Factor 6**	**Factor 7**	
A1			0.798					0.746
A2			0.836					0.782
A3			0.786					0.749
B1				0.802				0.730
B2				0.813				0.762
B3				0.772				0.711
C1					0.788			0.735
C2					0.766			0.713
C3					0.827			0.755
D1						0.818		0.737
D2						0.790		0.724
D3						0.781		0.732
E1	0.785							0.703
E2	0.783							0.701
E3	0.789							0.690
E4	0.797							0.715
F1		0.794						0.712
F2		0.777						0.704
F3		0.791						0.705
F4		0.769						0.697
G1							0.777	0.734
G2							0.752	0.750
G3							0.785	0.755
Cumulative variance explained (%) (Pre-rotation)	34.269%	42.065%	49.428%	56.029%	62.246%	67.872%	72.795%	-
Cumulative Variance Explained (%) (After Rotation)	12.462%	24.818%	34.732%	44.397%	54.046%	63.490%	72.795%	-

The sample data were processed using principal component analysis and cumulative variance rotation to conduct an exploratory factor analysis. Seven common factors were extracted and rotated orthogonally after extracting the factors with characteristic root values greater than 1. The factor loading coefficients of each variable item on its corresponding common factor and the communality of each observed variable item under its corresponding common factor were observed. When the absolute value of the factor loading coefficient is higher than 0.5, and the cumulative variance explanation rate is above 50%, it indicates that all measurement items in the sample meet requirements, and the scale can accurately and effectively measure variables; otherwise, it means that some items need to be deleted from the scale. As shown in Table 5, all measurement items have a high absolute value for their factor loading coefficients (>0.5), and after rotation, the cumulative variance explanation rate is 72.795%, which is greater than 50%. Therefore, this study's scale has a high degree of validity for explaining seven variables: anchor professionalism, promotional discounts, quality content, high interactivity perception, value perception, trustworthiness, and purchase intention.

5.3 Correlation Analysis

The researchers used Pearson product-moment correlation coefficient as a measurement index to test the correlation between dimensions, with a value range of -1 to 1. The closer the absolute value of Pearson product-moment correlation coefficient is to 1, the stronger the correlation between variables. In this section, Pearson product-moment correlation coefficient was used to analyze the correlations among dimensions.

Table 6: Pearson Correlation

	Purchase Intention	**Perceived Trust**	**Perceived Value**	**Highly Interactive**	**Premium Content**	**Promotions**	**Anchor Professionalism**
Purchase Intention	1						
Perceived Trust	0.448**	1					
Perceived Value	0.400**	0.384**	1				
Highly Interactive	0.404**	0.358**	0.341**	1			
Premium Content	0.451**	0.353**	0.349**	0.355**	1		
Promotions	0.430**	0.374**	0.409**	0.348**	0.390**	1	
Anchors Professionalism	0.463**	0.381**	0.362**	0.365**	0.381**	0.326**	1

* $p<0.05$ ** $p<0.01$

As shown in Table 6, the correlation coefficients between purchase intention and anchors' professionalism, perceived value, perceived trust, premium content, promotions and high interactivity are 0.463, 0.400, 0.448, 0.451, 0.430, and 0.404, respectively, all greater than 0. It shows that there is a significant positive correlation between purchase intention and anchors' professionalism, perceived value, perceived trust, premium content, promotions and high interactivity.

5.4 Linear Regression Analysis

5.4.1 Regression Analysis of the Characteristics of Live Marketing and Consumer Perceived Value

In order to verify the impact of live marketing on consumer perceived value, highly interactive, premium content, promotions, and anchors were taken as independent variables, while perceived value was taken as the dependent variable for linear regression analysis.

Table 7: Linear Regression Analysis Results (n=403)

	Non-standardized coefficient		**Standardized coefficient**	***t***	***p***	**Collinearity diagnosis**	
	B	**Standard Error**	***Beta***			**VIF**	**Tolerance**
Constant	1.303	0.264	-	4.928	0.000**	-	-
Highly Interactive	0.141	0.049	0.142	2.910	0.004**	1.282	0.780
Premium Content	0.134	0.050	0.133	2.679	0.008**	1.335	0.749
Promotions	0.241	0.047	0.250	5.119	0.000**	1.284	0.779
Anchors Professionalism	0.170	0.047	0.178	3.641	0.000**	1.289	0.776
R^2			0.262				
Adjusted R^2			0.254				
F			$F(4, 398)=35.249$, $p=0.000$				
D-W			1.985				

Dependent Variable: Perceived Value

* $p<0.05$ ** $p<0.01$

Table 7 shows the regression coefficients of high interactivity, premium content, promotions and anchors' professionalism at 0.141, 0.134, 0.241 and 0.170, respectively. The linear regression model formula is: perceived value = 1.303 + 0.141*high interactivity + 0.134*premium content + 0.241*promotions + 0.170*anchors' professionalism. The R2 value of this model is 0.262, indicating that these four independent variables can explain

the change in perceived value by up to 26 .2%. The F-test of the model (F=35 .249, p=0 .000<0 .05) passed the test which means at least one of these four independent variables will have an impact on perceived value. In addition, in this model all VIF values are less than 5, which means there is no collinearity problem; the D-W value is around two digits which indicates that there is no autocorrelation in this model, and there is no correlation between sample data. Therefore, this model performs well. Thus, it can be concluded that high interactivity, premium content, promotions and anchors' professionalism appear to have a significant positive impact on perceived value, i.e., hypotheses H1a, H2a, H3a, and H4a hold true.

5.4.2 Analysis of the Impact of Live Streaming Marketing on Consumer Perception and Trust

The researchers conducted a linear regression analysis with high interactivity, premium content, promotions, and anchors as independent variables and perceived trust as the dependent variable.

Table 8: Linear Regression Analysis Results (n=403)

	Non-standardized coefficient		**Standardized coefficient**	***t***	***p***	**Collinearity diagnosis**	
	B	Standard Error	*Beta*			VIF	Tolerance
Constant	1.338	0.263	-	5.095	0.000**	-	-
Highly Interactive	0.164	0.048	0.166	3.401	0.001**	1.282	0.780
Premium Content	0.141	0.050	0.141	2.834	0.005**	1.335	0.749
Promotions	0.186	0.047	0.195	3.982	0.000**	1.284	0.779
Anchors Professionalism	0.192	0.046	0.203	4.139	0.000**	1.289	0.776
R^2				0.259			
Adjusted R^2				0.252			
F			*F* (4, 398)=34.815, *p*=0.000				
D-W				2.133			

Dependent Variable : Perceived Trust

* $p<0.05$ ** $p<0.01$

As seen in Table 8, the regression coefficients of high interactivity, premium content, promotions and anchors' professionalism are 0.164, 0.141, 0.186 and 0.192, respectively. The linear regression model formula is: perceived trust = 1.338 + 0.164*high interactivity + 0.141*premium content + 0.186*promotions + 0.192*anchors' professionalism. The R2 value of this model is 0.259 which indicates that these four independent variables can explain

the variation in perceived trust by up to approximately 25 .9%. The F-test for the model (F=34 .815, p=0.000< 0.05) passed the test indicating that at least one of these four independent variables has a significant impact on perceived trust. In addition, all VIF values in this model are less than 5 which means there is no collinearity problem; D-W value around 2 indicates that there is no autocorrelation in this model and there is no relationship between sample data suggesting a good fit for the model. Therefore, high interactivity, premium content, promotions and anchors' professionalism appear to have significant positive effects on perceived trust which supports hypotheses H1b, H2b, H3b, and H4b being as true statements.

5.4.3 Analysis of the Impact of Perceived Value and Trust on Consumers' Purchase Intention

Perceived value and trust are taken as independent variables, while purchase intention is taken as the dependent variable for linear regression analysis.

Table 9: Linear Regression Analysis Results (n=403）

	Non-standardized coefficient		**Standardized coefficient**	*t*	*p*	**Collinearity diagnosis**	
	B	Standard Error	*Beta*			VIF	Tolerance
Constant	1.631	0.234	-	6.970	0.000**	-	-
Perceived Value	0.270	0.047	0.268	5.756	0.000**	1.173	0.853
Perceived Trust	0.351	0.047	0.346	7.430	0.000**	1.173	0.853
R^2			0.262				
Adjusted R^2			0.258				
F			*F* (2, 400)=71.028, *p*=0.000				
D-W			1.970				

Dependent Variable: Purchase Intention

* $p<0.05$ ** $p<0.01$

According to Table 9, the regression coefficients of perceived value and perceived trust are 0.270 and 0.351, respectively. The linear regression model formula is: purchase intention = 1.631 + 0.270*perceived value + 0.351*perceived trust. The R2 value of this model is 0.262, which indicates that these two independent variables can explain 26.2% of the variation in purchase intention reasons. The F-test was conducted on the model (F=71.028, p=0.000<0.05), which passed the test indicating that at least one of these independent variables will have an impact on perceived trust relationship. In addition, all

VIF values in this model are less than 5, meaning there is no collinearity problem; D-W values around 2 indicate that there is no autocorrelation in this model and there is no correlation between sample data, making it a good model. Therefore, both perceived value and perceived trust appear to have a significant positive impact on purchase intention relationships, thus supporting hypotheses H5 and H6 as valid assumptions in this study.

5.5 Summary of Research Hypotheses

As reported, the results in Table 2-9 support all ten hypotheses with the obtained empirical evidence.

Table 10: Results of Research Hypotheses

No.	Hypotheses	Results
H1a	High interactivity has a significant positive impact on perceived value.	Accepted
H1b	High interactivity has a significant positive impact on perceived trust.	Accepted
H2a	Anchors' professionalism has a significant positive impact on perceived value.	Accepted
H2b	Anchors' professionalism has a significant positive impact on perceived trust.	Accepted
H3a	Promotions have a significant positive impact on perceived value.	Accepted
H3b	Promotions have a significant positive impact on perceived trust.	Accepted
H4a	Premium content has a significant positive impact on perceived value.	Accepted
H4b	Premium content has a significant positive impact on perceived trust.	Accepted
H5	Perceived value has a significantly positive effect on consumers' purchase intention.	Accepted
H6	Perceived trust has a significantly positive effect on consumers' purchase intention.	Accepted

6. Discussion and Conclusion

6.1 Discussion and Prospects

The results of this study were consistent with those findings on the impact of the characteristics of e-commerce anchors on consumers reported by earlier researchers. Fang (2018) asserted that the anchor's professional abilities and interactive communication with the audience in e-commerce live broadcast marketing can enhance consumers' value perception, thereby increasing purchase intention. Yang et al. (2018) studied the impact of the characteristics of "Internet celebrities" on consumers' purchase intention, and concluded that the professional knowledge possessed by "Internet celebrities" can create consumers trust, thereby promoting purchase intention. Chen (2020) found that discounts affect consumers' purchase intention in e-commerce live broadcasts. Jiang (2019) emphasized high-quality content of live broadcast marketing as affecting consumers' cognitive attitudes

and consumers' purchasing decisions.

By comparing the major findings in this study with those of previous scholars, we can see that the anchor's professionalism, promotions, premium content, high interactivity, consumer perceived value, and consumer perceived trust are all factors that affect consumers' purchase intention on e-commerce live broadcasts. And the anchor's marketing characteristics can positively affect consumer perceived value and perceived trust, thereby affecting consumers' purchase intention. Therefore, the findings suggest that the e-commerce live broadcast industry--both enterprises and live broadcast platforms--should focus on these six factors as confirmed by the hypotheses in this study.

6.2 Research Conclusion

All the hypotheses under study are established, which shows that in e-commerce live broadcast marketing, anchors' professionalism, promotions, premium content, high interactivity, consumer perceived value and consumer perceived trust are all factors that affect consumers' willingness to purchase. Among them, perceived value and perceived trust appear to have direct impacts on consumers' willingness to purchase. Anchors' professionalism, promotions, premium content, and high interactivity of e-commerce live broadcast marketing can all directly and significantly affect consumer perceived value and perceived trust, and thus determine consumers' purchase intention. This conclusion is consistent with the findings reported by previous scholars. It is expected that future research would be conducted on other types of products to further confirm the influencing factors of consumers' purchase intention.

6.3 Limitations

It should be noted that this study is confined to beauty products on live broadcasts, which limits generalizability of the obtained results. In this regard, future researchers might want to cover other types of products as research objects to gain insight into the overall picture of consumers' purchase intention in e-commerce live broadcast marketing. Moreover, the intermediate variables could be extended to cover perceived functional value and perceived emotional value, so as to compare the influence weight of perceived value from different perspectives. The combination of qualitative and quantitative research could also be used to project a clear image on the dimensions of consumers' purchase intention.

6.4 Recommendations

Based on the obtained findings, the researchers would like to recommend four points on live streaming marketing:

(1) E-commerce live streaming platforms should strengthen the training of their hosts and establish supervision and assessment mechanisms. As known, the low entry barriers in the e-commerce live streaming industry have resulted in a mixed level of

professionalism among hosts. As they are the core figures in live marketing, their level of professionalism is crucial in creating consumer trust and enhancing their perceived value. Therefore, hosts need quality training to enhance their professional knowledge and communication skills to attract consumers during live broadcasts. In this regard, major e-commerce platforms need to strengthen host training and mechanisms to increase consumer trust in products and willingness to purchase.

(2) It is important to establish good interactions on live broadcast. Hosts can promptly respond to consumers' questions through bullet comments, involve them in discussions or ask questions, and give/ elicit feedback in support of friendliness in participation.

(3) Hosts should continuously carry out promotional activities by providing limited-time discounts, coupons giveaways or lucky draws during live streams which will attract viewers who feel that they will get greater benefits after making purchases.

(4) Live streaming platforms need to provide quality content ensuring sufficient information volume as well as attractiveness while strengthening standard product control measures to satisfy customers' needs and expectations.

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Factors Affecting the Acceptance Intentions of Consuming at Unmanned Stores in Chengdu, China

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Abstract

Unmanned stores are a modern and efficient form of retail that offers convenience, speed, and personalized shopping experiences. They are particularly appealing to younger generations who value freshness, fashion, and technology. While the development of unmanned stores in China is still relatively new, consumer acceptance is critical to the industry's success. At present, the current usage rate of unmanned stores in Chengdu is relatively low, and many people still feel unfamiliar and uncertain about using them. With the support from the Chengdu Municipal Government and the consumer market, Chengdu's unmanned stores have a great potential for future development. In this regard, it is important to explore consumers' acceptance intentions of consuming at unmanned stores in Chengdu so that the local government can take a proper direction in the unmanned retail industry. The study therefore adopted a consumer perspective for *a theoretical model of consumer acceptance behavior for unmanned stores* based on the Technology Acceptance Model 2 (TAM2) framework. Data were collected through a questionnaire survey, and obtained from various statistical analyses to validate the research hypotheses. The results revealed significant positive relationships between the technological characteristics of unmanned stores and consumers' perceived usefulness and ease of use. Additionally, perceived usefulness and ease of use were found to positively influence usage intention, which, in turn, positively impacted usage behavior. Recommendations were for (1) technological innovation and improvement of advanced unmanned store systems and devices to enhance consumer experience and trust, (2) simplified operation processes and clear interfaces for the ease of use, (3) marketing and consumer education, (4) safety of unmanned stores, and (5) personalized services and promotional activities based on consumer preferences and behaviors. These are for unmanned store companies to gain a competitive edge in the market

development of the unmanned retail industry.

***Keywords**: Unmanned store acceptance, willingness to accept, technology acceptance model, consumers*

1. Introduction: Research Background

Unmanned stores as a new way of shopping in the retail industry has reached a certain stage of development in China. They utilize automation technology and intelligent devices to facilitate product sales and services in the absence of salespersons or cashiers (Feng, 2018). Compared to traditional store models, unmanned stores offer higher efficiency and lower labor costs, providing a more convenient, fast, and personalized shopping experience. In 2019, the market size of unmanned stores in China reached 51 billion yuan, with a year-on-year growth of 260.6% (Huang et al., 2020). Unmanned stores are an important form of unmanned retail, and their market size is continuously expanding (Fang & Fang, 2022). The advantages of unmanned stores lie in their use of advanced technological means, enabling unattended operation, significantly reducing operating costs, improving efficiency, and better adapting to market changes (Fang & Fang, 2022). With the rapid development and widespread adoption of technologies, such as artificial intelligence, the Internet of Things, and computer vision, the technological barriers and implementation costs of unmanned stores are continuously decreasing, making them easier to promote and apply (Technology, 2019).

Currently, the most active cities in the development of unmanned stores in China are mainly concentrated in first-tier cities and some new first-tier cities, such as Shanghai, Shenzhen, Beijing, Guangzhou and Hangzhou (Daily, 2018). Among them, Shanghai has the highest number of unmanned stores, while Shenzhen leads in terms of technological and marketing innovation in unmanned stores. Beijing, as China's political and economic center, has attracted many unmanned store brands and enterprises, becoming one of the important cities for the development of unmanned stores (Anonymous, 2022). In comparison, Chengdu has relatively fewer unmanned stores in terms of quantity and scale, but they are gradually increasing. In recent years, the Chengdu Municipal Government has started to strongly support the development of unmanned stores, issuing a series of policy measures and providing financial support, which has attracted some unmanned store brands and enterprises to settle in the city. Chengdu is considered one of the cities in China with a good potential for innovation and the development of emerging industries. In recent years, Chengdu has been actively promoting innovation and technological development, attracting high-tech enterprises and startups (Wang, Liu & Liu, 2019). The core concept of the innovative city proposed by Landry (2012) is to promote urban development, enhance urban competitiveness, and improve the quality of life for residents through culture, creativity, education, and social innovation theory. Chengdu has currently secured the first place in the ranking of China's

top ten most promising innovative cities (Bai, 2023). Although Chengdu may not be able to compare with cities like Shanghai, Shenzhen, and Beijing at present, the Chengdu Municipal Government and the Foundation of the Consumer Market have supported the city's unmanned stores to develop its potential in the unmanned retail industry.

With such support, Chengdu has moved toward the development of unmanned stores. Currently, it should be noted that many people in Chengdu still feel unfamiliar and uneasy about using unmanned stores (Pidu, 2023). Although the unmanned store industry in China has been developing for several years, it is still considered an emerging industry (Ye, 2017). Dawar (2013) asserted that consumers are the driving force behind emerging industries, and these industries can only succeed when consumers accept their products and services. Therefore, consumers' acceptance is a crucial factor for the success of emerging industries. In this regard, this study aims to address three main questions: (1) What factors can influence consumers' willingness to accept the technological characteristics of unmanned stores? (2) How do these factors affect consumers' acceptance willingness toward the technological characteristics of unmanned stores? (3) What recommendations can be provided for the future development of unmanned stores or the unmanned economy in Chengdu? It is expected that understanding of consumers' acceptance willingness toward the technological characteristics of unmanned stores and the factors that influence it, can provide theoretical guidance to the field of unmanned economy field and practical implications for the development of retail unmanned stores.

2. Research Status of Unmanned Stores

Unmanned stores utilize technologies, such as the Internet of Things, big data, and artificial intelligence to achieve intelligent sales through self-service selection, self-payment, and self-retrieval functions, all in an unattended store setting (QbitAI, 2018; Hamidi et al., 2020). Unmanned stores rely on various technological means, including the Internet of Things, artificial intelligence, big data analysis, and cloud computing (Hong, 2017). Therefore, technological characteristics form the foundation for the development of the unmanned store industry. Given the background of this emerging shopping method, existing research mainly focuses on the current status, models, development opportunities, and challenges of unmanned stores (Yu, 2017; Feng, 2018; Ding & Li, 2019; Wang & Tian, 2023). For instance, research on unmanned store technologies can be summarized into six aspects: (1) self-service shopping (Huang & Rust, 2018; Al-Qirim et al., 2022), (2) intelligent recognition (Zhang et al., 2021), (3) automatic payment (Liu, 2017; Wang & Yang, 2017), (4) data analysis (Bordonaba-Juste et al., 2012; Lu & Chen, 2020), (5) AI technology support (Chen & Shang, 2021; Bae & Jeon, 2022), and (6) intelligent security control (Zhou et al., 2017). These technological characteristics of unmanned stores, working together, have a significant impact on store operations and consumers' shopping experiences, which can be specifically reflected in: (i) improving efficiency, (ii) reducing

costs, (iii) increasing accuracy, (iv) enhancing consumer experience, and (v) improving security. Based on the research findings of domestic and foreign scholars in the unmanned store industry, the current market development is favorable and holds certain potential, with challenges mainly concentrated on areas, such as consumers' experience, product damage rates in unmanned supermarkets, related intelligent technologies, business models, and legal regulations.

It is evident that relatively little research on consumers has focused on unmanned stores. Chengdu, as a core city in Southwest China and currently driven by both market environment and policy support, clearly possesses a good potential for unmanned stores. The current status of unmanned stores in Chengdu can be summarized as: (1) multiple brands entering the market, (2) coverage of various product categories, (3) technological innovation, (4) widespread geographical distribution, and (5) positive consumer feedback. Despite initial explorations in unmanned stores, there is a lack of targeted research on the acceptance willingness of consumers toward their technological characteristics, and consumers' understanding and willingness to use this technology. The researchers of the present study noted an urgent need to fill the research gap from consumers' perspective on the demand side.

3. Research Methods

3.1 Technology Acceptance Model of Research on Acceptance Willingness of Unmanned Stores

This study assumes that the TAM2 model is equally applicable to the study of acceptance willingness toward unmanned stores. Therefore, the following hypotheses are proposed as shown in Table 1.

