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Impact of Gamification on Knowledge Sharing _ The Mediating Role of Self-Determination

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Abstract: With the development of social Q&A communities, many communities were facing the dilemma of user loss and insufficient knowledge sharing. Gamification was a design paradigm that promoted user knowledge sharing, and its promotion mechanism was also worth studying. Taking Zhihu as an example, based on discussing the relationship between gamification and knowledge sharing, which included knowledge-seeking and knowledge-contribution, this paper further discusses the mediating role of self-determination in the relationship between them. The research used hierarchical regression as the research method. The results of this research demonstrated that the interaction of gamification traits (immersion, fulfillment, and socially relevant traits) has a significant positive effect on self-determination. All have significant positive effects on knowledge-seeking behavior and knowledge-contribution behavior. Self-determination has a significant positive impact on knowledge-seeking behavior and knowledge-contribution behavior. Self-determination was fully mediated between immersion-related gamification, social-related gamification, achievement-related gamification, and knowledge-seeking behavior. Self-determination was partially mediated between immersion-related gamification, social-related gamification, achievement-related gamification, and knowledge-contribution behavior. The research presented that was a new research model to explore the effect of gamification on knowledge sharing. In addition, there also demonstrated that improving the game level of the knowledge-sharing platform was an effective way to improve knowledge-seeking behavior and knowledge-contribution behavior.

Keywords: Gamification, Knowledge Contribution, Knowledge Collection, Self-Determination, S-O-R Model

1. Introduction

Gamification was increasingly used as an important component of today's services, software, and systems to engage and motivate users and motivate further behavior (Xi and Hamari, 2019). In games, there has been widely observed that we were generally highly engaged and intrinsically motivated and that we gained cognitive, emotional, and social benefits (Chou and Ting, 2003). Furthermore, gamification was introduced into non-game scenarios such as education (Niu and Ren, 2006, Feng, 2015, Kapp, 2012, Lee and Hammer, 2011, Dominguez et al., 2013), medical care (King et al., 2013, Nevin et al., 2014), marketing (Yang, 2006, Kai and Hamari, 2011), and corporate governance (Luo, Sun, and Feng, 2016). There also played an important role in driving user engagement.

With the development of the Internet and driven by the sharing economy, knowledge-sharing platforms such as social question and answer have developed rapidly. Yahoo! Quora and Zhihu account for the vast majority of the market, along with other social sharing platforms such as Weibo and Xiaohongshu. A knowledge community that facilitated member collaboration and increased user contributions enables the sustainable development of the platform (Bagherzadeh et al., 2019). There also combined the functions of socialization and traditional question-answering systems. There were established social connections between users, thereby providing an effective channel for users to share personalized problems and solutions. However, most social Q&A communities faced the problem of too many knowledge-seeking actors and too few knowledge-contributing actors. Therefore, motivating online users actively participate in the knowledge-sharing process, including knowledge-seeking behavior and knowledge-contribution behavior. There has become a major challenge for the online question-answering community (Chen, Baird, and Straub, 2019, Luo et al., 2020, Wang et al., 2020). After Yahoo's use of leaderboards and Marblar's use of points to significantly promote knowledge sharing, more and more gamification has been applied to knowledge-sharing platforms. Based on this, there

was necessary to deeply study the specific impact mechanism of different dimensions of gamification on the knowledge contribution behavior and knowledge-seeking behavior of the Chinese contextual question-answering platform. As a well-known and trustworthy question-and-answer community on the Internet in China. Zhihu was gathering people in China's Internet technology, business, culture, and other fields. Build trust and connection through knowledge, and communicate rationally, deeply, and deeply. There were discussed hot events or topics in multiple dimensions, sharing high-quality content, building and enhancing personal brand value, and discovering and acquiring new opportunities. Based on this, this paper took Zhihu as a typical case to conduct an in-depth study on the gamification of the Chinese knowledge-sharing platform.

2. Theoretical Background

Kevin Werbach demonstrated that the founder of the Global Gamification Course defined "gamification" as the use of game elements and game design techniques in non-game contexts (Ye and Kishida, 2003). With gamification, game elements were considered in different ways and applied to services outside the game. Literature on playing games, gamification, game design categories, and player motivation. Three main gamification features were usually distinguished, such as immersive, satisfying, and socially relevant gamification features. These three gamification features reflected key elements of game design and player motivation orientation. Common game elements included levels, points, rewards, challenges, badges, and avatars. However, the most commonly used were points, badges, and Leaderboards referred to as PBL (Hamari and Eranti, 2011). Typical gamification elements used by the platform included credits/scores, leaderboards/rankings, badges/achievements, levels, progress, feedback, virtual objects/resources, storytelling, virtual territories, teams, quests, and avatars/avatars (Morschheuser et al., 2017). Later scholar Hamari divided the elements into three categories according to the motivation orientation of players, such as immersion, social-related, and achievement (Koivisto and Hamari, 2019).