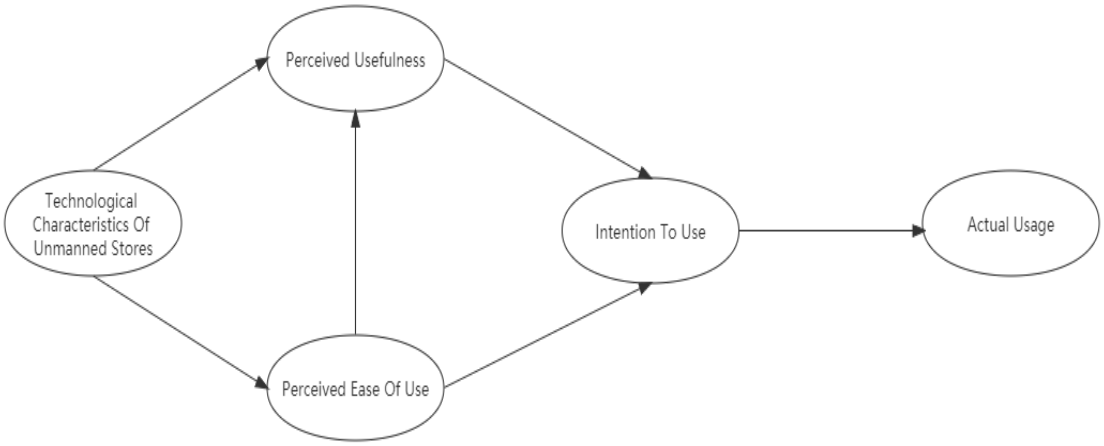
Table 1: Summary of Hypotheses

NO.	Hypotheses Based on Four Key Factors
H1	There is a significant positive relationship between the technological characteristics of un manned stores and consumers' perceived usefulness.
H2	There is a significant positive relationship between the technological characteristics of un manned stores and consumers' perceived ease of use.
H3	There is a significant positive relationship between consumers' perceived ease of use and consumers' perceived usefulness.
H4	There is a significant positive relationship between consumers' perceived usefulness and consumers' intention to use.
H5	There is a significant positive relationship between consumers' perceived ease of use and consumers' intention to use.
H6	There is a significant positive relationship between consumers' intention to use and consumers' actual usage behavior.

3.2 Hypotheses of Research on Willingness to Accept Unmanned Stores Based on Technology Acceptance Model

Based on the hypotheses in Table 1, the causal relationship diagram illustrating the influences is depicted in Figure 1.

Figure 1: Extended Acceptance Intention Model for Unmanned Stores Based on TAM2.



3.3 Questionnaire Design

The scale design in this study consists of 5 latent variables and 16 items based on the five dimensions mentioned earlier. The questionnaire contains two sections: the first section includes demographic information of the participants, and the second section consists of measurement items to assess the latent variables in the proposed model. The scale adopts a Likert five-point rating scale, for respondents to rate each item from their own perspective: 1=strongly disagree, 2=disagree, 3=somewhat disagree, 4=neutral, 5=somewhat agree, 6=agree, 7=strongly agree (Zhou et al., 2017).

Table 2: Model Variable Index System

Variable	Measurement Standard	Scale Items
Technological characteristics of unmanned stores	TT1	I believe that in unmanned stores, the placement of products should facilitate my search and purchase.
	TT2	I believe that unmanned stores should accurately identify and track the products I select for purchase.
	TT3	I believe that unmanned stores should automatically recognize product information and prices.
	TT4	I believe that unmanned stores should provide automatic payment functionality, eliminating the need for manual cashiering.
	TT5	I believe that the automatic payment functionality in unmanned stores should make me feel convenient and secure.
	TT6	I believe that the use of data analysis in unmanned stores to understand consumer preferences and behavior will contribute to providing me with a more personalized shopping experience.
	TT7	I believe that the automation of operations and information dissemination services in unmanned stores will enhance my shopping experience.
	TT8	I believe that unmanned stores should be equipped with intelligent security control systems to ensure my safety and privacy.
Perceived usefulness	PU1	I believe that choosing to shop at unmanned stores will enhance my shopping experience.
	PU2	I believe that choosing to shop at unmanned stores will increase the convenience of my shopping.
	PU3	I believe that choosing to shop at unmanned stores will make my shopping more efficient.
Perceived ease of use	PEO U1	I believe that learning how to use unmanned retail systems is very simple.
	PEO U2	The transaction process of unmanned stores should be highly smooth.
	PEO U3	I believe that the reliability of unmanned stores (product supply, inventory accuracy, stability of payment systems, etc.) should be very high.
	PEO U4	I believe that operating unmanned stores should be simple, quick, and effortless.
Intention to use	CSI1	I believe that the products and brands of unmanned retail systems currently available on the market (such as Alibaba, JD.com, Bingobox, Futuremart, etc.) are trustworthy.
	CSI2	I believe that the services provided by unmanned stores currently align with my expectations.
	CSI3	I believe that the development of unmanned stores is a trend that cannot be ignored.

Variable	Measurement Standard	Scale Items
Actual usage	BIS1	I believe that purchasing goods in unmanned stores is a good shopping choice.
	BIS2	I am willing to buy products in unmanned stores.
	BIS3	I think unmanned stores are worth recommending to others.
	BIS4	If someone asks me, I would recommend them to shop in unmanned stores.

4. Results

4.1 Descriptive Statistics of Questionnaire Results

The survey collected sample data from Chengdu residents using a random sampling method. A total of 409 responses were collected, and after manual inspection and screening, those samples with excessively short completion time or repetitive answers to multiple questions were excluded. Finally, 396 valid responses to the survey questionnaire were obtained, resulting the return rate at 96.82%.

Table 3: Demographic Variables of Respondents

Project	Variables	Frequency	Percentage
Gender	Male	190	47.98
	Female	206	52.02
Age	20 years old and below	52	13.13
	21-30 years old	133	33.59
	31-40 years old	91	22.98
	41-50 years old	65	16.41
	51-60 years old	44	11.11
	61 years old and above	11	2.78
Educational background	High school or below	56	14.14
	College diploma	107	27.02
	Bachelor's degree	184	46.46
	Master's degree and above	49	12.37
Profession	Government or public institution employees	93	23.48
	Corporate employees	89	22.47
	Professional and technical personnel (such as doctors, teachers, engineers, etc.)	98	24.75
	Students	53	13.38
	Self-employed business owners	63	15.91

Project	Variables	Frequency	Percentage
Disposable income	3000 CNY or below	52	13.13
	3001 CNF to 5000 CNY	128	32.32
	5001 CNY to 8000 CNY	83	20.96
	8001 CNY to 10000 CNY	62	15.66
	10001 CNY to 15000 CNY	53	13.38
	Above 15000 CNY	18	4.55
Unmanned store	Yes	172	43.43%
understanding	No	224	56.57%
	Multiple times a day on average	100	25.25
	Once a day on average	88	22.22
Shopping frequency	Once every two days on average	83	20.96
	Once every five days on average	93	23.48
	Once a week on average	32	8.08

The respondents' demographic variables and their potential as consumers of unmanned stores in Chengdu point to the young age groups with higher levels of education. This indicates that young consumers with higher education tend to have a stronger acceptance of new technologies. Over a quarter of the respondents reported being aware of unmanned stores, indicating a relatively high level of awareness among the surveyed sample. This result appears to suggest a widespread trend of unmanned stores in Chengdu--due to a good level of understanding of the existence and basic concept of unmanned stores. The respondents' shopping frequency also suggests that Chengdu residents have a significant and stable shopping demand.

4.2 Data Analysis of Questionnaire Results and Research Model Hypothesis Testing

4.2.1 Reliability Analysis

Reliability analysis is used to examine the stability and reliability of a scale. Before analyzing questionnaire data, it is necessary to test the stability and validity of the scale. Cronbach's α coefficient is commonly used to measure the reliability of a scale, where a higher coefficient indicates better reliability. A reliability coefficient between 0.7 and 0.9 is considered acceptable, while a coefficient below 0.7 indicates a need for scale revision. In this study, the SPSS 22.0 software was used to examine the scale data. The Cronbach's α coefficients are presented in Table 4 showing all coefficients higher than 0.7, indicating a high level of data reliability, which in turn validates their use for further analysis.

Table 4: Results of the Reliability Analysis for Each Variable

Variable Names	Reliability of Variable
Technological characteristics of unmanned stores	0.952
Perceived usefulness	0.920
Perceived ease of use	0.949
Intention to use	0.883
Actual usage	0.927

4.2.2 Validity Analysis

Validity can be divided into four types: content validity, construct validity, convergent validity, and discriminant validity (WMS Analyseis., 2000).

(1) Content validity: The method for testing content validity should be referenced from relevant literature sources.

(2) Construct validity: The methods commonly used to test construct validity are exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). EFA is a dimensionality reduction technique that involves conducting tests, such as the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity to determine if the data is suitable for factor analysis. If the fit is satisfactory, CFA can be performed to assess the construct validity. The KMO test coefficient is calculated to compare the simple correlations and partial correlations between variables, with values ranging from 0 to 1. A higher KMO value indicates stronger correlations among variables. Typically, a KMO value greater than 0.6 indicates suitability for factor analysis. The validity verification using KMO and Bartlett's tests is presented in Table 5, with a KMO value of 0.897. Since the KMO value is greater than 0.8, the research data is highly suitable for information extraction.

Table 5: Results of Validity Analysis

KMO and Bartlett's Test		
KMO Data		0.897
Bartlett's Sphericity Test	Approximate Chi-Square	5210.008
	df	231
	p	0.000

Table 6: The Factor Loading Coefficients, the AVE and CR Indicators of the Model

Factors	Measurement Items (Manifest Variables)	Std. Estimate	AVE	CR
Technological characteristics of unmanned stores	TT1	0.737	0.626	0.930
	TT2	0.838		
	TT3	0.733		
	TT4	0.818		
	TT5	0.739		
	TT6	0.743		
	TT7	0.911		
	TT8	0.793		
Perceived usefulness	PU1	0.822	0.583	0.807
	PU2	0.701		
	PU3	0.762		
Perceived ease of use	PEOU1	0.817	0.659	0.885
	PEOU2	0.765		
	PEOU3	0.875		
	PEOU4	0.785		
Intention to use	CSI1	0.847	0.683	0.866
	CSI2	0.844		
	CSI3	0.787		
Actual usage	BIS1	0.768	0.594	0.854
	BIS2	0.756		
	BIS3	0.804		
	BIS4	0.755		

(3) The method used to test convergent validity is generally Confirmatory Factor Analysis (CFA), which involves examining indicators, such as CR (Composite Reliability) and AVE (Average Variance Extracted). CR assesses the internal consistency of the construct, similar to Cronbach's α coefficient. A higher CR indicates higher internal consistency and stronger convergence. The typical threshold is >0.7. AVE represents the average amount of variance that is extracted by the latent variable and reflects the construct's ability to explain the observed variables. A higher AVE indicates higher convergent validity. The typical threshold is >0.5. In this study, CFA analysis was conducted on the five constructs of consumer acceptance: (i) technology acceptance, (ii) perceived usefulness, (iii) perceived ease of use, (iv) intention to use, and (v) actual usage behavior. All factor loadings were above 0.7, indicating significance. The CR values were above 0.8, and the AVE values were above 0.5 for all constructs, demonstrating their convergent validity, as shown in Table 6.

(4) Discriminant Validity: Discriminant validity is generally assessed through the comparison of the Average Variance Extracted (AVE) values and the results of correlation analysis in Confirmatory Factor Analysis (CFA). The purpose of discriminant validity is to ensure that the correlations within dimensions are higher than the correlations between dimensions. The results are shown in Table 7: For the dimension of Technological Features, the square root of AVE is 0.791, which is greater than the maximum absolute value of inter-factor correlations (0.394), indicating good discriminant validity. For the dimension of Perceived Usefulness, the square root of AVE is 0.764, which is greater than the maximum absolute value of inter-factor correlations (0.390), indicating good discriminant validity. For the dimension of Perceived Ease of Use, the square root of AVE is 0.812, which is greater than the maximum absolute value of inter-factor correlations (0.381), indicating good discriminant validity. For the dimension of Intention to Use, the square root of AVE is 0.826, which is greater than the maximum absolute value of inter-factor correlations (0.416), indicating good discriminant validity. For the dimension of Actual Usage, the square root of AVE is 0.771, which is greater than the maximum absolute value of inter-factor correlations (0.416), indicating good discriminant validity.

Table 7: Discriminant Validity: Discriminant Validity by Pearson Correlations and the Square Root of Average Variance Extracted (AVE) Values

	Technological Characteristics of Unmanned stores	**Perceived Usefulness**	**Perceived Ease of Use**	**Intention to Use**	**Actual Usage**
Technological characteristics of unmanned stores	0.791				
Perceived usefulness	0.359	0.764			
Perceived ease of use	0.381	0.246	0.812		
Intention to use	0.394	0.390	0.206	0.826	
Actual usage	0.347	0.264	0.262	0.416	0.771

Note: The numbers along the diagonal represent the square root of AVE values.

4.2.3 Structural Equation Model Analysis of Unmanned Store Acceptance Research

Structural Equation Modeling (SEM) is a multivariate statistical method based on the covariance matrix of variables, used to analyze the relationships between variables. It is suitable for studying the mediating effects and causal relationships among multiple independent and dependent variables. The combination of the Technology Acceptance Model and Structural Equation Modeling allows for the logical investigation of influencing factors based on reasonable hypotheses, while also verifying the significance and scientific validity of the hypotheses.

4.2.4 Structural Equation Model Fitting Effect Fitness Test

To ensure the applicability of the model, it is necessary to test the model fit. The fitting results obtained by computer statistical software are shown in Table 8. The test results all meet the standard, indicating that the structural equation modeling used in this study is appropriate for the data analysis.

Table 8: Model Fit Indices

Common Indicators	$\chi2$	*df*	*p*	$\chi2/df$	GFI	RMSEA	RMR	CFI	NFI	NNFI
Judgment criteria	-	-	>0.05	<3	>0.9	<0.10	<0.05	>0.9	>0.9	>0.9
Value	434.234	203	0.000	2.139	0.918	0.054	0.253	0.955	0.919	0.948
Other indicators	TLI	AGFI	IFI	PGFI	PNFI	SRMR	RMSEA 90% CI			
Judgment criteria	>0.9	>0.9	>0.9	>0.9	>0.9	<0.1	-			
Value	0.948	0.997	0.955	0.936	0.907	0.085	0.047 to 0.061			

Default Model: $\chi2(231)=5333.468, p=1.000$

4.2.5 Analysis of Structural Equation Modeling Results

Using computer statistical software, the exploratory and confirmatory analysis of the model's causal relationships was conducted. The standardized path coefficients and their significance were obtained, as shown in Figure 2 and Table 9. The model fit results indicate that all hypotheses are supported, and the summarized results are presented in Table 10.

Table 9: Model Regression Coefficients Summary Table

X	→	Y	Unstandardized Path Coefficients	SE	z(CR value)	p	Standardized Path Coefficients	Results
Technological characteristics of unmanned stores	→	Perceived usefulness	0.316	0.051	6.167	0.000	0.340	significant
Perceived ease of use	→	Perceived usefulness	0.120	0.047	2.534	0.011	0.122	significant
Technological characteristics of unmanned stores	→	Perceived ease of use	0.415	0.050	8.213	0.000	0.201	significant
Perceived usefulness	→	Intention to use	0.366	0.048	7.627	0.000	0.451	significant
Perceived ease of use	→	Intention to use	0.111	0.045	2.462	0.014	0.112	significant
Intention to use	→	Actual usage	0.405	0.044	9.109	0.000	0.541	significant

Remarks: → Indicates the path influence relationship

Figure 2: Structural Equation Model of Acceptance of Consumers toward Unmanned stores (Standardization Coefficient)

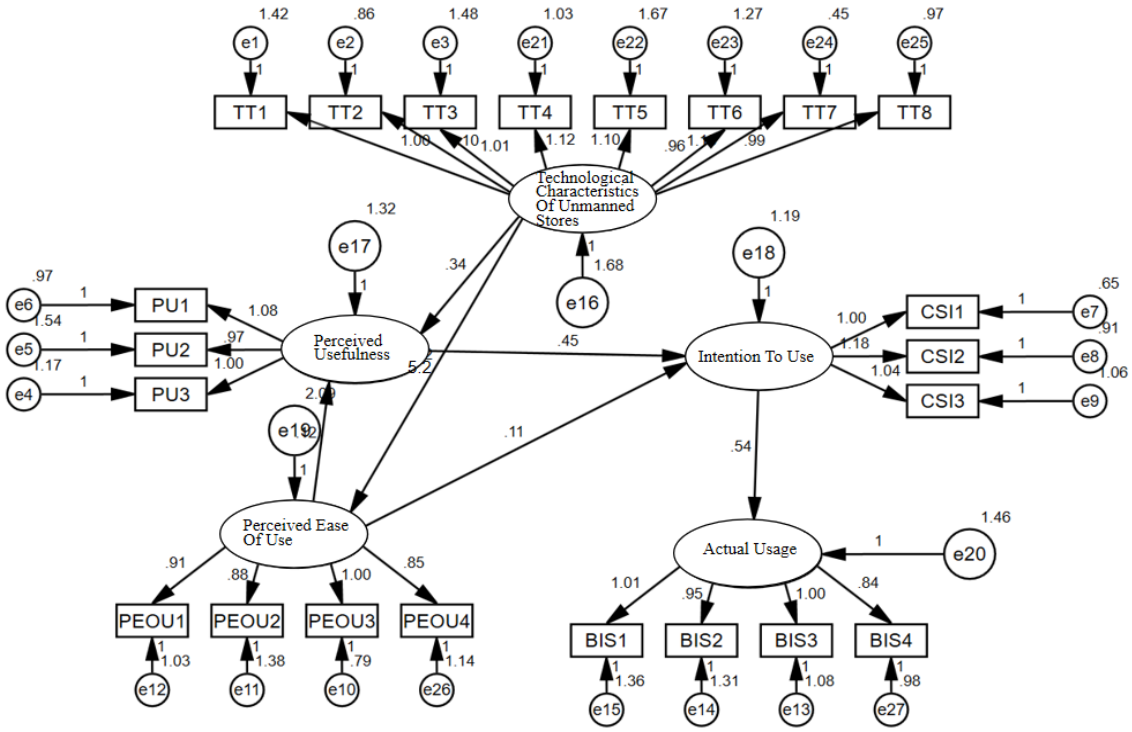


Table 10: Summary of Research Hypotheses and Results

No.	Hypotheses	Results
H1	There is a significant positive relationship between the technical characteristics of unmanned store technology and consumers' perceived usefulness.	Supported
H2	There is a significant positive relationship between the technical characteristics of unmanned store technology and consumers' perceived ease of use.	Supported
H3	Consumers' perceived ease of use has a significant positive relationship with their perceived usefulness.	Supported
H4	Consumers' perceived usefulness has a significant positive relationship with their intention to use.	Supported
H5	Consumers' perceived ease of use has a significant positive relationship with their intention to use.	Supported
H6	Consumers' intention to use has a significant positive relationship with their actual usage behavior.	Supported

5. Conclusions and Suggestions of Acceptance Willingness of Unmanned Stores

5.1 Research Conclusions on Willingness to Accept Unmanned Stores

Based on the analysis results, the following conclusions can be drawn: There is a positive relationship between the technological characteristics of unmanned stores and consumers' perception of usefulness and ease of use. Technological characteristics include self-service shopping, intelligent identification, automatic payment, data analysis, AI technology support, and intelligent security control, which can provide convenient and personalized shopping experiences, enhancing consumers' recognition and acceptance of unmanned stores. Consumers' perception of ease of use also has a positive impact on perceived usefulness and willingness to use. Simplifying the operation process, providing clear and understandable guidance and interface design can reduce consumers' learning costs and operational difficulties, making it easier for them to adapt to and use unmanned stores. Consumers' perception of usefulness positively influences their willingness to use, meaning that when consumers perceive that unmanned stores can meet their needs and provide beneficial shopping experiences, they are more likely to use them. Furthermore, there is a positive relationship between consumers' willingness to use and their actual usage behavior. Positive evaluations and decision support from consumers toward the stores can motivate them to actually choose unmanned stores for shopping and consumption. In this regard, enhancing the technological characteristics, ease of use, and perceived usefulness of unmanned stores is crucial to consumers' acceptance and willingness to use, thereby driving the development of unmanned stores.

5.2 Recommendations

Based on the obtained findings, the researchers would like to encourage and support unmanned store companies in Chengdu to gain a competitive advantage and promote the healthy development of the unmanned store industry as follows:

(1) Innovate and improve unmanned store technology: To enhance consumers' acceptance of unmanned stores, focus on technological innovation and improvement. Consider introducing advanced systems like automated shelves, smart devices, optimized face recognition technology, and smart payment systems. Utilize sensors and data analysis to understand consumer preferences, provide personalized recommendations, and enhance their shopping experience.

(2) Emphasize ease of use and usefulness: Simplify the operation process of unmanned stores and provide clear guidance and user-friendly interfaces. Highlight the practicality and value of unmanned stores by offering personalized product recommendations, preferential activities, and high-quality products. This enhances consumer satisfaction, perceived benefits, and encourages them to convert their intention into actual shopping behavior.

(3) Marketing and consumer education: Promote the advantages, convenience, and safety of unmanned stores through advertising, social media, television, and radio. Emphasize 24-hour convenience, fast payment, and personalized shopping experiences. Use platforms like WeChat, Weibo, and Douyin to share news, promotions, and user reviews. Organize demonstration events and temporary unmanned stores in public places to allow consumers to experience the convenience firsthand. Educate consumers through detailed guides and instructions on the shopping process, payment methods, and goods pickup in unmanned stores.

6. Conclusion

In this study, the researchers conducted a comprehensive investigation and analysis of unmanned stores in Chengdu. By collecting extensive data and employing statistical methods and structural equation modeling, the study arrived at major findings as follows:

Firstly, technological characteristics have a significant positive impact on consumers' perceived usefulness and perceived ease of use. This implies that enhancing the technical characteristics of unmanned stores can improve consumers' perception of their usefulness and ease of use, thereby increasing their acceptance of unmanned stores.

Secondly, consumers' perceived ease of use and perceived usefulness have a significant positive impact on their willingness to use unmanned stores. This indicates that the easier and more useful consumers perceive unmanned stores to be provided, the more likely they are to use them for shopping.

Finally, consumers' willingness to use unmanned stores has a significant positive impact on their actual usage behavior. This means that consumers' willingness translates into concrete usage behavior, making them more likely to shop in unmanned stores.

As for practical implications of the study, the researchers would like to propose for the development of unmanned stores in Chengdu:

(1) Prioritize technological innovation and improvement by introducing more advanced unmanned store systems and equipment to enhance consumer experience and trust.

(2) Highlight the ease of use and usefulness of unmanned stores by simplifying the operation process, providing clear and user-friendly interfaces and guidance. This ensures that consumers can easily use and enjoy the convenience of unmanned stores.

(3) Strengthen marketing and consumers' education for the advantages, convenience, and safety of unmanned stores.

(4) Provide personalized services and preferential activities by analyzing consumer purchasing preferences and behaviors through data analysis for pleasant personalized shopping experience.