The research used the last one, namely gamified immersion, social-related, and achievement-related gamification features. Immersion-related gamification features primarily included avatars, role-playing mechanics, storytelling, narrative structure, and customization. There was primarily an attempt to immerse the player in an autonomous, curious activity. The activity acted on persuasion systems, encouraging users to engage in autonomous activities, sparking curiosity, and ultimately increasing their engagement (Goes et al., 2016). Social-related gamification features included social network functions such as chat, blog, and peer rating. Promoting frequent communication, knowledge exchange, and mutual assistance enhanced and established social network connections and users' sense of belonging. Achievement-related gamification features usually included points, levels, and badges. These gamification elements, such as Zhihu's level and Yanzhi, increased competitiveness. There was served as a visible indicator of the player's progress and dependence, which provided psychological incentives for continued use (Feng et al., 2022).

Knowledge sharing referred to the concentration of scattered and redundant knowledge, experience, and intellectual resources of individuals or institutions on the Internet platform. There was shared with specific individuals or institutions for free or for a fee. There was maximized mobilization of the intellectual resources of the whole society to meet the needs of production and life services with higher efficiency and lower cost. A Q&A site was a place specifically designed to allow people to ask and answer questions on a wide range of topics. There encompassed three forms of knowledge sharing, for instance, digital reference services, which were traditional in the digital environment, expert services, which were question-and-answer services provided by various commercial and non-commercial organizations outside libraries, and social question-and-answer services, which seek information from other users on the web problematic process. Their respondents were referenced librarians, subject experts, or people who have access to questions and were willing to provide answers and participate voluntarily in sharing knowledge and information (Shah, Oh, and Oh, 2009). Knowledge sharing included knowledge-seeking behavior and knowledge contribution behavior (Hwang, Lin, and Shin, 2018, Kang, Jin, and Kim, 2017). In the virtual community environment, knowledge-sharing behavior was the basis for the smooth operation of virtual communities and Zhihu. Knowledge sharing was crucial and often used to describe users' participation in virtual communities (Yen, Hsu, and Huang, 2011).

In the research, the third form of knowledge sharing was adopted. As users of Zhihu, their knowledge sharing played a crucial role in enabling Zhihu to accumulate resources and continuously grow. The researchers believed that the knowledge contribution behavior of Zhihu's main UGC source referred to users' sharing and answering in Zhihu as well as all behaviors of co-creating knowledge.

Knowledge-seeking behavior of online community users has a positive impact on their social capital, which was further positively correlated with their knowledge contribution behavior (Wang et al., 2022). Studies show that, although knowledge-seeking behavior was called free riding (Tsai and Kang, 2019), it could meet the needs of knowledge-seeking behavior. There also brought new knowledge growth to the community by incentivizing other users to contribute (Chen and Hung, 2010).

According to the self-determined theory (Deci, Connell, and Ryan, 1989), a person feels self-determined when he/she experiences that his/her actions were autonomous, effective in actions or interactions, and connected to other individuals or groups. Self-determination was considered one of the most fundamental sources of human motivation and well-being (Deci, 2000). The play

was a major theoretical lens in self-determination theory in male studies (Seaborn and Fels, 2015). The theory postulated that the fulfillment of three main internal needs (autonomy, competence, and relatedness) led to free shipping behavior (Deci, 2000). However, only a few studies investigated the relationship between different features of gaming and internal demand satisfaction. Therefore, in the research, the goal was to have gamification characteristics (immersion, achievement, and socially relevant characteristics) through investigations. Zhihu extended this theoretical and practical research on the relationship between user interaction and the satisfaction of internal needs (autonomy, competence, and relevance).

3. Research Model and Hypothesis Development

3.1. Research Model

Being initiated in environmental psychology, the S-O-R system was created from the old-style stimulus-response theory. The S-O-R system comprised three fundamental components, namely, stimulus (external triggers that excite users' responses), organism (users' affective, cognitive, or normative evaluations of the external triggers), and response (users' behavioral outcomes of responses). In the context of knowledge sharing platform, gamification features (immersion, achievement, and socially-related features) were huge triggers of users' three basic psychological needs, according to self-determination theory, such as competence needs, relatedness needs, and autonomy needs, which further impacted their subsequent knowledge seeking and contribution intention. Accordingly, the research identified gamification traits as important stimulating needs for biological self-determination, and knowledge-seeking and knowledge-sharing behaviors as responses in the research model.

The model below, shown in Figure 1, included three independent variables, namely, immersion, fulfillment, and socially relevant characteristics. There was one mediator variable, self-determination, and two dependent variables. There was knowledge-seeking behavior and knowledge-contribution behavior.

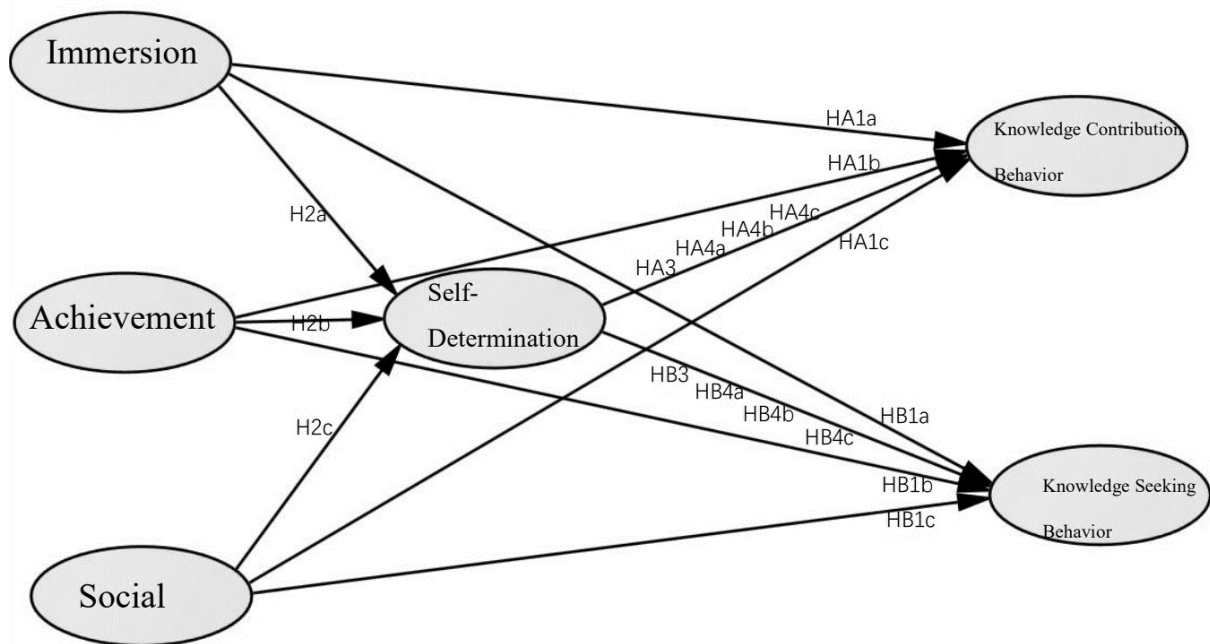


Figure 1. Hypothetical model of the research.

3.2. Hypothesis Development

3.2.1. The Relationship Between Gamification and Knowledge Contribution Behavior and Knowledge Seeking Behavior

Interaction with gamification has a direct impact on knowledge-contribution behavior and knowledge-seeking behavior Fedorenko(Fedorenko, Berthon, and Rabinovich, 2016) studied the Marblar platform, which used the points system to motivate

knowledge sharing between scientists and entrepreneurs. Another famous example was Yahoo! And Answers, which used points and leaderboards to facilitate knowledge contributions from registered users (Jin et al., 2013).

In the study of information search, scholar Yuan Hong believed that the interaction was in social media and the shortening of social distance also conducted the generation of social-related information search behavior when studying user searched behavior (Yuan, 2013a). There was introduced the gamification mechanism into the current research and exploratory search system, including avatars, points, medals, and asking friends for help to stimulate users' interest. There were incentivized users to continue to use and supported search interactions and increased search utilization of exploratory search systems (Yuan and Zhang, 2020). Based on the basic theory of gamification, relevant framework, and mechanism of information retrieval system, Li Yuelin and He Pengfei combined different game elements and designed modules with specific functions to realize the application of game elements in non-game situations on the premise of considering the relationship between different game elements and rules (Yuan and Zhang, 2020). In addition, Wang Nan (Wang et al., 2022) also explored the relationship between knowledge contribution and knowledge search. The results showed that the knowledge search behavior of online community users has a positive impact on their social capital, and was further positively correlated with knowledge contribution behavior. This was also a partially mediated process.