Although this study conducted an in-depth examination of unmanned stores in Chengdu, it does have certain limitations, particularly sample selection and research scope restrictions. Future research can address these limitations by expanding the sample size and extending the research scope to encompass other regions and different types of unmanned stores. This will yield more comprehensive and robust results in support of the unmanned retail industry.

7. The Authors

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Technical and Soft Skills of University Graduates in Thailand

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Abstract

Technical and soft skills development has been recognized for its prime importance in producing graduates at Thai universities. Both national and ASEAN standards require human or soft skills for graduates to perform well in collaborative tasks at work. This study examined university graduates' perception of their technical skills in the subject areas and soft skills as existing or lacking in current competency. The participants were 116 university graduates employed by public and business organizations selected by accessibility and voluntary participation. They responded to the online semi-opened questionnaire on their perception of both technical and soft skills competencies demanded on the job. They were also asked to identify what was lacking in the university programs in equipping graduates with both types of skills. The finding revealed that the graduates under study were rather confident in their technical than soft skills. They pointed to urgency for soft skills competency development in latest digital skills, speech communication and effective language interactions. The results of the study obviously call for program developers to balance the orientation in the specialized subject area and that in human or soft skills development for the graduates to function well in collaborative work as required in organizations to attain the expected goals in competitive operations now and beyond.

Keywords: Technical skills, soft skills, skill competency development, competency perception, university graduates

1. Introduction

All higher education institutions in Thailand have prepared their graduates for the job market with good technical competencies in knowledge and skills in specialized areas through various programs. They are well aware that graduates need to be equipped with appropriate human skills or soft skills to be able to work collaboratively in team work and contact customers tactfully. It is generally known that when employees proceed further in their career, more soft skills competencies can be trained via mentoring and development (Weber, Crawford, Lee & Dennison, 2013). Still, this is a critical issue on technical skills being developed within a specific program, whereas soft skills require the work process of an organization culture and human interactions to attain the expected levels (Wetsanarat, 2021). Thai higher education institutions need to observe the Association of Southeast

Asian Nations (ASEAN) Standards on human or soft skills, like digital literacy, communication skills, language abilities, initiative and creativity, life skills management, stress management and flexibility or willingness to adjust and cope with change. These identified standards are integrated into the vocationally-oriented programs in Thailand (Office of Standards for Vocational Education and Profession, 2008; Office of the Vocational Education Commission, 2008a, 2008b). Particularly, Latthasaksiri (2021) emphasized stress management skills to keep a good balance between life and work and to ensure that stress at work be at a level that yields productivity rather than depression. In such a scenario of soft skills requirement, these institutions typically use interim projects on soft skills development, followed by a series of lectures and workshops prior to or as part of final graduating orientation.

In this study, the researchers examined university graduates' perception of their technical skills in the subject areas and soft skills as existing or lacking in current competencies. The participating university graduates were asked provide data on their technical and soft skills at work as well as identify the technical/ soft skills development most needed in their career path to enable them to fit in and do well in their selected organizations. It was expected that the obtained findings could generate practical implications for universities to design and execute soft skills development programs suitable for their graduates to meet both the national and ASEAN standards. In addition, public and business organizations can also use the research results for their in-service human resource development programs as seen appropriate.

2. Selected Literature Review on Soft Skills Development

Upon entering the job market, employers tend to look for university graduates with good work attitude, effective time management and soft skills competency (Pholsward, 2017, 2022). Purdue, Ninemeier & Woods (2022) emphasized the importance of attitude, personality traits, motivation of individuals and willingness to learn new things at work. Weber, Finley, Crawford & Rivera Jr. (2009) asserted that individual employees' competencies should be pertinent to the goal of an organization. These competencies rest upon three elements known as knowledge, skills and attributes (KSA). The research team put these elements at three levels by assigned roles or tasks for employees (1) *threshold* for selection or recruitment, (2) *standard* for appraisal on the job, and (3) *ideal or desired* for training needs at the entry and developmental levels.

Weber, Finley, Crawford & Rivera Jr. (2009) noted that hard skills competencies are relatively easier to develop via training programs by organizations while soft skills competencies could be difficult to acquire and critically take time when moving up to managerial positions. Weber, Crawford, Lee & Dennison (2013) also supported this point on training time for soft skills development in that soft skills competencies tend to be done via mentoring for self-development. Similarly, Wetsanarat (2021) reported the research finding along the same notion on difficulty in soft skills training in that knowledge is the easiest part to impart to the employees, and skills and attributes take more time to attain the expected levels.

Testa & Sipe (2012) pointed out that soft skills competencies are required most in technically skilled service providers or employees in charge of customer relations, simply

because customers look for impressive services and experiences that are based on employees' human or soft skills. Such soft skills competencies are also demanded most in those employees in managerial positions and team leaders to be able to inspire, motivate and encourage followers or team members toward the identified organizational goals.

As for performance competency models, Langdon & Marrelli (2002) used *Language of Work* or LOW model to identify competencies of each employee using *performance standards* as the basis for personnel development. Wetsanarat (2021) studied competencies required in the travel incentive tourism industry by using the three elements developed by Weber, Finley, Crawford & Rivera Jr. (2009). The researcher interviewed 127 stakeholders or incentive travel planners under Thailand's Incentive and Convention Association (TICA) for elaborated details on knowledge, skills and attributes at the three levels of employees' performances: threshold, standard and ideal (see Appenndix 2). The researcher emphasized that the productivity and competitiveness of an organization can be realized by personnel with good knowledge, skills and attributes.

As seen in in the previous studies in soft skills competency and development, the earlier researchers highlighted that technical skills cannot do without good human or soft skills in rendering employees' success in their work performance. The present study therefore incorporated the national/ASEAN standards, technical/soft skills, and desirable attributes into the constructed semi-opened questionnaire to obtain data in two perspectives of the participating university graduates' perception toward the existing and desired status of both types of skills. The participants were also requested to identify the aspects of both skills to be trained further in coping with rapid changes in technology and work demands (see Appendix 1).

3. Research Objectives

The study carried two research objectives:

(1) To examine university graduates' perception of their technical skills in the subject areas and soft skills as existing or lacking in current competency.

(2) To identify the technical/ soft skills development most needed by university graduates in their career path to enable them to fit in and do well in their selected organizations.

4. Research Methodology

4.1 Participants

The participants were 116 voluntary university graduates from 40 higher education institutions (shown in Data Set 1) voluntarily responded to the online semi-opened questionnaire. Since the study was exploratory in nature, the researchers set the data to be obtained from 100 participants to observe consistency in response patterns which in turn could reflect representativeness of the group. It should be noted that 116 responses were obtained and the response analysis reflected consistent patterns in their responses. The group therefore was taken as an acceptable and valid in providing needed data.

4.2 Research Instrument

The researchers constructed a research instrument in the form of a semi-opened questionnaire to collect both quantitative and qualitative data from the participants. Since the research instrument was diagnostic in nature, the researchers focused on content relevancy and validity of the question items as assessed by ten specialists in communication and soft skills development. The specialists' feedback was used in revising the instrument into its final version for data collection.

The instrument contained two parts: the first part on the participants' demographic variables, and the second on the participants' perception on the existing/ desired technical and soft skills, together with suggestions for needed training. (See the research instrument in Appendix 1.)

The first part secured 13 demographic variables: (1) Gender, (2) Age, (3) Last educational qualification obtained, (4) Name of the university last attended, (5) Current occupation, (6) Current occupation by your choice/ by your parents' choice, (7) Number of years in the current occupation, (8) Position in the current occupation, (9) Current workplace, (10) Current workplace rate of hourly or monthly payment (by estimate, if applicable), (11) Your most competent technical skills (please specify), (12) Your most competent human or soft skills (please specify), (13) Your need for new technical/ soft skills (please specify).

The second part contained: (1) Technical Skills Required of University Graduates as Pertinent to Occupations/ Specialized Areas (6 items), (2) Please give additional information on your technical skills on the job, if any, (3) Soft Skills Required of University Graduates (16 items), and (4) Please give additional information on your soft skills on the job, if any. (See the research instrument in Appendix 1.)

5. Data Collection and Analysis

The researchers collected data from the participants via the online semi-opened questionnaire. It took about two months in August-September 2023 to obtain the expected target of 100 responses; the final total was 116 responses.

The obtained quantitative data were analyzed by frequency and percentage, and mean and standard deviation to see variability among the participants' perception toward their technical and soft skills trained or acquired in the university programs and work duties in their business/ public organizations. The qualitative data from the participants' responses to the open-ended questions were analyzed by classification of content analysis in terms of frequency and percentage.

6. Results

The results of the study are reported by the research objectives on the participants' perception of their existing and desired technical and soft skills, followed by the information based on the sequence of the semi-opened questionnaire, i.e., the participants' perception of their existing/ desired technical and soft skills on a rating scale of 1 low to 5 high, followed by additional information voluntarily provided.

6.1 The Participants' Demographic Data

As shown in Data Set 1, the majority of the participants (N=116) was female (73 or 62.93%), and about one-third was in the age range of 40+ (35 or 30.17%) with dominant academic qualification at the bachelor's level (57 or 49.14%). They were mainly graduates from the universities in the central part of Thailand (22 of 79 or 55.00%).

About one-third of those who volunteered information on their work for business organizations (20 of 64 or 31.25%) by their own choice. Those participating graduates had their work experience for 6-10 years (21 of 66 or 31.82%), and their current positions appeared scattered but dominantly in the field of education: Teacher (17 of 77 or 22.08%), Educational administrator (13 of 77 or 16.88%), Administrative officer (12 of 77 or 15.58%), followed by other 13 positions in smaller number. Their current workplaces were varied, but dominantly in three categories: Enterprise (13 of 93 or 13.98%), Municipality (13 of 93 or 13.98%), Government university (11 of 93 or 11.83%), and Government unit (10 of 93 or 10.75%). The majority specified their current monthly rate of payment: Up to 15,000 (20 of 83 or 24.10%), 16,000-25,000 (11 of 83 or 13.25%), and 26,000-35,000 (18 of 83 or 21.69%).

Data Set 1: Participants' Demographic Variables by Frequency and Percentage (Total=116)

- Gender: Male=33 (37.07%), Female=73 (62.93%)
- Age: 20+ =33 (28.45%), 30+ =29 (25.00%), 40+ =35 (30.17%), 50+ =13 (11.21%), 60+ =6 (5.17%)
- Last educational qualification obtained: Bachelor's=57 (49.14%), Master's=31 (26.72%), Doctorate=28 (24.14%)
- University last attended: Total responses=79 (68.10%), No answer=37 (31.90%)
  Total universities: 40 (100%): Central=22 (55.00%), North=3 (7.5%), Northeast=10 (25.00%), South=1 (2.5%), Other=4 (10.00%)
- Current occupation: Total responses=64 (55.17%), No answer=52 (44.83%)
  Of 64 responses: Company employee=20 (31.25%), Government officer=16 (25.00%), Teacher=14 (21.88%), Nurse=2 (3.125%), Other=12 (18.75%)
- Current occupation by personal choice: Similar to those responses under "Current occupation"
- Current occupation by parents' choice: Similar to those responses under "Current occupation," except Medicine doctor=1 (0.86%), Soldier=1 (0.86%)
- Number of years in current occupation: Total responses=66 (56.90%), No answer=50 (43.10%)
  Of 66 responses: 1-5=18 (27.27%), 6-10=21 (31.82%), 11-15=6 (9.09%), 16-20=9 (13.64%), 21-25=7 (10.61%), 26-30=2 (3.03%), 30+=2 (3.03%), Not working=1 (1.51%)
- Position in current occupation: Total responses=77 (66.38%), No answer=39 (33.62%)
  Of 77 responses: Teacher=17 (22.08%), Educational administrator=13 (16.88%), Administrative officer=12 (15.58%), Departmental head=9 (11.69%), Accounting officer=7 (9.09%), Engineer=4 (5.19%), Analyst=3 (3.90%), Academic officer=3 (3.90%), Nurse=2 (2.59%), Government officer=1 (1.30%), IT officer=1 (1.30%), Retiree=1 (1.30%) , Sales officer=1 (1.30%), Self-employed=1 (1.30%) , Student=1 (1.30%), Technician=1 (1.30%)

- Current workplace: Total responses=93 (80.17%), No answer=23 (19.83%)
  Of 93 responses: Enterprise=13 (13.98%), Municipality =13 (13.98%),
  Government university=11 (11.83%), Government unit=10 (10.75%), Secondary school=9 (9.68%),
  College=8 (8.60%), Primary school=8 (8.60%), Private university=6 (6.45%), Government enterprise=3 (3.22%),
  Hospital=3 (3.22%), Bank=2 (2.15%), Cooperative=2 (2.15%),
  Hotel=2 (2.15%), Foundation=1 (1.08%), Home=1 (1.08%),
  Kindergarten=1 (1.08%)
- Current monthly rate of payment: Total responses=83 (71.55%), No answer=33 (28.45%)
  Of 83 responses: Up to 15,000=20 (24.10%),
  16,000-25,000=11 (13.25%), 26,000-35,000=18 (21.69%),
  36,000-45,000=9 (10.84%), 46,000-55,000=6 (7.23%),
  56,000-65,000=5 (6.03%), 66,000+ =7 (8.43%),
  Not specified=7 (8.43%)

6.2 The Participants' Identified Most Competent Technical/ Soft/ Newly Needed Skills

As reported in Data Det 2, the participants identified their most competent technical skills as Teaching (22 of 98 or 22.45%), Digital skills (12 of 98 or 12.25%), Finance and accounting (11 of 98 or 11.23%), Management (10 of 98 or 10.21%),), Secretarial work (7 of 98 or 7.14%) and Communication (7 of 98 or 6.12%. There were also other 13 skills from the frequency of 5 or less.

As for their most competent human or soft skills, the participants identified four types of frequency 24-6: Communication (24 of 87 or 27.59%), Speaking skills (15 of 87 or 17.24%), Human relations (12 of 87 or 13.79%), and Four language skills (6 of 87 or 6.90%). There were also other 12 skills from the frequency of 5 or less.

The participants identified their needs for new soft skills in five types with frequency of 15-7: Digital skills (15 of 82 or 18.29%), English (10 of 82 or 12.20%), Critical thinking skills (8 of 82 or 9.76%), Communication skills (8 of 82 or 9.76%), and Speaking skills (7 of 82 or 8.54%). There were also other 14 skills from the frequency of 5 or less.

Data Set 2: Participants' Identified Most Competent Technical/ Soft/ Newly Needed Skills (Total=116)

- Your most competent technical skills: Total responses=98 (84.48%), No answer=18 (15.52%)
  Of 98 responses: Teaching=22 (22.45%), Digital skills =12 (12.25%), Finance and accounting=11 (11.23%), Management=10 (10.21%), Secretarial work=7 (7.14%), Communication=6 (6.12%),
  Research=5 (5.10%), Educational administration=4 (4.08%),
  Nursing=4 (4.08%), Marketing=3 (3.06%), Art=2 (2.04%),
  Engineering=2 (2.04%), English=2 (2.04%), Mathematics=2 (2.04%),
  Procurement=2 (2.04%), Acting=1 (1.02%), Law=1 (1.02%),
  Music=1 (1.02%), Technician's repair and maintenance skills=1 (1.02%)

- Your most competent human or soft skills: Total responses=87 (75.00%), No answer=29 (25.00%)

  Of 87 responses: Communication=24 (27.59%), Speaking skills =15 (17.24%), Human relations=12 (13.79%), Four language skills=6 (6.90%), Persuasion=5 (5.75%), Team work=4 (4.60%), Coordination=3 (3.45%), Discussion=3 (3.45%), Leadership=3 (3.45%), Analytical skills=2 (2.30%), Digital skills=2 (2. 30%), English=2 (2. 30%), Public relations=2 (2. 30%), Thai=2 (2. 30%), Interpersonal skills=1 (1.14%), Problem-solving skills=1 (1.14%)

- Your need for new technical/ soft skills: Total responses=82 (10.69%), No answer=34 (29.31%)

  Of 82 responses: Digital skills=15 (18.29%), English =10 (12.20%), Critical thinking skills=8 (9.76%), Communication skills=8 (9.76%), Speaking skills=7 (8.54%), Stress management=5 (6.10%), Foreign language skills=4 (4.88%), Chinese=3 (3.66%), Leadership skills=3 (3.66%), Listening skills=3 (3.66%), Negotiation skills=3 (3.66%), Persuasion=3 (3.66%), Human relations=2 (2.43%), Presentation skills=2 (2.43%), Team work=2 (2.43%), Accounting=1 (1.22%), Mynmar language=1 (1.22%), Preventive medicine=1 (1.22), Writing skills=1 (1.22%)

6.3 Technical Skills Required of University Graduates as Pertinent to Occupations/ Specialized Areas

As seen in Data Set 3, the participants were positive about their technical skills obtained from their specialized university programs as relevant or pertinent to their current occupations. It was obvious that they rated high on the scale as 5 and 4 combined at the level of 75-76%: Technical knowledge of the job, Application of technical knowledge on the job, Modification of technical knowledge on the job, Technical initiative on the job, and Technical creativity on the job. It was obvious that the participants perceived their problem-solving skills on the job very high at the levels of 5 and 4 combined at 83%.

Data Set 3: Technical Skills Required of University Graduates as Pertinent to Occupations/ Specialized areas (Total=116)

1. Your technical knowledge of the job (N=116):
   5=43 (37.07%), 4=44 (37.93%), 3=25 (21.55%), 2=1 (0.86%), 1=3 (2.59%)
2. Your application of technical knowledge on the job (N=116):
   5=39 (33.62%), 4=50 (43.11%), 3=24 (20.69%), 2=1 (0.86%), 1=2 (1.72%)
3. Your modification of technical knowledge on the job(N=116):
   5=41 (35.34%), 4=46 (39.66%), 3=25 (21.55%), 2=3 (2.59%), 1=1 (0.86%)
4. Your problem-solving skills on the job (N=116):
   5=43 (37.07%), 4=53 (45.69%), 3=16 (13.79%), 2=3 (2.59%), 1=1 (0.86%)
5. Your technical initiative on the job (N=116):
   5=33 (28.45%), 4=54 (46.55%), 3=23 (19.83%), 2=4 (3.45%), 1=2 (1.72%)
6. Your technical creativity on the job (N=116):
   5=37 (31.90%), 4=51 (43.97%), 3=24 (20.69%), 2=2 (1.72%), 1=2 (1.72%)

6.4 Technical Skills Required of University Graduates as Pertinent to Occupations/ Specialized Areas (Total=116): Variability

The researchers rechecked variability in the participants' responses regarding their perception of their existing technical skills, as shown earlier in Data Set 3. The results by means and standard deviation as shown in Table 1 indicate that the participants appeared to agree upon their satisfaction with their university specialized programs (Mean=4.06, S.D.=0.86) and their abilities in using the acquired/ trained technical skills on the job. They also expressed their high confidence in their problem-solving skills (Mean=4.15, S.D.=0.81).

Table 1: Technical Skills Required of University Graduates as Pertinent to Occupations/ Specialized Areas (Total=116)

Technical Skills Required of University Graduates as Pertinent to Occupations/ Specialized Areas	$\bar{x}$	S.D.	Required Level
1. Your technical knowledge of the job	4.06	0.92	high
2. Your application of technical knowledge on the job	4.06	0.85	high
3. Your modification of technical knowledge on the job	4.06	0.86	high
4. Your problem-solving skills on the job	4.15	0.81	high
5. Your technical initiative on the job	3.96	0.88	Moderate
6. Your technical creativity on the job	4.02	0.86	high
Total	**4.06**	**0.86**	**high**

6.5 Additional Information on Technical Skills on the Job

As shown in Data Set 4, the participants highly valued Digital skills (15 of 71 or 21.14%), English/ foreign language (13 of 71 or 18.31%), and AI (6 of 71 or 8.46%). There were also other 19 skills that show frequency of 5 or less.

Data Set 4: Additional Information on Technical Skills on the Job
Total responses=71/116 (61.21%)
Of 71 responses:
Digital skills (15 or 21.14%)
English/ foreign language (13 or 18.31%)
AI (6 or 8.46%)
Self-development (5 or 7.04%)
Leadership (4 or 5.63%)
Accounting/ finance (3 or 4.22%)
Communication (3 or 4.22%)
Procurement (3 or 4.22%)
Teaching media and skills (3 or 4.22%)
Teamwork (3 or 4.22%)
Critical/ creative thinking (2 or 2.81%)

Learning innovation (1 or 1.41%)
Life skills (1 or 1.41%)
Negotiation (1 or 1.41%)
Presentation skills (1 or 1.41%)
Quality assurance (1 or 1.41)
Research (1 or 1.41%)
Risk management (1 or 1.41)
Sales/ marketing (1 or 1.41%)
Speaking (1 or 1.41%)
Stress management (1 or 1.41%)
Tax documentation (1 or 1.41%)

6.6 Soft Skills Required of University Graduates

When considering Data Set 4, the researchers were able to detect confidence in the participants' soft skills and exiting and desired at work. The participants' perception of 16 soft skills varied in heir confidence of their existing skills, as seen in *the percentages of scales 5 and 4 combined*. It was obvious that 90% revealed high confidence, followed by descending percentages at 80%, 70%, 60%, 50%, 40% and 30% as reported in Data Set 4 as follows:

Soft Skills by Item Number and Description

15. Responsibility at work (93.11%)

_____

10. Life skills management (88.80%)
16. Loyalty to workplace (87.93%)
14. Commitment to assigned work (85.35%)
9. Service-mindedness (87.93%)
2. Communication skills (85.34%)
12. Change management (81.90%)
1. Information technology literacy (80.18%)
7. Creativity (80.18%)

_____

11. Stress management (79.32%)
13. Flexibility (79.32%)
6. Initiative (76.72%)

_____

5. Language abilities for communication (64.65%)

_____

8. Artistic expression (55.17%)

_____

3. Use of English for communication (40.52%)

_____

4. Use of ASEAN language(s) for communication (23.27%)

_____

As seen on the list above, the participants appeared less confident in their soft skills regarding English language communication, artistic expression and least confident in the use of ASEAN languages for communication.