Therefore, this study put forward the following hypotheses:

HA1a immersion-related gamification positively affected knowledge-contribution behavior.

HA1b Social-related gamification positively affected knowledge-contribution behavior.

HA1c achievement-related gamification positively affected knowledge contribution behavior.

HB1a immersion-related gamification positively affected knowledge-seeking behavior.

HB1b Social-related gamification positively affected knowledge-seeking behavior.

HB1c achievement-related gamification positively affected knowledge-seeking behavior.

3.2.2. The Relationship Between Gamification and self-determination

Knowledge-contribution behavior and knowledge-seeking behavior together constituted knowledge-seeking behavior. Knowledge-sharing behavior was influenced by perceived incentives, reciprocity (Wang and Cheng, 2016), personal traits (Gft et al., 2019), external motivation (Feng et al., 2022), and sharing attitude (Geng and Jing, 2019). Gamification elements as a new means also promoted knowledge sharing (Bravo, Catalan, and Pina, 2021). Moreover, according to self-determination theory, when there was environmental support for autonomy, competence, and a sense of relationship. The external motivation was internalized and integrated (Deci, 2000), which further promoted self-motivation and effective operation (Bravo, Catalan, and Pina, 2021). In other words, if users feel that these needs were met when they were exposed to gamification, they were likely to be intrinsically motivated to engage with gamified platforms. Therefore, gamification features satisfied human needs and intrinsic motivation (Sailer et al., 2017, Xi and Hamari, 2019).

As mentioned above, immersion-related functions mainly included avatars, role-playing mechanisms, storytelling, narrative structure, and customization, which mainly attempted to immerse players in a self-directed and exploratory activity (Schneider, 2010). These characteristics related to immersion usually lead to higher psychological investment in independent thinking and customization that provided free choices for game players (Kim et al., 2015), and produced a stronger sense of autonomy. In games, storytelling or narrative helped to promote the feeling of voluntary participation (Sailer et al., 2017). Therefore, there was speculated that users who interacted with immersive-related features were more likely to experience a higher sense of freedom, engagement, and participation in gamified systems.

The need for autonomy referred to the desire for a sense of self-direction, the willingness to act on one's own will or to complete specific tasks (Ryan, Rigby, and Przybylski, 2006). More precisely, there was the subjective experience of psychological freedom and choice when participating in an activity. According to self-determination theory, people have a high sense of autonomy when they were free to pursue the best outcome or engage in activities that were not subject to any external control. Following Sailer's previous research, there was providing users with more freedom of choice and more opportunities for expression stimulated and satisfied the need for autonomy and increased the internal motivation for independent decision-making.

The need for competence referred to the desire for self-control and growth (Ryan, Rigby, and Przybylski, 2006). Individuals have a natural tendency to manipulate their environment, overcome different challenges, and develop their skills. Combined with previous Valacich research, there suggested that revelations provided players with opportunities to learn new skills set clear goals, and received feedback may increase the ability to meet the intrinsic motivation of the self-awareness theory. Because these characteristics demonstrated their achievements and abilities. Things like points, badge leaderboards, and to-do lists provided players with a clear goal of learning new skills and increasing the likelihood of completion.

H2a immersion-related gamification positively affected self-determination.

H2b Social-related gamification positively affected self-determination.

H2c achievement-related gamification positively affected self-determination.

3.2.3. The Relationship Between self-determination and Knowledge Contribution Behavior and Knowledge Seeking Behavior

Concerning self-determination theory, Wei-Tsong Wang (Wang and Hou, 2015) tested a model that described the impact of different types of motivation on employee knowledge-sharing behavior (KSB). Hard reward, soft reward, and organizational benefit altruism were important influencing factors of KSBs, while the impact of altruism on individual satisfaction was not. Scholars (Wang and Lu, 2020) showed that self-determined needs for autonomy, ability, and belonging (Zhang et al., 2016, Yuan, 2016, Wang and Cheng, 2016, Yuan, 2013b) positively promoted knowledge-seeking and knowledge contribution.

The following hypotheses were obtained:

HA3 self-determination positively affected knowledge contribution behavior.

HB3 self-determination positively affected knowledge-seeking behavior.

3.2.4. The Mediating Effect of Self-determination

Based on self-determination theory and relevant literature, Yuanyue Feng (Feng et al., 2022) studied and theorized the mediating role of three kinds of intrinsic motivation (self-esteem, ability enhancement, and virtual community feeling) and extrinsic motivation in the relationship between three typical gamification mechanisms (immersion, social interaction, and achievement) and the knowledge contribution of the solver. The results showed that self-esteem and competence enhancement positively moderated the effect of gamification mechanisms on knowledge contribution, whereas extrinsic motivation negatively moderated this effect. There was competence corresponds to competence motivation in self-determination, community awareness corresponds to the association, and ego corresponds to self-esteem. The following hypotheses were drawn:

HA4a self-determination played a mediating role in the relationship between immersion-related gamification and knowledge contribution behavior.

HA4b self-determination mediated the relationship between social-related gamification and knowledge contribution behavior.

HA4c self-determination mediated the relationship between achievement-related gamification and knowledge contribution behavior.

HB4a self-determination mediated the relationship between immersion-related gamification and knowledge-seeking behavior.

HB4b self-determination mediated the relationship between social-related gamification and knowledge-seeking behavior.

HB4c self-determination played a mediating role in the relationship between achievement-related gamification and knowledge-seeking behavior.

4. Research Design

4.1. Participants

A total of 290 questionnaires were distributed, 289 were returned, and 235 were valid with the demographics described in Table 1. In terms of gender, male users account for 40.4% of the total sample, while female users account for 59.6%. The number of female users was slightly higher than that of male users. Studies have shown that female users account for a large proportion of most Q&A virtual communities (Pnina and Fichman, 2011). From the perspective of age distribution, the sample number of the 20-39 years old group accounts for 86.8% of the total number of people. It can be seen that the users of knowledge-sharing platforms were mainly young and middle-aged people. The age of 20 and 40 years old or above the under-representation of user groups, was 0% and 13.2%, respectively, which the groups were mostly high school students under the age of 20, they mainly study time, had less contact with the Internet, and more than 40 groups might lower proficiency in the application of the Internet. The registration time of Zhihu was concentrated in 3-5 years, accounting for 38.7%, followed by 5-7 years, accounting for 28.5%, and 1-3 years, accounting for 20.9%. In terms of educational background, the majority of the users were undergraduates, with undergraduates accounting for 79.1% of the total sample, and graduates and above accounting for 12.3%. In terms of occupational distribution,

students and company employees were the main ones, accounting for 14% and 66.4%, respectively, while other professionals accounted for 19.6% of the total sample. In the occupational distribution, the sample size of employees in enterprises was.

4.2. Concept of entrepreneurial marketing

Entrepreneurial marketing is a marketing strategy that can be better suited to resource constraints and challenges in SMEs (Bachmanna et al., 2020; Alqahtani and Uslay, 2020). The organizations that choose EM as their strategy benefit from linking the underlying dimensions. These links are valuable when pursuing exploratory as well as exploitative innovation. The interlinking between the EM dimensions offers different advantages, allowing them not only to create exploitative or exploratory innovation but to rotate between these innovation types (Alqahtani and Uslay, 2020). Moreover, in marketing and entrepreneurship literature, the concept of EM has primarily been associated with the need for creativity and innovativeness in small firms (Miles et al., 2015). All EM definitions, however, have something in common; they include both marketing and entrepreneurial aspects. The definitions of EM that may be frequently found in the literature are chronologically listed in Table 1.

Table 1. Demographics of respondents

Profile	Description	Total respondents	Percentage
Gender	Male	95	40.4%
	Female	140	59.6%
Age	Less than 20	0	0
	20-29	113	48.1%
	30-39	91	38.7%
	40-49	16	6.8%
	50 or more	15	6.4%
	Student	33	14%
Occupation	Professional/technical	25	10.6%
	Paid Employment	156	66.4%
	Military/Government	10	4.3%
	Self-employed	7	3%
	others	4	1.7%
	Less than 2500	22	9.4%
Income per month(RMB)	2500-4999	33	14%
	5000-7499	35	14.9%
	7500-9999	48	20.4%
	10000–12499	41	17.4%
	12500–14999	17	7.2%
	15000–17499	22	9.4%
	17500–19999	8	3.4%
	20000 or more	9	3.8%
Education	junior school or below	0	0
	High school & technical secondary school	4	1.7%
	College (3 years)	16	6.8%
	University	186	79.1%
	Graduate school or above	29	12.3%
Member History	< 1 year	8	3.4%
	1-3 year	49	20.9%

3-5 year	91	38.7%
5-7 year	67	28.5%
Over 7 year	20	8.5%

large, resulting in a large number of users with an income of 7,500-12,499 yuan, accounting for 37.8% of the total sample size. In addition, 5000-7499 and 2500-4999 account for 14.9% and 14% respectively.