Data Set 5: Soft Skills Required of University Graduates (Total=116)

1. Information technology literacy (N=116):
   5=51 (43.97%), 4=42 (36.21%), 3=19 (16.37%), 2=3 (2.59%), 1=1 (0.86%)
2. Communication skills (N=116):
   5=58 (50.00%), 4=41 (35.34%), 3=13 (11.21%), 2=3 (2.59%), 1=1 (0.86%)
3. Use of English for communication (N=116):
   5=22 (18.97%), 4=25 (21.55%), 3=41 (35.34%), 2=20 (17.24%), 1=8 (6.90%)
4. Use of ASEAN language(s) for communication (N=116):
   5=15 (12.93%), 4=12 (10.34%), 3=51 (43.97%), 2=24 (20.69%), 1=14 (12.07%)
5. Language abilities for communication (N=116):
   5=40 (34.48%), 4=35 (30.17%), 3=32 (27.59%), 2=6 (5.17%), 1=3 (2.59%)
6. Initiative (N=116):
   5=31 (26.72%), 4=58 (50.00%), 3=22 (18.97%), 2=3 (2.59%), 1=2 (1.72%)
7. Creativity (N=116):
   5=44 (37.93%), 4=49 (42.25%), 3=20 (17.24%), 2=2 (1.72%), 1=1 (0.86%)
8. Artistic expression (N=116):
   5=26 (22.41%), 4=38 (32.76%), 3=34 (29.31%), 2=17 (14.66%), 1=1 (0.86%)
9. Service-mindedness (N=116):
   5=68 (58.62%), 4=34 (29.31%), 3=12 (10.35%), 2=1 (0.86%), 1=1 (0.86%)
10. Life skills management (N=116):
    5=71 (61.21%), 4=32 (27.59%), 3=11 (9.48%), 2=1 (0.86%), 1=1 (0.86%)
11. Stress management (N=116):
    5=46 (39.66%), 4=46 (39.66%), 3=20 (17.24%), 2=2 (1.72%), 1=2 (1.72%)
12. Change management (N=116):
    5=49 (42.24%), 4=46 (39.66%), 3=19 (16.38%), 2=1 (0.86%), 1=1 (0.86%)
13. Flexibility (N=116):
    5=50 (43.11%), 4=42 (36.21%), 3=21 (18.10%), 2=2 (1.72%), 1=1 (0.86%)
14. Commitment to assigned work (N=116):
    5=66 (56.90%), 4=33 (28.45%), 3=14 (12.07%), 2=2 (1.72%), 1=1 (0.86%)
15. Responsibility at work (N=116):
    5=91 (78.45%), 4=17 (14.66%), 3=7 (6.03%), 2=0 (0.00%), 1=1 (0.86%)
16. Loyalty to workplace (N=116):
    5=74 (63.79%), 4=28 (24.14%), 3=11 (9.48%), 2=2 (1.72%), 1=1 (0.86%)

6.7 Soft Skills Required of University Graduates: Variability

The researchers rechecked variability in the participants' responses regarding their perception of their existing soft skills, as shown earlier in Data Set 4. The results by means and standard deviation as shown in Table 2 indicate that the participants appeared to agree upon their perception toward their abilities in using the acquired soft skills on the job (Mean=4.08, S.D.=0.88). They also expressed their high confidence in their Life skills management (Mean=4.47, S.D.=0.77), Service-mindedness (Mean=4.43, S.D.=0.78), and Communication skills in general (Mean=4.31, S.D.=0.83). Consistent with Data Set 4, the participants' perception was relatively low in confidence in Use of English for communication (Mean=3.28, S.D.=1.16), and Use of ASEAN language(s) for communication (Mean=2.85, S.D.=1.12).

Table 2: Soft Skills Required of University Graduates (Total=116)

Soft Skills Required of University Graduates	$\bar{x}$	S.D.	Required Level
1. Information technology literacy	4.19	0.86	High
2. Communication skills	4.31	0.83	High
3. Use of English for communication	3.28	1.16	Moderate
4. Use of ASEAN language(s) for communication	2.85	1.12	Low moderate
5. Language abilities for communication	3.88	1.02	Moderate
6. Initiative	3.97	0.84	Moderate
7. Creativity	4.13	0.85	High
8. Artistic expression	3.61	1.01	Moderate
9. Service-mindedness	4.43	0.78	High
10. Life skills management	4.47	0.77	High
11. Stress management	4.13	0.88	High
12. Change management	4.21	0.81	High
13. Flexibility	4.18	0.85	High
14. Commitment to assigned work	4.38	0.83	High
15. Responsibility at work	4.69	0.66	High
16. Loyalty to workplace	4.48	0.80	High
Total	**4.08**	**0.88**	**High**

6.8 Additional Information on Soft Skills on the Job

As shown in Data Set 6 on additional information on soft skills on the job given by the participants, they highly valued Human relations (15 of 66 or 22.72%), Communication skills (11 of 66 or 16.66%), English/ foreign language (8 of 66 or 12.12%), Speaking skills (6 of 66 or 9.09%), and Teamwork (6 of 66 or 9.09%). There were also other 19 skills that show frequency of 5 or less.

Data Set 6: Additional Information on Soft Skills on the Job

Total response=66/116 (56.04%)
Of 66 responses:
Human relations (15 or 22.72%)
Communication skills (11 or 16.66%)
English/ foreign language (8 or 12.12%)
Speaking skills (6 or 9.09%)
Teamwork (6 or 9.09%)
Digital skills (5 or 7.57%)
Open-mindedness (3 or 4.54%)

Psychology (2 or 3.03%)
Social manners (2 or 3.03%))
Analytical thinking (1 or 1.52%)
Creative thinking (1 or 1.52%)
Deep listening (1 or 1.52%)
Leadership (1 or 1.52%)
Life skills (1 or 1.52%)
Persuasion (1 or 1.52%)
Responsibility (1 or 1.52%)
Sales (1 or 1.52%)

7. Discussion of Results and Conclusion

As seen in the demographic data of 116 participants, the participants were from forty universities in Thailand, with the majority from the central region; they were financially secure and with good work experience in their current positions. In this regard, it can be said that they should serve as a valid group in providing data on their existing and desired technical and soft skills as trained from their university program as well as acquired in the in-service training programs of or on the job (see Data Set 1).

In their responses, the participants identified their most competent technical skills on the job as Teaching, followed by Digital skills, Finance and accounting, Management, Secretarial work or Documentation, and Communication. It should be noted that their claimed competency on digital skills at work was somewhat limited (12 of 98 or 12.25%). As for their most competent human or soft skills, the participants dominantly claimed four types of relatively high frequency 24-6: Communication, Speaking skills, Human relations, and Four language skills. They specified their needs for new soft skills in five types with relative high frequency of 15-7: Digital skills, English, Critical thinking skills, Communication skills, and Speaking skills (see Data Set 2).

In the second part of the semi-open questionnaire, the participants were asked to rate their own competency on a scale of 1 low to 5 high regarding six technical skills on the job: technical knowledge, its application and modification, problem-solving, initiative and creativity. It was obvious that the participants perceived their problem-solving skills on the job very high at the levels of 5 and 4 combined at 83%. The participants' perception variability pointed to that their agreement upon their satisfaction with their training in university specialized programs (Mean=4.06, S.D.=0.86) and their abilities in using the acquired/ trained technical skills on the job. Particularly, they highly appraised their problem-solving skills (Mean=4.15, S.D.=0.81) (see Data Set 3 and Table 1)

The participants also rated their competency of 16 specific soft skills derived from the national/ASEAN standards and previous research: Information technology literacy, Communication skills, Use of English for communication, Use of ASEAN language(s) for communication, Language abilities for communication, Initiative, Creativity, Artistic expression, Service-mindedness, Life skills management, Stress management, Change management, Flexibility, Commitment to assigned work, Responsibility at work, Loyalty to workplace. Their item rating revealed confidence in the soft skills both existing and desired at work. The participants' perception of 16 soft skills varied in their confidence of their existing skills, as seen in the high percentages of scales 5 and 4 combined. It was

obvious that 90% revealed high confidence, followed by descending percentages at 80%, such as Responsibility at work (93.11%), Life skills management (88.80%), Loyalty to workplace (88.13%), Commitment to assigned work (85.35%), Service-mindedness (87.93%), Communication skills (85.34%), Change management (81.90%), Information technology literacy (80.18%), Creativity (80.18%). The participants appeared to agree upon their perception toward their abilities in using the acquired soft skills on the job (Mean=4.08, S.D.=0.88). (see Data Set 4 and Table 2).

Undoubtedly, experienced employees tend to be confident in their technical skills and their responses were not beyond the researchers' expectation. They expressed their high confidence in their Life skills management, Service-mindedness, and Communication skills in general. However, their perception was relatively low in confidence in Use of English for communication (Mean=3.28, S.D.=1.16), and Use of ASEAN language(s) for communication (Mean=2.85, S.D.=1.12). We have been well aware of English as weakness in Thai university graduates. As generally known among OECD countries, Thai people have relatively low English proficiency and appear to lack motivation in learning foreign languages even those of the neighboring countries. A new language requires time to acquire in a natural environment or learn in a formal classroom context. Success in language learning lies in learners' open-mindedness. University graduates or employees need to adjust their mindset that communication skills are not formulaic, but exploratory in nature. Developing a new mindset on willingness to interact effectively in a new language for career attainment with open-mindedness, Thai graduates can overcome a mythical obstacle that Thais are weak linguistically (Pholsward, 2018).

Of 16 soft skills, the participants valued Change management (81.90%) and Stress management (79.32%). We know that change and stress are closely related. It is important that employees learn new skills—both technical and soft skills—to be able to do well on their career path toward higher positions. However, stress and burnout are well-recognized as a deterrent factor if not controlled at a level that can stimulate employees to be productive at work. As Latthasaksiri (2021) emphasized, stress management skills keep a good balance between life and work as well as ensure stress at work at a level that yields productivity rather than depression. It is certain that soft skills take time in mentoring and acquiring in the work process of an organization's culture and interactions to attain the expected levels (Weber, Crawford, Lee & Dennison, 2013; Wetsanarat, 2021).

It was noted that the participants were aware of the skills they felt as weaknesses in adding information on the soft skills section dealing with thinking and communication skills and work attitude, particularly Analytical thinking, Creative thinking, Deep listening, Leadership, Life skills, Persuasion, Responsibility, and Sales abilities. These skills are essential in professional development and significant to self-development with a positive mindset (Weber, Finley, Crawford & Rivera Jr., 2009; Pholsward, 2022; Purdue, Ninemeier & Woods, 2022). As seen, the results of the present study and the previous findings of the earlier researchers highlighted the importance of attitude, personality traits, motivation of individuals as embedded in soft skills that in turn can help support initiative and creativity in the technical skills. In this regard, not only universities, but also both public and business organizations need to upgrade their human resource development programs to support and retain their employees for successful performances of the organizations.

8. The Authors

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10. Appendix 1: Research Instrument

A Survey Questionnaire on Technical and Soft Skills of University Graduates
Academic Year 2023

Technical skills refer to knowledge and technical competencies required in an occupation/ specialized area, as specified under section 2.1 in the questionnaire.

Soft skills refer to human skills identified as ASEAN Standards--mainly information technology literacy, communication skills, language abilities, initiative and creativity, life skills management, stress management, and flexibility or willingness to adjust and cope with change, as detailed under section 2.2 in the questionnaire.
Directions:
Dear Respondents:

This survey questionnaire is from Rattanakosin International College of Creative Entrepreneurship (RICE), Rajamangala University of Technology Rattanakosin (RMUTR), Nakhon Pathom, Thailand. The purposes are (1) to obtain information on the current conditions of technical and soft skills of university graduates, and (2) to identify those skills that are required by ASEAN standards in university graduates.

The obtained information from all respondents is treated as group data and kept strictly confidential. The data will be used to provide answers as relevant to the two research objectives. It is expected that the results of the study can give a comprehensive picture of technical and soft skills acquired by university graduates, and generate implications for the direction of higher education institutions in upgrading technical and soft skills by the ASEAN standards in their graduates for relevant career opportunities.

Rattanakosin International College of Creative Entrepreneurship (RICE) truly appreciates your time and kind assistance in providing needed data for this research project.

Respectfully,
Ruja Pholsward, Ph.D.
Associate Professor
Principal Researcher
_____

The questionnaire contains two parts.

Part 1: Respondents' Demographic Data
Directions: Please fill in the blanks with your data.

Gender: Male ___ Female ___
Age in years: 20+ ___, 30+ ___, 40+ ___, 50+ ___, 60+ ___
Last educational qualification obtained: BA __, MA __, Ph.D. __, Other (please specify)___
Name of the university last attended _____
Current occupation _____
Current occupation by your choice _____ by your parents' choice _____
Number of years in the current occupation _____

Position in the current occupation _____
Current workplace: _____
Current workplace rate of hourly or monthly payment (by estimate, if applicable) _____
Your most competent technical skills (please specify) _____
Your most competent human or soft skills (please specify) _____
Your need for new technical/ soft skills (please specify) _____

Part 2: Technical and Soft Skills of University Graduates as Pertinent to Occupations/ Specialized areas

Directions: Please provide your data by specifying the level of your competency of the given technical and soft skills from (1) low to (5) high. Please select one figure for each item.

2.1 Technical Skills Required of University Graduates as Pertinent to Occupations/ Specialized Areas

1.Your technical knowledge of the job: …… 1 2 3 4 5
2.Your application of technical knowledge on the job: ……1 2 3 4 5
3.Your modification of technical knowledge on the job: ……..1 2 3 4 5
4.Your problem-solving skills on the job: ……..1 2 3 4 5
5.Your technical initiative on the job: ……1 2 3 4 5
6.Your technical creativity on the job: …… ..1 2 3 4 5
Please give additional information on your technical skills on the job, if any.

_____

_____

_____

_____

2.2 Soft Skills Required of University Graduates:

1. Information technology literacy: ……...	1	2	3	4	5
2. Communication skills: ……	1	2	3	4	5
3. Use of English for communication: ……	1	2	3	4	5
4. Use of ASEAN language(s) for communication: ……	1	2	3	4	5
5. Language abilities for communication: ……...	1	2	3	4	5
6. Initiative: ……	1	2	3	4	5
7. Creativity: ……	1	2	3	4	5
8. Artistic expression: ……	1	2	3	4	5
9. Service-mindedness: ……	1	2	3	4	5
10. Life skills management: ……	1	2	3	4	5
11. Stress management: ……..	1	2	3	4	5
12. Change management: ……...	1	2	3	4	5
13. Flexibility: ……	1	2	3	4	5
14. Commitment to assigned work: ……	1	2	3	4	5
15. Responsibility at work: ……	1	2	3	4	5
16. Loyalty to workplace: ……	1	2	3	4	5

Please give additional information on your soft skills on the job, if any.

_____

_____

_____

11. Appendix 2: Details of Knowledge, Skills and Attributes at Three Levels (Wetsanarat, 2022)
Summary of Knowledge, Skills and Attributes at the Levels of Threshold, Standard and Ideal

Level 1: Threshold

Knowledge
Product knowledge: characteristics, costs, availability
Customer knowledge: their objectives, needs, business goals, key success factors, and decision process
Market intelligence: market trends, competitive intelligence
Knowledge about current affairs: domestic and international
Knowledge about project: structure, characteristics, components
Knowledge about internal working process in the organization
Knowledge about travel program arrangement: planning, operations, logistical requirement, timing, safety and security specification and requirement, and crowd management
Knowledge about legal issues pertinent to different MICE events

Skills
Communication skills: concise/precise/logical
Teamwork and team planning
Presentation skills: clear and logical
Basic cost and revenue
Task coordination
English proficiency
Computer literacy
Correspondence, and rank and file appropriate for functional areas and information recipients [Documentation and information handling]
Project management skills: according to the agreement, and timeline

Attributes
Acumen [the ability to make good judgements and quick decisions, usually in a business context, like “business acumen”]
Integrity
Optimism toward problems and obstacles
Observance and detail oriented
Service mind
Change adaptation
Personality: trust commanding, leadership
Good memory about work related issues
Intercultural awareness
Assertiveness with politeness
Pride in working organization
Avoid price cutting
Work experience in Incentive Travel Business

Level 2: Standard

Knowledge
Knowledge about adaptation, mixing, matching project components to create phenomenal experience
Knowledge about the working process of other departments

Skills
Strategic questioning
Negotiation: systematic, fair, responsive
Problem solving: unplanned situation
Planning skills: anticipative of potential problems
Presentation skills through CAD

Attributes
Neatness and meticulousness
Goal-oriented attitude
Dependability

Level 3: Ideal

Knowledge
Knowledge about other MICE events and their success factors

Skills
Communication: tactical with social acumen
Conflict management: systematic, integrative
Communication skills: charismatic and persuasive

Attributes
Conflict management to create best practice for the project

End of Appendix 2

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Needs Assessment of Academic Administration Development in Thai Colleges of Agriculture and Technology Based on the Concept of Smart Agripreneurial Skills

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Abstract

This research aims to assess the needs for academic administration development in Thai Colleges of Agriculture and Technology based on the concept of smart agripreneurial skills. The participants were 94 persons, including school administrators, faculty members, or deputy directors responsible for academic administration. The research instrument was a questionnaire assessing the needs for academic administration development in the Colleges of Agriculture and Technology based on the concept of smart agripreneurial skills. The overall reliability value was 0.81. The statistical techniques used for data analysis in this study were frequency, percentage, mean, standard deviation, and the modified Priority Needs Index ($PNI_{modified}$). The obtained findings indicated that the overall condition of current and desired conditions of academic administration in the colleges under study were at the high level (Mean=3.89) and the highest level (Mean=4.84), respectively. The analysis of the modified Priority Needs Index revealed the prioritization of needs in a descending order as follows: The educational institution's curriculum development ($PNI_{modified}$ = 0.26) held the highest importance, followed by the utilization of media and learning resources ($PNI_{modified}$ = 0.24), measurement and evaluation ($PNI_{modified}$ = 0.23), and teaching and learning management ($PNI_{modified}$ = 0.22).

Keywords: *Needs assessment, academic administration, agripreneurial skills, Thai colleges of agriculture and technology*

1. Introduction

Thailand 5.0 as the country's vision and policy for economic development, aims to transform the traditional economic structure into a value-based economy. The primary objective is to transition from commodity production to the development of innovative products. This entails a shift from relying solely on the industrial sector to being driven by technology, creativity, and innovation. Additionally, there is a shift in emphasis from the manufacturing sector to a greater focus on the service sector. One of the pilot target groups that the government prioritizes for development is the agricultural sector, with a specific focus on management and technology enhancement. The objective is to move toward smart

agriculture and smart farming, promoting the shift from low-skilled labor to a highly skilled and knowledgeable workforce (Ministry of Education, 2016).

External factors, particularly the influence of information technology, have led to the increasing adoption of automated systems to replace human labor. In particular, trade regulations, both domestically and for international exports, have become more stringent. This has placed significant pressure on Thailand's agricultural sector, prompting a rapid adaptation to smart agriculture practices and a heightened focus on the production of high- quality agricultural products. Achieving this requires adjusting the production model in alignment with the trends in smart agricultural technology. In response to climate change, the implementation of smart agriculture practices needs to reduce the reliance on traditional fertilizers and chemicals. Furthermore, the global population in a significant aging trend highlights the ongoing importance of food security worldwide. With the growing population, there is an imperative to incorporate technology to enhance production efficiency, ensuring an adequate food supply for the future. The Food and Agriculture Organization of the United Nations (FAO) has projected that by 2050, the world's population will rise from 7.5 billion to 7.9 billion, leading to a 60 percent increase in the demand for food crops compared to the current situation (Office of the National Higher Education, Science, Research and Innovation Policy Council, 2020).

Consequently, Thailand's agricultural sector must undergo a profound transformation toward smart agriculture, involving meticulous analysis of local conditions, efficiency enhancement, and advanced technology utilization. This approach encompasses control over the entire production process, including seed selection, real-time online proactive management through Agri-Map Online, and precise control of volume, light, temperature, and nutrient and water levels. Sensor systems and artificial intelligence (AI) are used for pest control and decision-making, enabling agriculture based on an accurate information database created through a Big Data Platform. This system aims to achieve production precision, cut down costs, minimize losses, and reduce pesticide, fertilizer, water usage, and manual labor. It enhances both the quantity and quality of agricultural output, boosts farmer income, enables precise production predictions, and aids marketing strategies and planning, including futures market determination and price stability maintenance (Pattama, 2020; Office of the Vocational Education Commission, 2021).

2. Research Background

The concept of smart farming, combined with agripreneurship, entails using digital technology throughout the agricultural product supply chain, from farmers to consumers, to enhance efficiency, reduce costs, and elevate standards (Pattama, 2020). Smart agripreneurs primarily focus on advancing agricultural development in four crucial areas: (1) cost reduction in the production process, (2) enhancement of production quality and standards, (3) risk mitigation in the agricultural sector, and (4) knowledge and technology transfer. These areas encompass the application of automation and production control systems to optimize both quantity and quality. Therefore, smart agripreneurs should prioritize producing high-quality agricultural products that are safe for consumers and environmentally friendly. To achieve this, they must possess 10 skills including (1) management, (2) creativity, (3) thought leadership, (4) coordination, (5) trust, (6) information technology, (7) health, (8) responsibility, (9) empowerment, and (10) risk-taking

skills (Dyer, Gregersen & Christensen, 2019). Additionally, smart agripreneurs should integrate information technology, biotechnology, and modern agricultural methods with traditional farming practices. This integration involves gathering information about plants, the agricultural environment and databases, which are interconnected and processed using computer programs to aid decision-making and optimize production factors as well as post-harvest management. Therefore, innovation in information technology is crucial for enhancing and refining agricultural processes, ultimately resulting in higher-quality agricultural products (Sukglun et al., 2018).

The Office of Vocational Education Commission (VEC) is a pivotal agency tasked with producing and developing high-quality, internationally standardized manpower using modern technology to align with the country's national strategic goals. In the fiscal year 2020, its primary focus was on preparing Thai people for the demands of the 21st century (Vocational Education Commission, 2021). Formal education management within the purview of the VEC pertains to the agricultural sector and is delivered through 43 Colleges of Agricultural and Technology, along with 3 Fishery Colleges and 1 Fisheries and Agriculture Technology College, comprising a total of 47 colleges distributed across various provinces throughout Thailand. Their major responsibility is to provide comprehensive and diversified agricultural education, encompassing all aspects of agriculture-related occupations. They work collaboratively with government policies and relevant agencies to enhance the management of vocational educational institutions, including agricultural and fisheries colleges, with the overarching goal of cultivating smart agripreneurship aligned with the demands of the 21st-century global society. This vision is realized through the Digital Agri College concept by integrating science, technology, and innovation into the teaching and learning process. The aim is to elevate vocational educational institutions in agriculture and fisheries to the status of Digital Agri Colleges through a range of processes and activities, including (1) Digital College, (2) Digital Community, (3) New Digital Farmer (Upskill/Reskill), (4) Young Digital Farmer (Vocational Certificate/Bachelor's Degree), (5) Coding for Farm, (6) F.F.T (Future Farmer of Thailand), and (7) STI (Science/Technology/Innovation) (Bureau of Monitoring and Evaluation, Vocational Education Commission, 2020).

Hence, the learning and instructional management of the Colleges of Agriculture and Technology is deemed crucial for producing and nurturing a workforce in vocational education equipped with knowledge, capabilities, attributes, and skills relevant to smart agripreneurship. This endeavor aligns with the national strategy, economic and social development plans, and various policies driving the nation's advancement. To achieve international competitiveness and enhance the country's economic value as well as skills for careers in the 21st century, developing smart agripreneurship skills within the Colleges of Agriculture and Technology is imperative. The development of smart agripreneurship skills within vocational education institutions primarily relies on an internal learning process within these colleges. This encompasses academic administrations, ranging from curriculum development and teaching and learning management to assessment, evaluation, and the effective utilization of media and learning resources. These aspects are essential for facilitating students' learning. Drawing from experiences in real-world learning spaces and hands-on learning spaces within agricultural enterprises, the vocational education curriculum must meet the standards set by the Office of the Vocational Education Commission. It should also embrace project-based learning (PBL), where students gain practical experience and develop

skills and expertise. Thus, academic administration has a crucial mission in promoting and instilling smart agripreneurship skills in students at Colleges of Agriculture and Technology. In this present study, the researchers recognized the necessity of studying and devising strategies to enhance academic administration within these colleges, particularly in the context of smart agripreneurship skills. It was expected that research findings would benefit educational institutions, management practices, and students, ultimately advancing Thailand toward the development of globally competitive and skilled workforce for the country.

Needs assessment is a fundamental and crucial step in the evaluation process, as it provides information regarding identified problems and various needs within an organization. Originally, assessment processes were typically conducted after projects being completed to examine the extent to which objectives were achieved. In practice, the concept of assessment has evolved to emphasize ongoing evaluation during project implementation. This approach yields data that aids in improving the project's effectiveness. Assessment plays a dual role by summarizing results and evaluating progress, thereby leading to clearer organizational goals. Due to its significance, some institutions even require the submission of needs assessment results to support funding requests for various activities or projects. The systematic process of needs assessment gathers information about the current state of the organization or individuals being assessed. Such information is then analyzed to identify discrepancies between the current state and the desired state. These gaps highlight the needs which are unsatisfactory conditions of the organization or individual that are intended to be assessed and should be addressed (Wongwanich, 2020).

Therefore, to develop students with the mindset of smart agripreneurs, it is essential to rely on the academic administration skills of educational leaders, particularly in efficiently managing academic affairs. In the context of managing academic affairs aligned with the concept of smart agripreneurship skills, it is imperative to investigate the necessary requirements for effective management. For this reason, the researchers felt the acute needs to examine academic administration within the Colleges of Agriculture and Technology on the basis of smart agripreneurship skills. The use of need assessment can help identify ways to enhance academic administration within these colleges regarding smart agripreneurship skills development. The study should benefit academic management, educational institutions, and students in vocational education in support of country's economic sustainability via Thailand 5.0 Policy.

3. Research Objective

The study aims to assess the needs for academic administration development in the Thai colleges of agriculture and technology based on the concept of smart agripreneurial skills.

4. Research Methodology

4.1 Participants

Ninety-four voluntary participants were from 47 Colleges of Agriculture and Technology under the Office of the Vocational Education Commission, Ministry of Education. They were educational administrators and teachers or deputy directors with the academic administration duties in their institutions.

4.2 Research Instrument

The researchers used a questionnaire with a 5-point Likert scale and a dual-response format to assess the needs for enhancing academic administration in 47 Thai colleges of agriculture and technology, by the concept of smart agripreneurship skills. The constructed questionnaire consisted of 4 aspects: (1) curriculum development, (2) teaching and learning management, (3) measurement and evaluation, and (4) the utilization of media and learning resources. Content validity was confirmed through content validity index (IOC) by three educational administration experts. The criterion was an IOC value greater than 0.5, indicating that questions with an IOC score above this threshold were considered valid in content (Kamket, 2012). Of all IOC values, each question item was within the range of 0.5 to 1.00. The questionnaire was distributed to 50 educational administrators and vocational college teachers supervised by the Office of the Vocational Education Commission. Subsequently, the data underwent internal consistency analysis using Cronbach's Alpha, with the acceptable criterion set at a Cronbach's Alpha value of 0.70 or higher (Srisathitnarakun, 2007). The questionnaire exhibited strong internal consistency, yielding a Cronbach's Alpha coefficient of 0.81 in this study.

5. Data Collection

The researchers sent a letter requesting the authorities' permission to collect data from the Colleges of Agriculture and Technology and provided a convenient online questionnaire link for the participants to provide needed data back online.

6. Data Analysis

Data analysis involved (1) basic statistical measures including frequency, percentage, mean, and standard deviation; and (2) modified Priority Needs Index using the principle of evaluating differences: $PNI_{modified} = (I - D) / D$ (Wongwanich, 2020).

7. Research Results

The data analysis results revealed that more than half of the respondents, classified by gender, were male (52.1%) and the highest educational level was a master's degree (79.8%), as presented in Table 1.

Table 1: Number and Percentage of Respondents

Variables	Number	Percentage
Gender		
Male	49	52.1
Female	45	47.9
Educational level		
Bachelor's degree	14	14.9
Master's degree	75	79.8
Doctoral degree	5	5.3
Total	**94**	**100.0**

The prioritization results of needs for academic administration development in Colleges of Agriculture and Technology based on smart agripreneurial skills revealed that every aspect displayed a critical necessity. The $PNI_{modified}$ values ranged from 0.22 to 0.26. The highest $PNI_{modified}$ value was observed in the curriculum development aligned with the concept of smart agripreneurial skills (0.26), followed by the utilization of media and learning resources in line with the concept of smart agripreneurial skills (0.24), and measurement and evaluation based on the concept of smart agripreneurial skills (0.23). The aspect with the lowest needs was teaching and learning management aligned with the concept of smart agripreneurial skills (0.22). When examined on a per-aspect basis, it was found as follows:

Curriculum development within the colleges: The highest need was the assessment of curriculum implementation, followed by the utilization of the curriculum, curriculum development planning, and curriculum aim setting ($PNI_{modified}$ = 0.0298, 0.280, 0.251, 0.236), respectively.

Teaching and learning management: The highest need was organizing learning activities, followed by the measurement and evaluation of the learning activities, setting learning objectives, and organizing student development activities ($PNI_{modified}$ = 0.237, 0.231, 0.223, 0.223), respectively.

Measurement and evaluation: The highest need was the measurement and evaluation design, followed by using various measurement and evaluation tools and using academic achievement to improve one's teaching and learning ($PNI_{modified}$ = 0.253, 0.229, 0.218), respectively.

Utilization of media and learning resources: The highest need was conducting surveys and analyzing the current state of issues related to the need for media and learning resources, followed by using various media and learning resources, developing media, textbooks, and learning resources to promote learning management, and creating and/or providing teaching media and learning resources ($PNI_{modified}$ = 0.277, 0.234, 0.234, 0.230), respectively.

The results are shown in Table 2.

Table 2: The Prioritization Results of Needs for Academic Administration Development in Colleges of Agriculture and Technology Based on the Concept of Smart Agripreneurial Skills

Academic administration in the colleges / Aspects	The Concept of Smart Agripreneurial Skills											
	1) Management skill	2) Creativity skill	3) Coordination skill	4) Trust skill	5) Thought leadership skill	6) Information technology skill	7) Health skill	8) Responsibility skill	9) Empowerment skill	10) Risk-taking skill	**Total average**	**Prioritization of needs**
Curriculum development within the colleges											**0.267**	**1**
1. Curriculum development planning	0.27	0.25	0.30	0.25	0.23	0.28	0.24	0.20	0.24	0.26	0.251	3

Academic administration in the colleges Aspects	The Concept of Smart Agripreneurial Skills											
	1) Management skill	2) Creativity skill	3) Coordination skill	4) Trust skill	5) Thought leadership skill	6) Information technology skill	7) Health skill	8) Responsibility skill	9) Empowerment skill	10) Risk-taking skill	**Total average**	**Prioritization of needs**
2. Curriculum aim setting	0.22	0.25	0.24	0.23	0.23	0.24	0.23	0.22	0.24	0.23	0.236	4
3. Utilization of the curriculum	0.34	0.27	0.30	0.26	0.27	0.30	0.26	0.25	0.30	0.31	0.280	2
4. Assessment of curriculum implementation	0.29	0.27	0.31	0.28	0.28	0.31	0.31	0.28	0.30	0.31	0.298	1
Teaching and learning management											**0.228**	**4**
1. Setting learning objectives	0.25	0.24	0.22	0.22	0.20	0.22	0.20	0.20	0.23	0.23	0.223	3
2. Organizing learning activities	0.20	0.21	0.24	0.24	0.23	0.25	0.23	0.24	0.23	0.25	0.237	1
3. Measurement and evaluation of the learning activities	0.20	0.20	0.20	0.25	0.20	0.23	0.24	0.21	0.25	0.27	0.231	2
4. Organizing student development activities	0.21	0.23	0.21	0.21	0.20	0.22	0.23	0.21	0.23	0.23	0.223	4
Measurement and evaluation											**0.234**	**3**
1. Measurement and evaluation design	0.21	0.23	0.26	0.27	0.25	0.23	0.26	0.26	0.28	0.25	0.253	1
2. Using various measurement and evaluation tools	0.21	0.23	0.22	0.22	0.22	0.22	0.22	0.20	0.25	0.25	0.229	2
3. Using academic achievement to improve one's teaching and learning	0.19	0.22	0.25	0.20	0.21	0.20	0.21	0.20	0.23	0.23	0.218	3
Utilization of media and learning resources											**0.243**	**2**
1. Conducting surveys and analyzing the current state of issues related to the need for media and learning resources	0.26	0.25	0.29	0.29	0.26	0.26	0.26	0.26	0.31	0.29	0.277	1

Academic administration in the colleges Aspects	The Concept of Smart Agripreneurial Skills											
	1) Management skill	2) Creativity skill	3) Coordination skill	4) Trust skill	5) Thought leadership skill	6) Information technology skill	7) Health skill	8) Responsibility skill	9) Empowerment skill	10) Risk-taking skill	**Total average**	**Prioritization of needs**
2. Creating and/or providing teaching media and learning resources	0.20	0.21	0.23	0.23	0.22	0.21	0.24	0.25	0.23	0.24	0.230	4
3. Using various media and learning resources	0.20	0.20	0.22	0.25	0.22	0.22	0.22	0.24	0.24	0.24	0.234	2
4. Developing media, textbooks, and learning resources to promote learning management	0.21	0.20	0.23	0.23	0.23	0.22	0.23	0.23	0.25	0.26	0.234	3
Overall											**0.243**	

8. Discussions

According to the research results, the researchers found important points for discussion as follows:

8.1 Curriculum Development within the Colleges

The research results suggested that educational institutions should prioritize the evaluation of curriculum implementation, followed by curriculum utilization, development planning, and goal setting. This corresponds with the National Education Act, B.E 2542 (1999), Section 27, paragraph 2, which mandated educational institutions to create curriculum content addressing community and local wisdom issues, fostering characteristics of responsible individuals within the family, community, society, and the nation (Ministry of Education, 2002). Additionally, institutions should focus on creating diverse curricula that develop well-rounded individuals in terms of knowledge, critical thinking, abilities, morality, and social responsibility. Curriculum development is crucial for guiding educational management, as emphasized in the Ministry of Education's policies and guidelines (Ministry of Education, 2002; Khaemmanee et al., 2005). Therefore, curriculum development plays a pivotal role in providing effective and enjoyable learning experiences responsive to the diverse needs of individual learners (Ministry of Education, 2016). To achieve these goals, educational institutions need standardized and student-centered curricula. This point is guided by the Department of Environmental Promotion (Ministry of Education, 2016) stating that curriculum development within educational institutions is the primary key to learner development success, entailing direct administrative responsibilities. In this context,

institutions must establish clear policies, visions, curriculum frameworks, and effective college management practices. The curriculum development, goal setting, utilization, and implementation processes should be well-planned and systematically executed. However, it is worth noting that in the current educational landscape, school administrators often lack the authority and control necessary to ensure that teachers align curriculum content, subject matter, and learning activities with the interests and abilities of individual students. Collaborative efforts are necessary to reach a consensus, and develop, and continually improve curricula to ensure desired alignment with expected educational outcomes, as emphasized by Poulton et al. (2010), who highlighted the importance of agricultural promotion agencies setting policies for integrating agricultural knowledge and entrepreneurship training for farmers. These agencies should collaborate with agripreneurs to arrange for training programs to impart knowledge and entrepreneurship skills. Similarly, Kangogo et al. (2021) emphasized that entrepreneurship and agricultural education programs have a significant influence on equipping farmers with characteristics, such as risk-taking, innovation, and creativity.

8.2 Utilization of Media and Learning Resources

The research results revealed that educational institutions should prioritize surveying, analyze needs, and utilize various learning resources. This is in line with the work of Sukglun et al. (2018), which promoted effective learning through material tools and methods, as well as creating a new learning environment for development and the use of educational technology. As known, there is a need for further promotion, support, development, and acquisition of teaching and learning resources from diverse sources. In this context, institutions should establish policies, development plans, information dissemination, monitoring, and evaluation of educational resource management and technology (Bureau of Monitoring and Evaluation, Office of the Vocational Education Commission. (2020). This approach is considered a process of student-centered learning management as guided by the Office of the Vocational Education Commission (2021) to use teaching and learning resources to access course content for students' transformation in daily life and learning behaviors. In other words, teaching resources and learning environments could help transmit knowledge and experiences to learners, leading to desired behavioral outcomes, and thus can independently achieve the curriculum's objectives.

8.3 Measurement and Evaluation

The results indicated that the Colleges have been focusing on the measurement and evaluation design, followed by using various measurement and evaluation tools and using academic achievement to improve one' s teaching and learning. This reflects the significance of understanding the measurement and assessment of students' learning achievement in accordance with their aptitudes and abilities, as highlighted by Dyer, Gregersen & Christensen (2019). These previous researchers asserted that effective assessment could improve and foster creativity in learners by using diverse methods. Furthermore, it involves observing behavior in response to questions, active participation in the classroom, and collaborative teamwork.

9. Recommendations

9. 1. Recommendations Based on the Research Results

9.1.1 Educational institutions should establish clear policies, vision, and a curriculum framework that supports the effective implementation of the curriculum. This clarity will facilitate coordinated actions within the college and community, ensuring that all stakeholders are directed toward the common goals.

9.1.2 Teachers should study and analyze curriculum structures that promote the concept of smart agricultural entrepreneurs among students. They should develop a learning management plan that incorporates and integrates the concept of smart agripreneurs, design media and learning resources that are up-to-date, easily accessible, and available for continuous and autonomous learning.

9. 2 Recommendations for Future Research

9.2.1 A study of causal factors influencing curriculum development, in accordance with the concept of smart agripreneurship.

9.2.2 More research and development of subject-specific curricula based on the concept of smart agripreneurs should be initiated and pursued.

10. The Authors

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Managing Extended Shelf Life of Thong Yod Snacks in the Modified Condition

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Abstract

This research aimed to (1) identify the basic recipe of Thong Yod dessert, (2) analyze microbial properties for shelf life extension of Thong Yod dessert, and (3) find the modified conditions to extend the shelf life of Thong Yod snacks. The researchers involved 30 food and nutrition specialists in tasting Thong Yod dessert formulas, and 100 voluntary consumers in giving their opinions on consuming behavior of Thong Yod snacks. The findings were in three folds: (1) thirty food science specialists evaluated the characteristics the basic formula of Thong Yod as acceptable in Formula 1 in terms of aroma, taste, flavor, texture and overall liking with averages of 8.32, 8.30, 8.40, 8.48 and 8.33, respectively; (2) carbon dioxide has an effect on inhibiting the growth of microorganisms during the log phase and helps delay the lag phase, physically; (3) the use of modified conditions can extend the shelf life of Thong Yod for the longest time by using 100% carbon dioxide, which can preserve for a maximum of 12 days. The shelf life of 10 days had a pH value of 2.99±0.01, a statistically significant difference ($p \leq 0.05$) shown in the experiment under study. Of 100 voluntary consumers, (i) 77% had consumed Thong Yod snacks; (ii) 57% consumed less than 1 time per week; (iii) 75% bought Thong Yod snacks for consumption for reasonable price, good taste and availability; and (iv) 75% preferred extended shelf life by using 100% carbon dioxide. It was expected that the obtained findings can add value to local raw materials that extend shelf life and support small business entrepreneurs of dessert products for the growth of income in the communities concerned.

Keywords: *Thong Yod dessert, shelf life extension, modified condition*

1. Introduction

"Thong Yod" was a dessert dated back to the reign of King Narai the Great of Thailand. The name means a gold drop by its shape; the dessert originated from a recipe of Thao Thong

Kip Ma, a Portuguese woman working as the head of the royal kitchen. She used egg yolk as the main ingredient, typical of Portuguese dessert, as in Foi Thong intertwined with ham and Thong Yib with a plump flower shape (Ban Chom Yut, 2000; Uppathak & Suttha, 2018; Hongpan, Ngernsombat & Rattanapibul, 2019). Thong Yod is now a Thai dessert containing egg yolk, rice flour and syrup. The syrup is clear; otherwise, it will affect the color of the dessert (Sirikhansaeng, Saenkoth & Chumsena, 2020; Praphala, Thongnam & Pannongwa, 2021). The color can be observed from the syrup sponge. If the syrup has an inappropriate concentration, the mixture when dropped into the syrup will not form the desired shape. The good characteristics of Thong Yod dessert are that it is a round drop, yellow-orange in color, with a sweet, juicy syrupy taste. This type of dessert is available in general markets and shoppers buy it for consumption as well as a souvenir. Since it is a sweet dessert and buyers are aware of the harm of sugar, its makers need to adjust how to use sugar or other sweeteners, especially erythritol, for consumers' health concern (Ying, Wang & Hsu, 2006). Therefore, there is an urgent need to research into the production of Thong Yod dessert to reduce the amount of sugar or substitute with coconut sugar. Dessert makers urgently need innovation and technological knowledge for production formulas to suit the body's needs. It is important to keep nutritional value while adding value with extended shelf life. These are for small entrepreneurs in dessert production to sustain their business and income in their local communities.

2. Research Methods

The researchers arranged for three stages in conducting this research: (1) Study of the basic recipe of Thong Yod dessert, (2) Analysis of microbial properties, and (3) Identification of the characteristics of modified conditions to extend the shelf life of Thong Yod dessert.

2.1. Study of the Basic Recipe of Thong Yod Dessert

The researchers selected 3 basic recipes for Thong Yod dessert from general dessert information. The next step was sensory quality testing of product samples using the 9-point hedonic scale (Feng, 2010) for acceptance test method with 30 testers who were specialists in the field of food and nutrition, responsible for service industry major and Phetchaburi community entrepreneurs. The test began with a sample of the product being served into a white plastic cup. Covered with aluminum foil and attached with a 3-digit code that was randomly drawn. Each sample was first rinsed with clean water. The testers were to test different features of product characteristics, regarding appearance, color, aroma, taste, flavor, texture and overall liking. It was found that the concentration of syrup had an influence on the physical quality and sensory quality of Thong Yod dessert.

Table 1: Selecting Thong Yod Formula

Ingredients (g.)	Formula		
	1	2	3
Egg yolk	170	-	180
Duck egg yolk	255	120	30
Sugar	2,000	475	475
Jasmine floated water	3,000	475	475
Thong Yod flour	-	135	135

Source: Formula 1, Formula 2, Formula 3

2.2 Analysis of Microbial Properties

2.2.1. Microbial Properties

Microbial quality analysis was performed by taking samples of Thong Yod dessert stored in modified conditions. The total number of microorganisms in the samples were analyzed to determine the total number of microorganisms using the Standard Plate Count (SPC) method (AOAC, 1984)

2.2.2 Physical Properties

The researchers studied physical properties in the internal and external characteristics of Thong Yod dessert. The study of the external appearance is based on the color of Thong Yod dessert using a colorimeter. (Spectrophotometer) This is because the color of the product can indicate the quality of the raw materials used in production (Ying, Wang & Hsu, 2006; Pianthong, Thanthiang, Kaewsrithong & Thanawatchai, 2022). and also affect acceptance by entrepreneurs. As for the study of the internal characteristics, the texture of Thong Yod dessert was studied by using sensory testing or sensory evaluation (Sirikhansaeng, Saenkoth & Chumsena, 2020). The measured characteristics indicate chemical changes occurring within the product.

Color Measurement

- Prepare a sample of Thong Yod dessert that has the longest shelf life. To get a representative example for quality testing, the researchers used modified conditions with the longest shelf life.
- Take a sample of Thong Yod dessert that has the longest shelf life and grind it thoroughly. Then measure the color using Spectrophotometer, KONICA MINOLTA brand, model CM-3500d, followed by measuring the transmission of light (Transmittance). In each sample, the color value L* (brightness value has a value of 0 to 100, where 0 means a dark object is black, 100 means a bright white object) a* (+ means the object is red, - means the object is green) and b* (+ means the object is yellow, - means the object is blue) by measuring each sample 3 times for accuracy in color measurement.

2.2.3 Chemical Properties

The researchers brought Thong Yod dessert under modified conditions with the longest shelf life by the measurement of the acidity-alkalinity (pH) value with a pH meter Satorius AQ model PB-10, and tested every measurement value 3 times to find the average of each test.

3. Identification of the Characteristics of Modified Conditions to Extend the Shelf Life of Thong Yod Dessert

The procedure is in the following stages:

(1) Travel to pick up snacks in Phetchaburi Province.

(2) Adjust the atmosphere using modified conditions.

Normal
Vacuum
N2 100%
CO2 100%
N2 60% : CO2 40%
N2 70% : CO2 30%
N2 80% : CO2 20%

(3) Keep for 15 days.

(4) Analyze microbial quality every day starting from day 0 – 15.