4.2. Research instrument

The data collection instrument was carried out using six parts of questionnaires representing each research variable, namely (a) the three aspects of gamification adopted by Xi and Hamari (Xi and Hamari, 2019) and Feng, Y. (Feng et al., 2022), (b) the self-determination obtained from Standage (Standage, Duda, and Ntoumanis, 2005) and Xi and Hamari (Xi and Hamari, 2019), (c) knowledge seeking behavior adopted from Kankanhalli (Kankanhalli, Tan, and Wei, 2005), Zha, X, J (Zha, Zhang, and Yan, 2015), (d) knowledge contribution behavior obtained from Zhang, Y (Zhang et al., 2019). Each variable was developed into several indicators as described in Table 2. The questionnaire was made using a Likert scale with a score of 1–7, with the information collected in the form of interval data. The score of 1 was for “strongly disagree,” and 7 for “strongly agree.” The Credamo website was also used to facilitate the distribution and filling of questionnaires to the participants.

Table 2. Variable indicator.

Variable	Indicator	Code
Interaction with immersion-related features	I often alter my avatars on Zhihu	IMM1
	I often alter the personal keywords on my profile in Zhihu	IMM2
	I often alter my homepage on Zhihu	IMM3
	I often pay attention to the originators' center on Zhihu	IMM4
	I attach great importance to the avatars on Zhihu	IMM5
	I attach great importance to the personal keywords in the profile on Zhihu	IMM6
	I attach great importance to being a knowledge originator on Zhihu	IMM7
	I attach great importance to my homepage on Zhihu	IMM8
Interaction with social-related features	I often express my ideas and interact with users on Zhihu	SOC1
	I often have private conversations with others on Zhihu	SOC2
	I often follow others and am often followed	SOC3
	I am often liked, thanked, collected, or rewarded	SOC4
	I attach great importance to expressing my ideas and interacting with users on Zhihu	SOC5
	I attach great importance to having private conversations with others on Zhihu	SOC6
	I attach great importance to following others or being followed	SOC7
	I attach great importance to being liked, thanked, collected, or rewarded	SOC8
Interaction with achievement-related features	I often attend to my Yanzhi on Zhihu	ACH1
	I often attend to my badges on Zhihu	ACH2
	I often attend to my levels on Zhihu	ACH3
	I often attend to the times that my contents were liked, thanked, and collected	ACH4
	I attach great importance to my Yanzhi on Zhihu	ACH5
	I attach great importance to my badges on Zhihu	ACH6
	I attach great importance to my levels on Zhihu	ACH7
	I attach great importance to the times that my contents were liked, thanked, and collected	ACH8

Table 2. *cont.*

Variable	Indicator	Code
Autonomy needs satisfaction	I feel free to visit this Zhihu	AUT1
	I feel free to express my ideas and opinions in the Zhihu	AUT2
	I feel free from outside pressures when I am visiting the Zhihu	AUT3
	I feel I can be myself when I visit Zhihu	AUT4
Relatedness needs satisfaction	When I visit the Zhihu, I feel like other people care what I have to say and what I do	REL1
	When I visit the Zhihu, I feel supported by other users	REL2
	When I visit the Zhihu, I feel that I am a valuable person to others	REL3
	When I visit the Zhihu, I feel that I am understood	REL4
Competence needs satisfaction	I feel like a competent person when I visit the Zhihu	COM1
	I am satisfied with my performance when I visit the Zhihu	COM2
	I feel like an expert in the Zhihu	COM3
	I think that I am pretty good when I visit the Zhihu	COM4
Knowledge seeking behavior	I often use Zhihu to search for information	COL1
	I will spend a lot of time searching for information using Zhihu	COL2
	I frequently use Zhihu to search for information	COL3
	I regularly use Zhihu to search for information	COL4
Knowledge contributing behavior	I often help questioners on Zhihu	CON1
	I often participate in knowledge-sharing activities on Zhihu	CON2
	I contributed my knowledge to Zhihu	CON3
	I shared my knowledge with other members and gave them new insights	CON4

5. Data analysis

This study used SPSS 26.0 to test the reliability and validity of each scale, and the results have shown in the table.