All Microorganisms

(i) 7 samples of dessert in the modified state, 2 replicates for each.
(ii) Prepare dessert samples.
(iii) Dilute the candy sample to 8 levels.
(iv) Take the diluted food samples and place them on 0.1 ml PCA medium plates, 2 plates per sample.
(v) Cure at 37 degrees Celsius for 24-72 hours.
(vi) Count the colonies that grow in each plate to calculate the average value as CFU/g.

S.aureus

(i) 7 samples of dessert in the modified state, 2 replicates for each.
(ii) Prepare dessert samples.
(iii) Dilute the candy sample to 8 levels.
(iv) Take the diluted food samples and place them on 2 plates of 0.1 ml BPA culture medium, each sample.
(v) Cure at 37 degrees Celsius for 24-72 hours.
(vi) Count the colonies that grow on each plate to calculate the average value as CFU/g.
(vii) Test the detected germs with a test kit. staphylococcus.

(5) When the condition that can extend life as long as possible is achieved, repeat the analysis.

All Microorganisms
S.aureus

(6) Confirm results.

(7) Analyze chemical and physical quality.

(i) pH value
(ii) Color value L* a* b*

The researchers studied the characteristics of extending the shelf life of Thong Yod dessert using modified conditions by packing Thong Yod snacks in plastic bags, sealed on 3 sides, Nylon/PET type, size 25x35 centimeters, half a kilogram per bag. In the modified state, the concentration of gas was changed in the normal room temperature, vacuum (Vacuum), Nitrogen gas (N_2) 100 percent, Carbon dioxide (CO_2) 100 percent, Nitrogen gas to carbon dioxide ($N_2 : CO_2$) at all 3 levels, namely 60:40, 70:30 and 80:20 percent by testing conditions. One replicate was carried out for 15 days by taking samples of Thong Yod dessert stored in modified conditions on days 0 to 15 of storage to analyze their microbial properties. Then the researchers selected the Thong Yod snacks in the modified state with the longest shelf life to analyze the physical and chemical properties.

3. Experimental Results

3.1 The Basic Recipe of Thong Yod Dessert

The appropriate formula was an adapted formula using sensory testing with 30 testers to evaluate by scoring the 9-Point Hedonic Scale. The results are shown in Table 2.

Table 2. The Selection of an Appropriate Formula

Sensory characteristics	Formula		
	1	2	3
Color	8.23±0.83^{ab}	**8.35±0.74^{a}**	8.18±0.78^{ab}
Odor	**8.32±0.76^{a}**	8.18±0.84^{ab}	7.93±0.86^{b}
Taste	**8.30±0.61^{a}**	8.20±0.65^{a}	7.58±1.08^{b}
Flavor	**8.40±0.63^{a}**	8.25±0.63^{a}	7.65±0.92^{b}
Texture	**8.48±0.55^{a}**	8.20±0.69^{b}	7.98±0.77^{bc}
Overall liking	**8.33±0.76^{a}**	8.13±0.65^{a}	7.55±0.90^{b}

Note: Mean with different small letters in the row are significantly difference ($p \leq 0.05$).
Values are presented as mean ± SD.

Table 2 shows the results of evaluating the sensory characteristics of samples of all 3 formulas of Thong Yod products. The average scores in terms of color, aroma, taste, texture (smooth and soft), and overall liking indicated that Formula 1 had the highest average liking score. When analyzing variance and finding statistical differences, the researchers found color, aroma, taste, flavor, texture and overall liking as significantly different at the statistical level ($P<.05$); and Formula 1 was chosen.

3.2. Analysis of Microbial Properties

3.2.1 Results of Microbial Properties

The analysis of microbial properties uses the total Plate Count and the amount of S.aureus by studying the number of days it can be stored for the longest time. The microorganisms will be counted according to the community product standards of Kanom Jeen [rice noodles] with

a total microorganism count not exceeding 1x10-6 and an amount of S.aureus not exceeding 100 colonies per 1 gram of the sample. The experimental results are shown in Table 3.

Table 3: The Results on Packaged Thong Yod in Modified Conditions per Amount of Analyzed Microorganisms

Packaging condition	Shelf life (day)	Microbial analysis result	
		Total microbial count (CFU/g.)	*S.aureus* (colony/g.)
Vacuum	0	1.4×10^3	ND
	1	3.3×10^3	< 100
	2	5.2×10^3	< 100
	3	3.4×10^3	ND
	4	2.5×10^6	< 100
Normal	0	1.19×10^3	< 100
	1	2.3×10^3	< 100
	.	.	.
	4	7×10^5	< 100
N_2 80% : CO_2 20%	0	3.3×10^2	< 100
	1	8.6×10^2	< 100
	2	1.4×10^3	< 100
	3	1.7×10^3	< 100
	.	.	.
	.	.	.
	10	2.6×10^6	< 100
N_2 100%	0	1.3×10^3	ND
	1	1.4×10^3	ND
	2	3.8×10^2	ND
	3	1.4×10^3	< 100
	.	.	.
	.	.	.
	11	2.5×10^6	< 100
N_2 60% : CO_2 40%	0	2.7×10^2	< 100
	1	3.0×10^2	< 100
	2	4.0×10^2	< 100
	3	1.6×10^3	< 100
	.	.	.
	11	1.4×10^6	< 100

Packaging condition	Shelf life (day)	Microbial analysis result	
		Total microbial count (CFU/g.)	*S.aureus* (colony/g.)
N_2 70% : CO_2 30%	0	2.8×10^2	< 100
	1	2.7×10^2	< 100
	2	4.1×10^2	< 100
	3	1.5×10^3	< 100
	.	.	.
	.	.	.
	12	3.0×10^6	< 100
CO_2 100%	0	3.5×10^2	ND
	1	6.7×10^2	ND
	2	1.2×10^3	ND
	3	1.0×10^3	ND
	.	.	.
	.	.	.
	13	4.5×10^6	< 100

Note: ND means colony not found, or colony found less than 10.

Table 3 examines the microbial quality of Thong Yod dessert stored in different modified conditions. From days 0-15, it was found that from storage using modified conditions, Vacuum, normal conditions, N_2 80% : CO_2 20%, N_2 100%, N_2 60% : CO_2 40%, N_2 70% : CO_2 30% and CO_2 100%. The study results indicated that the number of days that can be stored and not exceeding the standard value is 2.5x106, 2.4x106, 2.6x106, 2.5x106, 1.4x106, 3.0x106 and 4.5x10-5, respectively. It can be concluded from the experiments that modified conditions in the storage of Thong Yod snacks can extend the shelf life of Thong Yod for the longest time by using 100% CO_2, which can be stored for a maximum of 12 days. This is because of carbon dioxide qualified as Bacteriostatic can inhibit the growth of microorganisms (Phuwarodom, 1995).

3.2.2 Results of Physical Properties

Table 4: The Results of Physical Properties Analysis of Thong Yod in Modified Condition Using 100% CO_2

Modified condition	Duration (day)	Color		
		L*	a*	b*(ns)
CO_2 100%	0	79.05 ± 0.46^{bcd}	-1.53 ± 0.13^{a}	8.11 ± 0.16
	1	80.00 ± 0.80^{bc}	-1.60 ± 0.05^{ab}	8.64 ± 0.03
	2	79.23 ± 0.25^{d}	-1.73 ± 0.06^{abc}	8.26 ± 0.12
	3	80.04 ± 0.81^{bcd}	-1.64 ± 0.05^{abc}	8.44 ± 0.18
	.	.	.	.
	.	.	.	.
	10	84.05 ± 0.19^{a}	-1.66 ± 0.11^{abc}	8.22 ± 0.48

Note: Mean with different letters in the column is significantly different ($p>0.05$); ns is non significantly different ($p>0.05$).

Table 4 reports the analyzed physical properties of Thong Yod dessert using modified conditions of 100% carbon dioxide to extend the shelf life of Thong Yod dessert. It was found that the brightness value (L*) and value (a*) of Thong Yod snacks each day were significantly different ($p>0.05$) by shelf life being extended in 100% carbon dioxide conditions on the 10^{th} day of storage. The brightness value (L*) has increased because carbon dioxide gas has the effect of causing changes in the cell membranes of microorganisms, causing the process of entering and exiting abnormal substances in the cells, followed by reduction in enzyme activity and changes in proteins. Therefore, when microorganisms are slowed down in growth, they affect the brightness value (L*) and value (a*) as the shelf life increases, with the value (b*) throughout the storage period. There are also values that are not significantly different ($p>0.05$).

3.2.3 Results of Chemical Properties

Table 5: Chemical Properties Analysis of Thong Yod in Modified Condition Using 100% CO_2

Modified condition	Duration (day)	pH
CO_2 100%	0	$4.31^{a} \pm 0.00$
	1	$4.31^{a} \pm 0.00$
	2	$4.06^{b} \pm 0.02$
	3	$4.01^{c} \pm 0.03$
	.	.
	.	.
	10	$2.99^{h} \pm 0.01$

Note: Different letters in vertical line have significant statistical difference ($p \leq 0.05$).

Table 5 shows the analyzed chemical properties of Thong Yod dessert in the modified pH condition of 100% carbon dioxide gas. It was found that Thong Yod dessert varied in chemical properties in the modified conditions:

Shelf life of 1 day has a pH value of 4.31±0.00;
Shelf life of 2 days has a pH value of 4.06±0.02;
Shelf life of 3 days has a pH value of 4.01±0.03;
Shelf life of 4 days has a pH value of 4.01±0.03;
Shelf life of 5 days has a pH value of 3.66±0.06;
Shelf life of 6 days has a pH value of 3.53±0.04;
Shelf life of 7 days has a pH value of 3.53±0.04;
Shelf life of 8 days has a pH value of 2.53±0.02;
Shelf life of 9 days has a pH value of 2.50±0.01; and
Shelf life of 10 has a pH value of 2.99±0.01 with a statistically significant difference ($p \leq 0.05$).

The obtained results from the experiments indicated occurrence of bacteria Lactobacillus sp. and Streptococcus sp. which are acid-producing groups. The yellow substance is caused by Lactobacillus sp. During the fermentation period of 1 day, a slight fermentation odor will occur. Because the fermentation reaction is still in a short period of time, the bacteria are not yet fully grown. When the rice was fermented for another 2 days, the egg yolk, which is the main component, began to have more moisture suitable for bacterial growth, and as a result increased acidity.

3.3 Identification of the Characteristics of Modified Conditions to Extend the Shelf Life of Thong Yod Dessert

The researchers assessed consumers' acceptance of the use of modified conditions using 100% carbon dioxide by sending a survey questionnaire to 100 respondents. This section reports their positive responses to the use of 100% CO_2 in extending the shelf life of packaged Thong Yod. Table 6 shows the demographic variables of the respondents.

Table 6: Demographic Variables of the Respondents Assessing Acceptability of Thong Yod Using 100% CO_2 in Extending Shelf Life

Demographic variables	Percentage
Gender	
Male	47
Female	53
Age	
15-24	69
25-34	28
35+	3

Demographic variables	Percentage
Educational level	
High school	9
Graduate	79
Postgraduate	12

Table 6 shows the majority of the respondents as female (53%), with male at 47%. The age group of 15-24 appears dominant at 69%; most have graduate education at 79%.

Table 7 reports the respondents' consumption behavior of Thong Yod dessert in a modified condition using 100% carbon dioxide to extend shelf life.

Table 7: Consumption Behavior of the Respondents Assessing Acceptability of Thong Yod Using 100% CO_2 in Extending Shelf Life

Consumption behavior	Percentage
Have you ever eaten Thong Yod?	
Yes	77
No	23
Frequency eating Thong Yod	
Less than 1 time/week	57
1-2 time/week	30
3-4 time/week	8
More than 3-4 time/week	5
If 100% CO_2 is used for extending Thong Yod's shelf life, would you be interested?	
Yes	75
No	25
Where do you usually buy Thong Yod from?	
Shophouse	17
Restaurant	28
Market	55
What is the reason why you buy Thong Yod to eat? (You can chose more than 1 answer.)	
Good taste	35
Good price	45
Easy to come by	28

Consumption behavior	Percentage
The problem found when you buy Thong Yod.	
Strong fermented odor	42
Short shelf life	28
Too sour	20
Fermented rice flour	10
Do you have diarrhea or gastrointestinal tract disease when you eat Thong Yod?	
Yes	38
No	62

As seen in Table 7, those who had previously consumed Thong Yod were 77%, and 57% accounted for the frequency of less than 1 time per week in consuming it. The respondents at 75% accepted Thong Yod snacks using 100% carbon dioxide in extending shelf life. The buyers were positive to reasonable price (45%), good taste (35%) and availability (28%). Two major problems the buyers have encountered were fermenting odor (42%) and short shelf life (28%); 62% reported no gastrointestinal effect on eating Thong Yod.

4. Discussion and Conclusion

The results of the evaluation of the sensory characteristics of the 3 formulas of Thong Yod products in terms of color, aroma, taste, texture and overall liking indicated that Formula 1 had the highest average liking score. The variance and statistical differences in color, aroma, taste, flavor, texture and overall liking, were significant at the statistical level ($p<.05$). In fact, Formula 1 was chosen in line with the earlier research by Mongkolwan, Chaengchad &Wongthong (2002a, 2002b) and Netsawang, & Niyaboon (2021). It was also evident that the concentration of syrup had an influence on the physical quality and sensory quality of Thong Yod dessert, statistically significant ($p<.05$). When the syrup concentration increased from 68+1 to 71+1 degrees Brix, the hardness of Thong Yod dessert decreased and then increased. It should be noted that with the syrup concentration increased from 71+1 to 74+1 degrees Brix, Thong Yib dessert decreased its hardness value, while Foi Thong increased its stickiness. In this regard, the appropriate syrup concentration for producing Thong Yod [and also Foi Thong and Thong Yip] is 71+1, 74+1, and 68+1 degrees Brix, respectively. However, the researchers recorded the average total liking score at the moderate liking level. It should be noted that the obtained results appeared to agree with the findings by Mongkhonwan, Chaengchad & Wongthong (2002a, 2002b), and Netsawang & Niyaboon (2021).

As for the inspection of the microbial quality of Thong Yod dessert stored in different modified conditions for a period of 15 days, the researchers found Thong Yod stored in vacuum conditions had the lowest shelf life of 3 days. The total amount of microorganisms was detected at 2.5×106 CFU/g on day 4, which exceeded the standard criteria. When

Thong Yod was stored in 100% carbon dioxide, the longest shelf life was 12 days, with a total microorganism count of 4.5×106 CFU/g detected on the 13th day, which exceeded the standard set by the Thai Authority of Medical Sciences (Phuwarodom, 1995). It should also be noted that the samples in both conditions had S.aureus amounts not exceeding 100 colonies/gram.

The analysis of the physical properties of Thong Yod dessert using modified conditions of 100% carbon dioxide to extend the shelf life revealed the brightness values (L*) and values (a*) of Thong Yod snacks each day as significantly different ($p>0.05$). The values (b*) of Thong Yod each day was consistent throughout. The color values that appear to affect consumer preferences and acceptance, in fact, show the deterioration stages of food (Muhoro, 2022).

The chemical properties of Thong Yod with extended shelf life in 100% carbon dioxide condition showed the shelf life of 1 day with a pH value of 4.31±0.00. When the shelf life reached the 10th day, the pH value was equal to 2.99±0.01. It can be seen that the pH value decreased with longer shelf life because microorganisms produced lactic acid in just 1 day, with a slight fermentation odor. As time passed, the microorganisms increased in size, and caused more of lactic acid, followed by a decrease in pH value (Phuwarodom, 1995; Praphala, Thongnam & Pannongwa, 2021).

The researchers assessed consumers' acceptance of extending the shelf life of Thong Yod with 100% CO_2. Such information is vitally important to Thong Yod entrepreneurs in producing this type of dessert for buyers (Nuwongsri, 2019; Netsawang & Niyaboon, 2021). It was found that most consumers accept the Thong Yod under 100% CO_2 condition. The obtained findings in this study were expected to generate practical implications for entrepreneurs of dessert products in adding value to local raw materials that extend shelf life and support dessert production for the growth of income and communities' sustainability as concerned.

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The Influence of Environmental, Social and Governance (ESG) Ratings on Credit Ratings: A Case Study of Chinese Listed Companies

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Abstract

This research, utilizing empirical data from firms listed on China's CSI 800 Index between 2019 and 2021, explicates the connection between Environmental, Social and Governance (ESG) performance and corporate credit ratings. Significant positive correlation was found, which is further influenced by the size, financial condition and nature of the enterprises. Larger enterprises are more inclined to achieve superior ESG ratings and credit rankings. A robust financial standing facilitates easier investment in ESG initiatives, leading to an enhancement in credit ratings. The ESG performance was found to have a more pronounced effect on the credit ratings of non-state entities, with state-owned firms leaning more toward governance. The obtained findings provide an insightful contribution to the improvement of ESG performance, enhance credit ratings, and foster sustainable development. These can help fill in the empirical research void in the domestic context, support policy formulation and advance the infrastructure for persistent ESG evaluation.

Keywords: *ESG (Environmental, Social, and Governance), corporate credit ratings, sustainable development*

1. Introduction

1.1 Research Background

In recent years, the impact of Environmental, Social, and Governance (ESG) criteria on credit ratings has been increasingly noticed, largely being driven by the Principles for Responsible Investment (PRI) suggested by the United Nations. In 2016, the

PRI initiated the ESG Credit Risk and Ratings Initiative (United Nations Principles for Responsible Investment (PRI) (2016), prompting credit rating providers to incorporate ESG considerations into their analyses. Sustainable development regulations were put into place at the UN COP2015 Climate Summit in Glasgow in 2021, compelling regulators and investors to set stricter demands for businesses in the context of Corporate Social Responsibility (CSR) and ESG issue.

Rating agencies have started to contemplate on how to integrate ESG factors into credit decision-making processes to identify premium opportunities to mitigate risk or establish more sustainable future business prospects. Renowned rating agencies, such as Standard & Poor's, Moody's, and Fitch have all agreed to the PRI statement on ESG in credit risk and ratings. As signatories, they're committed to "methodically and openly incorporate ESG into credit ratings and analyses" (S&P Global Ratings, 2019).

In China, regulatory authorities have actively encouraged ESG investments and necessary information disclosure procedures, leading to an improved ESG rating system. Concurrently, investors have become increasingly attuned to ESG-related investment information.

A comprehensive research body has studied the association between ESG ratings and credit ratings, and their effects on credit risk. Studies suggest that corporations with high ESG scores often demonstrate superior financial performance and higher credit ratings (Wang, Zhang, & Li, 2021). Certain researchers are primarily investigating the utilization of ESG ratings in the credit rating process by analyzing how to increase the precision and breadth of credit ratings through ESG factors (Liu, Zhang, & Liu, 2020). As consistent with the data from the 2021 "White Paper on ESG Development of Chinese Listed Companies," until June 2021, 1112 of A-share listed companies released ESG-related reports, a significant surge from 371 in 2019. This exemplifies the majority of listed companies' robust ESG disclosure awareness, and that these companies are persistently pressing for the enhancement of long-term corporate value through improving their ESG performance. Consequently, empirical research into the relationship between ESG ratings and credit ratings, using Chinese listed companies as a model, is crucial to grasp the sustainable development and credit risk of these firms.

1.2 Research Objectives

The research objective was to investigate the impact of ESG (Environmental, Social, Governance) ratings on the credit ratings of publicly listed companies within the Chinese context. There has been a growing trend among corporations to undertake environmentally and socially sustainable actions and align governance strategies that resonate with stakeholder interests. It is, therefore, incumbent upon companies to balance both the pursuit of maximizing shareholder wealth and acting in a socially responsible manner.

This study also aimed to enhance the body of literature concerning the interplay between ESG performance and credit ratings of companies listed in China. The researchers sought to offer an empirical elucidation of these complex relationships. Furthermore, a detailed evaluation of the relationship between the three factors that constitute ESG--environmental stewardship (E), social responsibility (S), and governance adequacy (G)--and corporate credit ratings as integral to relevant ESG rating factors within the framework of China's credit rating system.

Through this empirical exploration, the researchers aspired to deliver a comprehensive understanding of the relationship between ESG scores and the credit ratings of Chinese listed corporations. It was expected to obtain insights into ESG performances and credit ratings to benefit investors, financial institutions, and policy-makers alike.

1.3 Research Questions

The central research question of this study was on the impact of ESG (Environmental, Social, Governance) ratings on the credit ratings of publicly listed firms within the Chinese context. This also includes an assessment of the degree to which ESG ratings influence credit ratings.

Within the context of corporate ESG ratings, the researchers expected to unravel the nature of the relationship between the three core components of the ESG performance assessment—Environmental Stewardship (E), Social Responsibility (S), and Governance (G)—and the credit ratings of the respective firms.

As for the Chinese publicly listed firms, the study was to investigate factors, such as the size of the company, financial condition, and the nature of the corporation (state-owned or non-state-owned) whether they mediate or modify the relationship between ESG scores and credit ratings.

1.4 Significance of the Study

The obtained findings were to generate practical implications for improvement in companies' ESG performance, enhancement of credit ratings, and sustainability of business development. Potentially, they could serve as a valuable reference for the planning and oversight of pertinent policies, contributing to the construction of a more transparent and sustainable financial system.

ESG ratings and credit ratings both encompass quantitative and qualitative assessment metrics for corporate entities. ESG encapsulates the trending movement toward green and low-carbon development, while credit ratings underscore the foundational trust and safety in contemporary commercial bank management. Incorporating relevant components of ESG ratings into the credit rating system can equip domestic financial institutions to adapt their operational practices to align with the requirements of the evolving development landscape, which serves high-quality economic development and

comprehensively aids in achieving the target goals of peak carbon emissions and carbon neutrality.

2. Literature Review and Four Hypotheses

2.1 The Relationship between ESG Ratings and Credit Ratings

ESG ratings amalgamate traditional credit rating methods and models with ESG indicators, creating a crossroads between ESG investment and traditional credit rating narrative. Rather than standard credit ratings, ESG ratings fundamentally implement the theory, techniques, and models employed in credit ratings to the ESG sector, subsequently offering a comprehensive ESG level for rated subjects in a sortable numeric or symbolic format.

Research presented by Zaidi et al. (2022) indicated the significant role of Environmental, Social, and Governance (ESG) factors in distinguishing high-credit companies from their low-credit companions, further foregrounding the necessity of ESG indicators in corporate credit evaluation. Consistent with the seminal work by Friede et al., (2015), numerous studies identified a positive correlation between ESG factors and credit risk.