5.1. Validity and Reliability Analysis

As the results showed in Table 3, the Klonbach Alpha coefficients of immersion-related gamification, Social-related gamification, achievement-related gamification, self-determination, knowledge-seeking behavior, and knowledge contribution scales were all greater than 0.7, indicating good reliability and reliability of each scale. The KMO value of the scale was 0.953, and the result of the Barthes spherical value test was significant, which passed the validity test.

Table 3. Cronbach's alpha and combined reliability coefficient.

Variable	Cronbach's alpha	
gamification	Interaction with immersion-related features	0.900
	Interaction with achievement-related features	0.928
	Interaction with social-related features	0.948
Self-determination	0.914	
Knowledge seeking behavior	0.722	
Knowledge contributing behavior	0.880	

The means, standard deviations, and intercorrelations among all variables were calculated by an SPSS before examining the hypotheses of this study in Table 4.

Table 4. Means, standard deviations, Cronbach' s alpha, and intercorrelations among the study.

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Gender	1.60	0.49	-											
2. Age	2.71	0.85	-.17**	-										
3. Occupation	2.77	0.97	-0.11	.30**	-									
4. Income per month (RMB)	4.22	2.08	-.24**	.32**	.34**	-								
5. School type	4.02	0.51	-0.09	-.15*	-.18**	.15*	-							
6. Member History	3.18	0.97	-0.09	.14*	0.10	.33**	.23**	-						
7. Interaction with immersion-related features	4.34	1.21	-.17**	.24**	.25**	.47**	0.01	.23**	1					
8. Interaction with achievement-related features	5.01	1.22	-.25**	.27**	.23**	.47**	0.09	.30**	.76**	1				
9. Interaction with social-related features	4.82	1.45	-0.02	.23**	.23**	.18**	0.01	.21**	.55**	.65**	1			
10. Self-determination	5.41	0.87	-.20**	.28**	.23**	.48**	0.03	.31**	.71**	.83**	.57**	1		
11. Knowledge-seeking behavior	5.50	0.86	-0.12	.23**	.19**	.33**	0.00	.23**	.54**	.58**	.45**	.65**	1	
12. Knowledge-contributing behavior	5.54	1.09	-.15*	.19**	.22**	.41**	0.04	.22**	.66**	.79**	.60**	.82**	.66**	1

*** $p < 0.001$; * $p < 0.05$; ** $p < 0.01$.

5.2. Testing of Hypothesis

The results of the hypothesis testing have shown in Tables 5 and 6. Based on the hypothesis testing shown in Tables 5 and 6, the following proofs were obtained:

In table 5, the direct effect test was to test the relationship between independent variables and dependent variables. The dependent variable (knowledge contribution) was respectively regressed with the control variable and independent variable (immersion-related gamification, Social-related gamification, and achievement-related gamification) (Model 2, Model 3, and Model 4), and the regression coefficients were 0.54 ($p < 0.001$), 0.71 ($p < 0.001$) and 0.42 ($p < 0.001$), respectively. And they're all significant. Thus, hypothesis HA1a to hypothesis HA1c was supported.

In table 5, The procedure recommended in the literature(Wen et al., 2004)was used for mediating effect test.

First, the relationship between the independent variables (immersion-related gamification, Social-related gamification, achievement-related gamification) and the dependent variable (knowledge contribution behavior) was tested, and the results showed that the regression coefficients of each variable reached a significant level.

Second, the relationship between mediating variables (self-determination) and independent variables (immersion-related gamification, Social-related gamification, achievement-related gamification) was tested. The results were the same as above. Thus, hypothesis HA3 was supported.

Thirdly, the relationship between the mediating variable, and the dependent variable was tested (model 6), and the regression coefficient was 1.04 ($p < 0.001$), reaching a significant level. Thus, HA3 was supported.