Credit ratings, typically employed as a proxy for credit risk, thus signifying the likelihood of "counterparties in financial transactions failing to fulfill their obligations" (Arnold, 2008), might be upgraded or downgraded contingent on variations in corporate-related particulars. Thus, previous researchers intuitively investigated whether improved ESG performance could result in advantageous credit rating issues. If enhanced ESG performance positively influences a superior credit rating level, it implies that businesses could secure beneficial conditions for debt costs.

In a venture to analyze the Indian market, Bhattacharya & Sharma (2019a,b) drew on Bloomberg's ESG data and concluded that ESG initiatives solely left a positive print on small and medium-sized companies' credit ratings. Notably, two-thirds of the poorly-rated companies in terms of annual credit ratings in emerging markets occur due to ESG factors. JoLock (2021) demonstrated that ESG determinants could steer credit ratings by evaluating a myriad of factors and indicators in the qualitative and quantitative domains.

When the ESG elements are embedded into the credit-rating process as influencing dynamics, any downgrade could escalate the capital requirements of lenders, thus intensifying the financial risk. Untreated ESG issues could potentially engender dire consequences, such as reputational damage, conduct risk, pricing inaccuracies, and developmental challenges in business. Hence, firms proficient at navigating ESG risks inherent in their operations should theoretically maintain superior, longstanding credit statuses. Given that ESG risks constitute genuine credit risks, investors are entrusted with designing comprehensive ESG strategies to alleviate these concerns (O'Connell, 2022).

Through evaluating the Fitch ESG rating relevance score model, Gao (2021), a distinguished domestic scholar in China, studied how fluctuations in ESG factors could depict changes in a company's operational status or financial condition over time. By continuously monitoring each ESG factor of the rated entity, the forward-looking and timely nature of credit ratings can be enhanced to a certain extent. In light of these findings, the first hypothesis is proposed:

H1 Hypothesis: There exists a positive correlation between the ESG ratings and credit ratings of listed corporations in China.

2.2 The Influence of Factors within ESG on Credit Ratings

2.2.1 The Relationship between Environmental Performance and Credit Rating

Related studies indicate firms with higher ESG environmental performance scores possess more significant credit worthiness, resulting in superior credit ratings and lower credit risk premiums. Graham & Maher (2006) studied the impacts of ESG environmental elements on credit risk, elucidating that off-balance sheet environmental obligations have a detrimental effect on bond ratings. Their findings suggest that environmental obligations are considered in bond yields. However, if bond ratings are incorporated into the model, environmental responsibility information provides no additional explanatory power. Bauer & Hann (2010) affirmed the positive influence of sound environmental management on bond ratings and yield spreads. Yet, their findings reveal no general industry or sector-level effects to mitigate ESG impacts on credit risk due to significant heterogeneity within these firms, exemplified by a medium-sized Chilean utility--Guacolda Energía, armed solely with coal-fired power plants, which are progressively becoming unpopular, leading to a loss in clientele.

Dorfleitner et al. (2019) conducted research in this realm, concluding that considering social and environmental standards can enhance credit rating predictions, with firms boasting high social or environmental sustainability receiving better credit ratings. Höck (2020) and his team used credit default swap (CDS) spreads to measure the link between credit risk and the "E" (Environmental) element in ESG. The results proposed that environmental sustainability significantly influences credit risk premiums for high credit-rated, reputable companies. Furthermore, for companies with lower leverage and higher market values, this effect is pronounced; however, for small and heavily indebted companies, being green is not worth it, although they don't get penalized for sustainability.

China's People's Bank, among seven other departments, issued "Guidelines on Building a Green Financial System" on August 31, 2016, encouraging credit rating agencies to evaluate issuers' green credit records, green levels of funds raised, and the impact of environmental costs on issuers and bond credit ratings during the credit rating process. This suggests that at least the "E" factor in ESG may influence credit ratings. (China’s People’s Bank, 2016）

Given these previous findings, the researchers of the present study formulate the second hypothesis concerning environmental performance and credit ratings:

H2 Hypothesis: There is a positive correlation between environmental performance and credit ratings of listed corporations in China.

2.2.2 The Relationship between Social Responsibility Performance and Credit Rating

The majority of perspectives suggest that there is a connection between corporate social responsibility (CSR) performance and credit ratings. However, there are differing opinions. Feng et al. (2016) found that in the Chinese economic environment, whether the company is state-owned or non-state-owned, actively taking on social responsibility contributes to reducing corporate risk and enhancing credit ratings. Further research revealed that, during the 2008 financial crisis, listed companies with good CSR performance experienced a more significant reduction in corporate risk and were better equipped to resist the negative impact of the financial crisis. Studies by Oikonomou et al. (2014) showed that positive corporate social performance leads to lower bond yield rates and better credit ratings. Attig et al. (2013) and Schuitema (2018) found evidence from MSCI ESG STATS that companies with good social performance benefit from relatively higher ratings provided by credit rating agencies. Across different economic cycles, Ryana et al. (2017) found that during economic downturns, announcements of changes in credit ratings have a greater impact. Therefore, it is relevant for companies to understand whether the influence of CSR performance on credit ratings varies between economic cycles. Corporate social responsibility's relationship with credit rating has been researched in several studies, such as those by Attig et al. (2013), Jiraporn et al. (2014), and Oikonomou (2014). They found that CSR performance has a positive impact on credit ratings, but these studies focused primarily on the United States.

Not all previous studies support the positive correlation between CSR performance and corporate risk levels. Some studies show a negative correlation, with ESG factors having a neutral or negative effect on credit risks. For example, Menz (2010) found that companies with low social responsibility have higher risk premiums compared to those with high social responsibility. Zheng et al. (2020) studied the lagging CSR effects on financial performance, revealing that during economic downtimes, state-owned companies' CSR performance in the previous year significantly reduces current financial performance, which can generate risks for the company to some extent. Brammer et al. (2008) and Barnea et al. (2010), based on information asymmetry and principal-agent theories, suggested that managers may sacrifice shareholder interests for their own social reputation, overusing corporate resources for self-serving CSR activities, which increases the risks in corporate development and may even damage corporate value. Meanwhile, European literature offers differing views, as Stellner et al. (2015) found no significant relationship

between CSR performance and credit ratings in their study of European firms. By examining the European corporate bond market, considering national-level CSR equivalents, and utilizing ASSET4 ESG ratings data from 12 countries in the Economic and Monetary Union along with Standard & Poor's and Moody's ratings based on 872 bond samples between 2006 and 2012, they found only weak evidence suggesting that exceptional CSR performance systematically reduces credit risks. However, they did discover evidence showing that excellent CSR performance is rewarded in countries where ESG performance is above average.

In light of these research findings, the third hypothesis regarding CSR performance and credit ratings is proposed:

H3 Hypothesis: CSR performance is positively correlated with credit ratings of listed corporations in China.

2.2.3 The Relationship between Governance Performance and Credit Ratings

The structural specification of corporate governance has been identified as a significant element for modern enterprises. Abundant empirical evidence and academic studies have demonstrated an association between corporate governance efficiency and a firm's credit rating. As presented in the research study conducted by Fitch Ratings, and the subsequent discussion in its white paper, "At a credit angle, overall governance stands as the most dynamic ESG factor." While sound governance practices and well-managed governance risks may not necessarily improve the company's credit status from the baseline, poor governance can assuredly deteriorate it and could severely impact all aspects of the company's risk profile in the short, medium, and potentially long-term. Therefore, it is of crucial importance that companies strategically consider governance factors and risks and incorporate them broadly into their long-term planning.

Chinese scholars, particularly Yu et al. (2008) carried out empirical research on the influence of corporate governance on corporate risk by taking listed companies from 2002-2005 as a sample. Their findings pointed out a significant positive correlation between the concentration of equity and the financial risk of the firm. Separation of the two positions between the general manager and the chairman can reduce corporate financial risk. The proportion of executive shareholding and independent directors has a significant negative relationship with corporate financial risk.

Liu & Xu (2021) posited that corporate governance efficiency and long-term sustainable development capacity reflect the quality of financial information disclosure. Governance risks and adverse effects generated from the dimension of information disclosure often foreshadow a potentially deteriorating financial situation and credit level of the firm. If corporations hide their true financial status, it can lead to market investors misjudging the entity's financial information, or in some cases, failing to accurately obtain severely deteriorating financial data due to corporate financial statement fraud.

A study by Ashbaugh-Skaife et al. (2006) revealed a positive correlation between corporate governance activities and the credit ratings of American companies. Kiesel & Lücke (2019) exhibited the minimal yet distinct impact of ESG performance on rating decisions, particularly in terms of corporate governance. Jang et al. (2020) focused on South Korea, and used the ESG data of the Korean Corporate Governance Service (KCGS); ESG ratings are viewed as supplements to credit ratings as they contain basic non-financial information that can lower the cost of debt financing, especially for smaller enterprises.

Based on the work discussed, one can forecast a positive correlation between credit ratings and corporate governance. Hence, the fourth hypothesis is proposed:

H4 Hypothesis: There is a positive correlation between corporate governance and credit ratings of listed corporations in China.

2.3 Correlation Theory

2.3.1 Stakeholder Theory

The term "stakeholder" was initially introduced by the Stanford Research Institute in 1960 (Stanford Research Institute, 1960 as cited in Freeman & Reed, 1983). However, it was R. Edward Freeman who systematically delineated the stakeholder theory. This framework argues that the shareholder-centric perspective is overly restrictive, over-emphasizing the employment of labor by capital, and fundamentally denies the essential contributions of stakeholders, most notably human capital, to a firm's value creation. Stakeholder theory posits that shareholders and creditors are not the sole parties influencing a company's operation and management. Employees, upstream and downstream clients, and the natural environment are also integral factors.

In 2010, Freeman and his colleagues in their opus "Stakeholder Theory: The State of the Art," simplified stakeholders into primary and secondary categories (Freeman, Reed, Harrison, Wicks, Parmar, & Colle, 2010). They believed the responsibilities taken by companies to parties beyond shareholders should be included in the overarching fiduciary duty of the management, constituting corporate social responsibility in a broader sense. Fulfilling these social responsibilities embodies both a moral obligation and an essential requirement for businesses to attract and maintain strategic resources. Without capital input from shareholders, factor contributions from other stakeholders, and robust consumer support, it is virtually impossible for a business to create value for shareholders through sustained operations.

Following the stakeholder theory, Donaldson, Preston & Jones (1995) suggested that the satisfaction of different types of stakeholders could potentially enhance financial performance. Galbreath (2013) pointed out that ESG has evolved into a crucial indicator of a company's non-financial performance. Negligence concerning environmental pollution, the lack of social responsibility, and the deficiency of corporate governance will negatively impact employees, communities, and broader societal interests, consequently affecting

corporate performance and lowering company valuations.

2.3.2 Information Asymmetry Theory

The theory of information asymmetry was initially proposed by American economists Joseph Stiglitz, George Akerlof, and Michael Spence. It refers to the different understanding of relevant information among various individuals in market economic activities. Those who have more information are usually in a more advantageous position, while those with limited information are in a less advantageous position. From the perspective of capital markets, there exists information asymmetry between a company's managers and its investors. The management team has access to the latest operational information, which is often lagging for external investors. This can lead to adverse selection problems, where one party, due to its natural information advantage, makes decisions that benefit themselves but harm the other party with limited information. The party with information advantage violates market rules, distorts market prices, undermines fairness and justice in the capital market, reduces market efficiency, and creates moral hazards. The current stock prices in the capital market mainly reflect a company's historical performance. In order to understand the specific situation of a company, investors must dig deeper into the information that is not included in the stock price. However, company managers often tend to hide negative information during operations. This results in a more serious information asymmetry, and investors make investment decisions based on false information. Once the risks of listed companies become uncontrollable, it can lead to huge losses (Stiglitz, Akerlof & Spence, 1970).

Information asymmetry arises from the separation of ownership and control in modern corporate systems. In this situation, business operators or managers have access to all the true information about the company's operations, while owners or investors, as principals, find it difficult to obtain comprehensive and authentic information as they do not participate in the actual business operations. Moreover, this process often incurs significant costs. Therefore, investors have to bear high information acquisition costs in this information transaction and usually can only rely on reports disclosed by the company to society to obtain relevant information, which also requires evaluation. Thus, the public disclosure of information related to the company's environment, social responsibility, and corporate governance can effectively reduce the current market situation of information asymmetry.

2.3.3 Sustainable Development Theory

Sustainable development theory refers to development that adheres to the three basic principles of fairness, sustainability, and commonality, which meets the needs of current society without endangering the ability of future generations to satisfy their own needs. "Maximizing net economic benefits while maintaining the quality of natural resources and the services they provide" is the definition put forth by Edward B. Barbier. Other scholars propose that sustainable development refers to "current resource use should

not reduce actual future income". Clearly, economic development in the definition refers to economic development that does not decrease environmental quality or destroy the world's natural resource base, rather than traditional economic development that sacrifices resources and the environment. Sustainable development goals fundamentally alter the traditional development concept, emphasizing coordinated economic, social, and environmental development. Attention is paid not only to the quantity but also the quality of economic growth. The concept of sustainable development requires companies to change traditional "high-consumption, heavy-pollution" production and management models and instead adopt clean production as a guiding principle, while focusing on improving economic efficiency and conserving resources and reducing emissions as much as possible. Development is restrictive. Without restrictions, sustainability cannot be attained. Companies should attach great importance to environmental protection issues, rather than opposing environmental protection actions to their own growth, to solve problems from the source and fundamentally (Barbier, 1987)

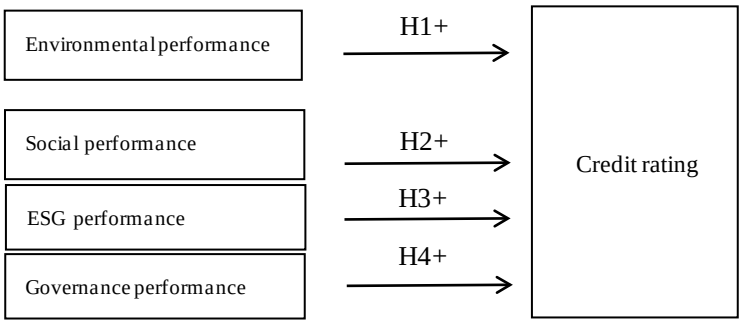
Because ESG reporting and financial reporting have different evaluation perspectives on enterprise performance and sustainability, the former focuses on macro (stakeholder) evaluation of enterprise performance and sustainability, while the latter primarily evaluates enterprise performance and sustainability from a micro (shareholder) perspective. Through examining ESG initiatives and proposals from different international organizations, it can be seen that most ESG report frameworks take providing information that helps stakeholders assess the risks and opportunities of a company's sustainable development as the main objective of ESG reporting. The profound impact of sustainable development theory on ESG is evident. In addition, many ESG report frameworks incorporate the essence of sustainable development theory in their concepts and ideas when designing indicator systems, particularly in terms of social and environmental sustainable development (Huang, 2021)

In conclusion, extensive research has begun to explore the relationship between ESG performance and credit ratings from various perspectives. Stakeholder theory, information asymmetry theory, and sustainable development theory have been used for research analysis, and while differing viewpoints exist, the consensus is that ESG performance does have an impact on enterprise credit ratings. However, opinions on the relationship and degree of impact vary depending on the region and subject. Currently, there are limited empirical analysis papers on this subject in China, and further empirical analysis is needed.

2.4 Conceptual Framework

The conceptual model is depicted in Figure 1 and it serves as the basis for the empirical analysis discussed in the subsequent section.

Figure 1：Conceptual Framework



H1 Hypothesis: There exists a positive correlation between the ESG ratings and credit ratings of listed corporations in China.

H2 Hypothesis: There is a positive correlation between environmental performance and credit ratings of listed corporations in China.

H3 Hypothesis: CSR performance is positively correlated with credit ratings of listed corporations in China.

H4 Hypothesis: There is a positive correlation between corporate governance and credit ratings of listed corporations in China.

3. Research Method and Design

3.1 Research Method

The methodology of this study primarily comprises theoretical research and empirical research approaches. After literature review, the study aims to explore the impact of ESG rating outcomes and separate Environmental (E), Social (S), and Governance (G) scores on the primary credit ratings of publicly listed companies in China from 2019 to 2021, while considering control variables to eliminate potential external influential factors. Based on research assumptions, suitable sample data were selected, models were constructed, and the statistical software 'STATA' was utilized for data analysis. This analysis included descriptive statistical analysis, correlation exploration, multicollinearity testing, and regression analysis, with E, S, and G as explanatory variables in a stepwise regression process.

To enhance the credibility of the study, research assumptions were further confirmed through robustness tests that regressed all independent variables with a one-period lag. Additionally, considering China's unique circumstances of state-owned and non-state-owned enterprises, the study conducted heterogeneity analyses for property rights to investigate the differential impacts of corporate ownership. Finally, empirical results were summarized and discussed.

Through the aforementioned research design and analytical methods, a deeper understanding of the relationship between ESG rating outcomes and individual E, S, and G scores, and the credit ratings of publicly listed companies in China will be achieved. Moreover, this study aims to explore the moderating role of corporate factors within this relationship.

3.2 Sample Selection and Data Source

The sample selection for this paper consists of enterprises in the CSI 800 Index for publicly listed companies in China from 2019 to 2021. Considering the information disclosure of ESG rating agencies and the companies, the analysis of Chinese publicly listed companies in this study uses secondary data obtained from Wind and the China Stock Market & Accounting Research Database (CSMAR).

ESG rating data are sourced from reports by Rankins CSR Ratings (RKS), a globally renowned provider of financial information services and analysis, which also offers ESG (Environmental, Social, and Governance) rating data for Chinese publicly listed companies. There are considerable differences in ESG rating systems between different countries and evaluation agencies. Nonetheless, Rankins CSR Ratings independently developed China's first listed corporate social responsibility report rating system and the country's first ESG rating system (RKS ESG Ratings), making the research more regionally distinctive and tailored.

The choice to use data from 2019 to 2021 is a comprehensive decision. China lags in domestic ESG development and the quality of information disclosure is poor. In recent years, policies related to ESG have been intensively introduced. In September 2018, China issued its revised "Corporate Governance Guidelines for Listed Companies," establishing the basic framework for ESG information disclosure. In November 2018, the "Research Report on China's ESG Evaluation System for Listed Companies" and the "Guidelines for Green Investment (Trial)" were released, constructing the core index system for measuring the ESG performance of listed companies. With the basic framework for ESG information disclosure and the core index system for measuring the ESG performance of listed companies now available, more comprehensive and accurate data samples can be obtained. The choice of recent years' data samples to support research can provide a more evidence-based research foundation, making the research results more convincing.

The reason for choosing the CSI 800 Index as the research sample is a comprehensive consideration of the ESG information disclosure rate, the coverage rate of listed companies, and corporate representativeness. Based on data compiled from WIND: In 2021, the disclosure ratios of the Shanghai Stock Exchange 50 Index, Shanghai 180, CSI 300, CSI 500, CSI 800, and CSI 1000 were 94.00%, 86.11%, 89.33%, 67.60%, 75.75% and 33.70% respectively. From the perspective of corporate attributes, the disclosure ratio of state-owned enterprises was 49%, while that of non-state-owned enterprises was 23%. (Dong, 2022). The CSI 800 Index includes 800 listed companies in China with substantial market value, covering different sectors and industries. These companies usually hold important positions in China’s economy, and their operational performance and ESG practices are highly representative (Guo, You & Guo, 2018). Choosing this index as the research object can provide a wide sample coverage, thereby better understanding the ESG performance of all listed companies in China. The CSI 800 Index is one of the important representatives of the Chinese stock market, receiving attention from a wide range of investors, research institutions, and regulatory agencies. In empirical research in

the ESG field, choosing an index that captures high market attention as the sample can increase the acceptance of the research results and the possibility of practical application.

Lastly, in the selection of the sample, due to the uniqueness of the financial sector where its financial structure and revenue levels are significantly different from other industries, companies from the financial sector are excluded. Companies labelled as ST, *ST and PT, indicating poor operating conditions, are eliminated. Also, those with missing or discontinuous data during the period are excluded.

3.3 Variables

The dependent variable in this study was the credit rating of companies listed in the China Securities Index 800 from 2019 to 2021. The independent variables incorporated the results of the RKS ESG Ratings along with the individual scores for the Environmental, Social, and Governance (E, S, G) sections. Methodologies by Huang, Liu & Liu (2014) and Shen et al. (2019) were referred to for the selection of a series of control variables that account for various corporate factors. These control variables included credit ratings, ESG Index, environmental indices, corporate social responsibility indices, corporate governance indices, company size, debt-to-asset ratio, net profit rate of total assets, cash flow ratio, sales growth rate, the number of board directors, and the years since the company was established. By controlling these factors, a comprehensive understanding of the relationship between the ESG ratings and credit ratings of listed Chinese companies could be achieved while eliminating the impact of other potential factors.

4.Empirical Research Results and Analysis

4.1Variable Definition

The selected variables for this study are summarized in Table 4-1.

Table 4-1: Variable Definitions Table

Credit	Credit Rating	Credit rating index
ESG	ESG Index	Rankings ESG score
E	Environmental Index	Rankings E Index
S	Corporate Social Responsibility Index	Rankings S Index
G	Corporate Governance Index	Rankings G Index
Size	Firm Size	Natural logarithm of total assets
Lev	Debt Ratio	Total debt at year-end divided by total assets at year-end
ROA	Return on Assets	Net profit/average total assets
Cashflow	Cash Flow Ratio	Net cash flow generated from operating activities divided by total assets
Growth	Revenue Growth Rate	Current-year revenue divided by previous-year revenue minus 1
Board	Number of Directors	Natural logarithm of the number of directors on the board
Firm Age	Firm Age	In-log (current year - firm establishment year + 1))

The study investigated the influence of RKS Global ESG Ratings and individual E, S, G scores on the credit ratings of listed companies, while considering other control variables. Specifically, the credit (credit) index was used to assess the credit risk level of listed firms. The RKS ESG Index (ESG) measures performance in three areas: environment (E), social responsibility (S), and corporate governance (G). The E score evaluates environmental protection and sustainable development, the S score gauges social responsibility performance, such as employee welfare and community contribution, and G assesses governance structure and practices.

Additional control variables include company size (Size), represented by the natural logarithm of annual total assets; asset-liability ratio (Lev), indicating financial risk level; return on total assets (ROA), showing profitability; cash flow ratio (Cashflow), reflecting cash flow health and asset utilization; business growth rate (Growth), measuring revenue growth speed; number of directors (Board), demonstrating board composition; and company operational history (FirmAge), indicating business longevity.

By studying these variables, the researchers expected to gain a comprehensive understanding of the relationship between ESG ratings, E, S, G scores and corporate credit ratings in listed Chinese companies, considering factors, such as company size, asset-liability ratio, profitability, cash flow situation, growth, and corporate governance. This provides key insight for decision-making.

4.2 Descriptive Statistical Analysis

Using Stata 15.0, the variables were subjected to a descriptive statistical analysis, as shown in Table 4-2.

Table 4-2： Descriptive Statistical Analysis

VarName	Obs	Mean	SD	Min	Median	Max
credit	793	10.0277	1.1994	0.0000	10.0000	11.0000
ESG	793	2.0463	1.2969	0.0000	1.9600	5.8600
E	793	1.6418	1.7497	0.0000	1.0800	7.1000
S	793	2.0074	1.4483	0.0000	2.0300	7.7300
G	793	2.4919	1.2192	0.0000	2.6500	6.4300
Size	793	24.5452	1.2380	21.8916	24.3465	28.5483
Lev	793	0.5208	0.1676	0.0143	0.5283	0.9601
ROA	793	0.0508	0.0603	-0.3612	0.0420	0.4249
Cashflow	793	0.0684	0.0631	-0.3977	0.0627	0.4133
Growth	793	0.2090	0.7820	-0.6930	0.1363	18.5551
Board	793	2.1859	0.2115	1.6094	2.1972	2.7726
FirmAge	793	3.1144	0.2573	2.0794	3.1355	3.7612

The study presents descriptive statistical analysis of various parameters like credit rating, ESG Ratings, company size, leverage ratio, ROA, cashflow, board and firmage, based on a sample of 793 data points. These parameters exhibit significant variances indicating diverse samples. Descriptive statistics provide the groundwork for understanding the relationship between ESG ratings, credit ratings, and other variables, enabling further in-depth research.

4.3 Correlation Analysis

Correlation analysis can help us understand the linear relationship between variables. It provides information about whether variables are positively or negatively correlated and the strength of their correlation. This helps to determine the associations between influencing factors and reveals patterns and trends among variables. To further ascertain the efficacy of the selected variables, Spearman correlation tests were conducted on each variable using Stata 15.0 software. The results of the correlation analysis are presented in Table 4-3.

Table 4-3： Correlation Analysis

	Credit	ESG	E	S	G	Size	Lev	ROA	Cashflow	Growth	Board	FirmAge
Credit	1											
ESG	0.397***	1										
E	0.361***	0.898***	1									
S	0.333***	0.909***	0.723***	1								
G	0.352***	0.822***	0.573***	0.676***	1							
Size	0.556***	0.471***	0.482***	0.374***	0.368***›	1						
Lev	0.216***	0.167***	0.176***	0.115***	0.144***›	0.570***	1					
ROA	-0.070**	-0.039	-0.044	-0.006	-0.054	-0.205***	-0.431***	1				
Cashflow	-0.017	0.051	0.055	0.053	0.020	-0.100***	-0.255***	0.486***	1			
Growth	-0.047	-0.056	-0.034	-0.040	-0.082**	0.039	0.050	0.141***	0.067*	1		
Board	0.150***	0.117***	0.091**	0.113***	0.109***›	0.158***	0.029	-0.052	0.026	-0.012	1	
FirmAge	0.070**	-0.032	-0.052	-0.009	-0.014	0.030	0.061*	-0.084**	-0.053	-0.019	0.141***	1

Note: *, **, and *** represent significance levels of 10%, 5%, and 1% respectively.

The correlation coefficient matrix reveals significant relationships between various factors and credit ratings. ESG and its sub-indicators (E, S, G) show a positive correlation with credit ratings at the 1% significance level, indicating higher ESG ratings may lead to higher credit ratings. Other correlations include:

Size and Credit have a strong positive relationship, suggesting larger firms have higher credit ratings. Leverage ratio and credit show a positive correlation, implying higher leverage ratios may result in lower credit ratings.

ROA and Credit exhibit a negative relationship, meaning lower ROA may indicate lower credit ratings.

Cashflow and Growth have weak and insignificant negative correlations with credit ratings.

Board and FirmAge display positive correlations with credit ratings, suggesting that higher board ratings and longer company history might lead to higher credit ratings.

These findings are based on the given sample data. It should be noted that further research is needed for broader inferences.

4.4 Multicollinearity Test

The document emphasizes the importance of a multicollinearity test in empirical analysis to guarantee accurate estimations and model stability. Multicollinearity, an issue of high correlation among independent variables, is checked using Variance Inflation Factor (VIF). A high VIF (>5) points to severe multicollinearity. The results of such a test are provided in Table 4-4.

Table 4-4: Multicollinearity Test

	VIF	**1/VIF**
Size	1.93	.518
Lev	1.808	.553
ROA	1.56	.641
ESG	1.335	.749
Cashflow	1.328	.753
Board	1.06	.943
Growth	1.044	.958
FirmAge	1.031	.97
MeanVIF	1.387	.

The table shows that all VIF values for the variables range from 1.031 to 1.93, and are less than 5. This suggests no significant multicollinearity amongst the variables in the model, indicating their relative independence. Also, an average VIF of 1.387, far less than 5, confirms this absence of severe multicollinearity. But, despite this, caution should be maintained while interpreting model results to avoid potential bias or underlying issues.

4.5 Regression Analysis and Results

This research utilized the Ordinary Least Squares method for regression analysis, using four models to investigate the relationships between credit ratings and various variables. The values in the table signify the regression coefficients for each independent variable, and the t-statistics are shown in parentheses. The results of the regression analysis are presented in Table 4-5.

Table 4-5: Regression Analysis

	(1)	(2)	(3)	(4)
	credit	credit	credit	credit
ESG	0.127***			
	(3.835)			
E		0.066***		
		(2.622)		
S			0.085***	
			(3.005)	
G				0.147***
				(4.483)
Size	0.517***	0.543***	0.551***	0.533***
	(10.998)	(11.392)	(12.242)	(12.139)
Lev	-0.393	-0.402	-0.416	-0.394
	(-1.206)	(-1.227)	(-1.275)	(-1.215)
ROA	0.952	0.958	0.896	1.039
	(1.238)	(1.240)	(1.161)	(1.356)
Cashflow	-0.286	-0.251	-0.242	-0.267
	(-0.425)	(-0.370)	(-0.357)	(-0.399)
Growth	-0.086*	-0.093**	-0.093**	-0.084*
	(-1.836)	(-1.977)	(-1.978)	(-1.809)
Board	0.007	0.012	0.013	-0.023
	(0.037)	(0.065)	(0.069)	(-0.125)
FirmAge	0.368**	0.374**	0.360**	0.354**
	(2.464)	(2.484)	(2.399)	(2.380)
_cons	-3.734***	-4.254***	-4.436***	-4.151***
	(-3.123)	(-3.505)	(-3.815)	(-3.660)
industry	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes
N	793	793	793	793
F	7.913	7.713	7.768	8.050
R2	0.418	0.412	0.414	0.423

Note: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively, with t-values reported in parentheses.

The regression results indicate that ESG indicators and components (E, S, G) have a positive, significant relationship with credit ratings ($p < 0.01$), suggesting higher ESG scores lead to improved credit ratings. Firm size also positively impacts credit ratings ($p < 0.01$), with larger companies having better ratings. However, leverage, return on assets, cash flow, growth rate, board size, and company age do not significantly influence credit ratings. In conclusion, ESG factors and firm size significantly affect credit ratings, while other variables do not.

4.6 Robustness Test

The research conducted a lagged regression analysis of independent variables, one time period backward, to examine time robustness, control for lag effects, and enhance result accuracy. This analysis is a robustness test. Four models were split into separate equations with lagged independent variables. The table of regression results presents each model as a column, with rows as independent variables. Table figures show regression coefficients and t-values, asterisks and bars denote significance levels. The results of the robustness test are presented in Table 4-6.

Table 4-6: Robustness Test

	(1)	**(2)**	**(3)**	**(4)**
	F.credit	F.credit	F.credit	F.credit
ESG	0.095**			
	(2.381)			
E		0.060***		
		(2.648)		
S			0.078**	
			(2.060)	
G				-0.010
				(-0.189)
Size	0.516***	0.519***	0.524***	0.568***
	(10.271)	(10.308)	(11.112)	(9.987)
Lev	-0.677*	-0.676*	-0.684**	-0.753**
	(-1.923)	(-1.907)	(-1.971)	(-2.084)
ROA	-0.209	-0.141	-0.293	-0.270
	(-0.252)	(-0.168)	(-0.355)	(-0.314)
Cashflow	0.081	0.078	0.162	0.390
	(0.096)	(0.094)	(0.192)	(0.450)
Growth	-0.335***	-0.329***	-0.346***	-0.337***
	(-2.918)	(-2.884)	(-2.988)	(-2.946)
Board	0.282*	0.291**	0.273*	0.281*
	(1.904)	(1.967)	(1.834)	(1.865)

	(1) F.credit	(2) F.credit	(3) F.credit	(4) F.credit
FirmAge	0.208	0.221*	0.195	0.195
	(1.561)	(1.653)	(1.477)	(1.467)
_cons	-3.639***	-3.662***	-3.727***	-4.636***
	(-3.202)	(-3.180)	(-3.464)	(-3.736)
N	386	386	386	386
F	30.095	30.085	31.129	30.775
R2	0.414	0.414	0.415	0.408

Note: *, **, ***, respectively, represent the significance levels of 10%, 5%, and 1%, with t-values shown in parentheses.

In the lagged one-period regression model, ESG indicators (overall, environmental, and social) show a statistically significant, positive impact on credit ratings one period later. However, the corporate governance (G) indicator has an insignificant impact, requiring further research. Higher debt levels correlate with lower credit ratings, while larger firms tend to have higher credit ratings. The effect of ESG indicators may become uncertain when considering other variables and lag effects, suggesting further research is needed to determine causality.

4.7 Analysis of Property Rights Heterogeneity

Finally, to examine the differences in the impact of property rights, this study conducted an analysis of property rights heterogeneity. The results of the analysis of property rights heterogeneity are presented in Table 4-7.

Table 4-7： Analysis of Property Rights Heterogeneity

				Private enterprise		**Government-owned enterprise**		
	(1) Credit	**(2) Credit**	**(3) Credit**	**(4) Credit**	**(5) Credit**	**(6) Credit**	**(7) Credit**	**(8) Credit**
ESG	0.164***				0.074**			
	(3.082)				(2.238)			
E		0.080*				0.037		
		(1.958)				(1.514)		
S			0.129***				0.039	
			(2.840)				(1.438)	
G				0.184***				0.092***
				(3.409)				(2.859)
Size	0.826***	0.867***	0.858***	0.851***	0.305***	0.324***	0.333***	0.311***
	(9.099)	(9.400)	(9.758)	(9.834)	(7.165)	(7.628)	(8.330)	(7.991)
Lev	-0.726	-0.742	-0.713	-0.704	-0.340	-0.349	-0.368	-0.328
	(-1.238)	(-1.256)	(-1.213)	(-1.205)	(-1.172)	(-1.198)	(-1.264)	(-1.137)
ROA	1.469	1.285	1.403	1.746	1.657*	1.719*	1.616	1.652*
	(1.316)	(1.143)	(1.255)	(1.559)	(1.691)	(1.747)	(1.641)	(1.693)

	Private enterprise				Government-owned enterprise			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Credit	Credit	Credit	Credit	Credit	Credit	Credit	Credit
Cashflow	0.537	0.825	0.603	0.428	-0.758	-0.829	-0.736	-0.697
	(0.480)	(0.736)	(0.539)	(0.383)	(-1.165)	(-1.269)	(-1.126)	(-1.075)
Growth	-0.224*	-0.207	-0.238*	-0.230*	-0.058*	-0.064**	-0.064**	-0.055*
	(-1.742)	(-1.598)	(-1.842)	(-1.790)	(-1.793)	(-1.994)	(-1.980)	(-1.721)
Board	-0.665*	-0.620*	-0.606*	-0.756**	0.094	0.089	0.086	0.089
	(-1.901)	(-1.760)	(-1.733)	(-2.152)	(0.612)	(0.581)	(0.558)	(0.585)
FirmAge	0.307	0.301	0.277	0.303	0.019	0.033	0.026	0.004
	(1.146)	(1.112)	(1.034)	(1.137)	(0.138)	(0.242)	(0.192)	(0.032)
_cons	-10.083***	-10.878***	-10.816***	-10.697***	2.027*	1.633	1.443	1.857*
	(-4.699)	(-4.962)	(-5.190)	(-5.213)	(1.757)	(1.414)	(1.299)	(1.722)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	384	384	384	384	409	409	409	409
F	4.451	4.271	4.405	4.518	7.418	7.309	7.300	7.545
R2	0.411	0.402	0.409	0.415	0.509	0.505	0.505	0.513

Note: *, **, and *** represent the significance levels at 10%, 5%, and 1% respectively, and the values in parentheses indicate the t-values.

Table 4-7 reveals that ESG, E, S, and G all have positive effects on credit ratings in non-SOEs, while in SOEs the positive effects are only seen with ESG and G. Further, non-SOEs show stronger impacts than SOEs. In non-SOEs, positive and significant coefficients can be seen for ESG (0.164), E (0.080), S (0.129), and G (0.184), indicating their influence. Conversely, SOEs only show significant effects in ESG (0.074) and G (0.092). The key takeaway is that ESG, E, S, and G have stronger positive impacts on credit ratings in non-SOEs than in SOEs, though ESG and G still moderately affect SOEs' credit ratings.

5. Discussion of Major Findings and Future Research

5.1 Major Findings

The study investigated the relationship between the ESG ratings of listed companies in China's A-share CSI 800 Index and their credit ratings, as well as the impact of other relevant corporate factors. The researchers used empirical analysis methods and testing the proposed hypotheses and concluded the major findings thus:

Based on correlation analysis results, a significant positive relationship was observed between the ESG scores along with their subcategories--environment (E), social responsibility (S), and corporate governance (G)--and the credit ratings of listed companies within the CSI 800 Index in the A-share market of China. At a 1% significance level, the

correlation coefficients are found to be 0.361 for environment ratings, 0.333 for social responsibility ratings, and 0.352 for corporate governance ratings with respect to credit ratings. These results indicate a relatively stable positive correlation between ESG ratings and credit ratings (Friede et al., 2015; Zaidi et al., 2022).

The empirical analyses confirm a considerable influence of ESG ratings and firm size on credit ratings (Liu & Wu.2020; JoLock, 2022), with larger firms and higher ESG scores yielding better credit ratings. This influence is significant at a 1% level. However, other parameters like leverage ratio, return on assets, cash flow, growth rate, board size, and company age do not show a substantial impact.

Notably, individual ESG components (E, S, G) present distinct trends in relation to credit ratings varying in state-owned enterprises (SOEs) and non-SOEs (Attig et al., 2013; Feng et al., 2016; Schuitema, 2018; Dong 2022). Non-SOEs show positive effects for all three ESG parameters, while in SOEs, only the overall ESG rating and corporate governance aspect echo the same influence. It evidently suggests the stronger effects of ESG factors in non-SOEs compared to SOEs.

Moreover, the study corroborates a time-lagged impact of ESG scores on credit ratings, with positive effects observed a period later (Zheng et al., 2020; Liu & Xu, 2021). However, the corporate governance (G) aspect's impact remains uncertain, necessitating future exploration.

Ultimately, this analysis underscores the imperative for extending research, accounting for other variables and effects. The definitive impacts of these parameters can only be unveiled through additional diverse and broad-based investigations.

5.2 Future Research

It is important to examine the societal implications of ESG and credit ratings, and their associations with stakeholders, such as investors, customers, and employees. The relationship between ESG ratings and credit ratings should be studied across different types of businesses and industries, considering their unique characteristics and risk factors. Understanding these individualities can inform industry-specific recommendations for investors and policymakers.

Furthermore, exploring the relationship between ESG performance and credit ratings specifically for state-owned enterprises (SOEs) in China is crucial. Differential influences of enterprise nature on ESG scores and credit ratings indicate varying importance of ESG for SOEs and non-SOEs. Future research should investigate the underlying reasons and propose corresponding suggestions based on the differing management and regulatory characteristics of SOEs and non-SOEs. Factors, particularly government policies, market pressures, and stakeholder interest levels should be considered to provide precise guidance for the sustainable development of SOEs and non-SOEs. For SOEs, attention to governmental requirements, public interest, and social responsibility may be crucial, while for non-SOEs, emphasis on

brand building, public image maintenance, and stakeholder communication might be more important.

Longitudinal and multinational data can provide a global perspective. Accounting for long-term dynamics and dynamic relationships is crucial. Comparisons between Chinese mainland companies' ESG ratings and those of other countries can offer insights into Chinese corporate sustainability in a global context. Enhanced ESG data collection and reporting through collaborations, use of alternative data sources like social media for ESG performance analysis, and mandatory auditing of ESG data could enhance quality. Cross-country comparisons could provide more comprehensive insights. Additionally, studying the impact of ESG ratings on corporate performance and market value can reveal ESG ratings' role in corporate sustainability.

6. Limitations and Further Study

Limitations in this study could stem from data sources and sample selection in affecting the generalizability of the obtained results. The sample size could have included diverse industries and regions for higher reliability. The study's sample data on ESG development in China appeared to show low disclosure rates, inconsistent standards, and "greenwashing." The CSI 800 Index was used for data quality, but it perhaps did not represent all Chinese listed companies. Financial industry firms were excluded and it could potentially impact the analysis results.

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Sharing Professional Viewpoint

Will Bullet Screens Affect the Attractivity of Live E-commerce to Internet Users?

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1. Opening

In modern society, where live economy is becoming very popular, consumers are likely to buy goods in online live broadcasts. According to the monitoring of the Ministry of Commerce of China, in the first half of 2023 alone, the cumulative sales of live e-commerce in China reached 1.27 trillion yuan, with more than 110 million live shows, more than 70 million goods on the shelves, and more than 2.7 million active anchors (Zhida, 2024). Different from the general e-commerce model, in live e-commerce, anchors will introduce the relevant elements of the goods in the live broadcast room, and use the bullet screen function to communicate with the audience in real time, improve the conversion rate of audience to potential buyers, and then promote consumer buying behavior (Gang, 2023). It can be seen that making good use of the bullet screen function in e-commerce live broadcasts can help businesses attract more consumers.

2. Emotional Value

As an instant information flow, one of the main reasons for the bullet screen to attract consumers is that it can provide consumers with emotional value. The underlying logic of emotional value is closely related to the basic needs and human weaknesses of human beings. The emotional value brought by bullet screen interaction is more of the value in the ecological context of live broadcasting. The immediacy and fragmentation of bullet screen determine its emotional nature. In many cases, consumers may decide to buy a certain product to meet their material needs, but it may also be to get emotional satisfaction (Chen & Zhan, 2024). Even some people do not consume in order to use the basic functions of the product, but purely to satisfy their own emotional experience in some aspects.

Bullet screen interaction can give live e-commerce new emotional value, making live broadcast a new place for online empathy. As the largest education group in China in the past, New Oriental announced its live delivery platform "Oriental Selection" officially launched and settled in Douyin short video platform in 2021 (Wei et al., 2023). In December 2022, the account of Oriental Selection increased from 1 to 6, the total number of fans exceeded 36 million, and a total of 52 self-run products have been launched, with a total sales volume of 18.25 million pieces (Shuo, 2024). "Emotional link" has always been the most important attribute created by Oriental Selection live broadcast. When you open the live broadcast of Oriental Selection, accompanied by soothing music, listening to the anchor's slow life philosophy, you may not imagine that he is actually selling agricultural products. At the same time, the barrage comments have led 88,000 netizens to scratch the screen in the comment area, typing the words "you are here," in order to show that they have been resonated (Pei, 2023). Live broadcast instantly becomes the site of online empathy for netizens, and a live broadcast becomes a spiritual journey, which has been liked by netizens (Chen & Zhan, 2024).

Therefore, the situational characteristics created by live streams can increase the enthusiasm of viewers to participate in live streams. The quasi-social interaction between viewers and posters positively affects viewers' impulse buying tendency. It has been observed that the higher the user participation in live streams, the more users will develop feelings for the corresponding brands and increase their purchases (Chen & Zhan, 2024). Generally speaking, the number of live streams reflects the enthusiasm of users for live discussions, and the emotional tendency reflected by live stream language reflects the subjective degree of users' identification. It has also been noted that the number of live stream information has a good performance on arousal and pleasure (An, 2023).

3. Bullet Screen Functions

Bullet screen functions can also help to establish the brand value of live anchor IP (Kai, 2023). Compared with traditional offline shopping, online audiences value the evaluation of live anchors and products by live bullet screens. The more bullet screens the anchor has, the higher the interaction with the audience, the better the user experience, and the higher the word-of-mouth score. Once a large number of fans are accumulated, the online audience of such live broadcasts will have a stronger emotional connection with the anchors. These fans will be more inclined to express their support and affirmation to the anchors in the form of live bullet screens, and will be more willing to participate in live interactions and actively maintain the anchors through live bullet screens. Undoubtedly, this will help to establish the brand value of the anchor IP.

Although there are many advantages to use the bullet screen functions in the process of e-commerce live broadcast, not everyone agrees with it. The theory of limited attention shows that the attention of each individual at a certain point of time is very limited, and the individual will allocate the limited attention to different work tasks. The more attention the work allocates, the less attention the rest work allocates. When consumers watch e-commerce live broadcast, they will watch the video and the bullet screen content at the same time, and the two will compete for consumers' attention. If consumers pay more attention to the bullet screen, they will be easily distracted by the bullet screen information, which will affect their judgment ability (An, 2023).

4. Reflection

Obviously, the use of live bullet screens in e-commerce live broadcast can help merchants attract more consumers. The bullet screen function allows consumers to interact with the anchor and other consumers, and gives the live e-commerce updates emotional value. How to make use of the live bullet screen function to make Internet users speak louder and learn to mine the emotional value of users is what the majority of Douyin e-commerce platforms and anchors need to think about.

5. The Author

Yingting Liu is a full-time lecturer in the Marketing Teaching Research Room at the Business School of Chongqing City Vocational College in China. Her research interest lies in the areas of marketing and current issues in digital marketing.

6. References

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