Finally, the relationship between the independent variable, the mediator variable, and the dependent variable knowledge contribution was verified. According to the regression results, when the independent variables and mediating variables enter the regression equation together, the relationship between immersion-related gamification, Social-related gamification, achievement-related gamification, and knowledge contribution was still significant (Model 8, Model 9, Model 10), the standardized regression coefficient became smaller, however, there was still very significant. There were 0.14 ($p < 0.01$), 0.34 ($p < 0.001$), and 0.16 ($p < 0.001$), respectively, indicating that self-determination plays an incomplete mediating role in the effect of gamification on knowledge contribution. Thus, hypothesis HA4a ~ Hypothesis HA4c was supported.

Table 5. Results of knowledge contribution behavior

Model	Knowledge contribution behavior											Self-determination		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Gender	-0.11	-0.04	0.11	-0.18	0.06	0.05	0.04	0.04	0.09	-0.01	-0.15	-0.09	0.03	-0.19*
Age	0.05	0.00	-0.06	-0.07	-0.08	-0.10	-0.07	-0.07	-0.08	-0.1	0.11	0.08	0.03	0.03
Occupation	0.10	0.04	0.05	-0.01	0.02	0.03	0.06	0.05	0.05	0.02	0.04	-0.00	0.00	-0.03
The income per month (RMB)	0.17	0.05	0.03	0.16	0.04	0.02	0.03	0.00	0.01	0.04	0.15	0.05*	0.04*	0.14
	***										***			***
School type	-0.05	0.03	-0.08	-0.08	-0.07	-0.01	0.04	0.05	-0.01	0.01	-0.08	-0.02	-0.11	-0.10
Member History	0.11	0.04	-0.03	0.01	-0.03	-0.07	-0.06	-0.06	-0.06	-0.07	0.16**	0.11*	0.06	0.09
Interaction with immersion-related features		0.54			0.08	0.01		0.14				0.43		
		***						**				***		
Interaction with social-related features			0.71		0.55	0.26			0.34				0.55	
			***		***	***			***				***	
Interaction with achievement-related features				0.42	0.12	0.10				0.16				0.29
				***	**	**				***				***
Self-determination						0.65	1.04	0.91	0.67	0.87				
						***	***	***	***	***				
R ²	0.19	0.31	0.64	0.46	0.65	0.73	0.68	0.69	0.72	0.71	0.28	0.55	0.71	0.49
F	8.61	14.56	56.69	27.33	101.28	60.02	67.96	62.42	72.42	68.07	14.82	40.02	78.54	30.90
	***	***	***	***	***	***	***	***	***	***	***	***	***	***
ΔR^2	0.19	0.17	0.45	0.27	0.47	0.08	0.49	0.24	0.08	0.25	0.28	0.27	0.43	0.21
ΔF	8.61	54.34	281.59	114.04	47.08	61.87	345.91	172.46	67.03	192.14	14.82	137.88	331.85	91.92
	***	***	***	***	***	***	***	***	***	***	***	***	***	***

*** $p < 0.001$; * $p < 0.05$; ** $p < 0.01$.

Table 6. Results of knowledge-seeking behavior

Model	Knowledge seeking behavior											Self-determination		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Gender	-0.05	-0.01	0.07	-0.09	0.03	0.03	0.04	0.04	0.06	0.02	-0.15	-0.09	0.03	-0.19*
Age	0.12	0.08	0.05	0.04	0.04	0.03	0.04	0.04	0.03	0.02	0.11	0.08	0.03	0.03
Occupation	0.05	0.02	0.02	-0.01	0.00	0.01	0.02	0.02	0.02	0.01	0.04	-0.00	0.000	-0.03
The income per month (RMB)	0.09**	0.02	0.02	0.09	0.02	-0.00	0.00	-0.01	-0.00	0.01	0.15***	0.05*	0.04*	0.14***
School type	-0.07	-0.03	-0.09	-0.09	-0.07	-0.03	-0.02	-0.01	-0.03	-0.03	-0.08	-0.02	-0.11	-0.10
Member History	0.13*	0.09	0.06	0.08	0.05	0.03	0.03	0.03	0.03	0.03	0.16**	0.11*	0.06	0.09
Interaction with immersion-related features		0.33***			0.13*	0.08		0.10				0.43***		
Interaction with social-related features			0.38***		0.23***	0.01			0.09				0.55***	
Interaction with achievement-related features				0.23***	0.07	0.05				0.07				0.29***
Self-determination						0.49***	0.62***	0.53***	0.53***	0.55***				
R ²	0.15	0.31	0.35	0.28	0.38	0.45	0.43	0.44	0.44	0.44	0.28	0.55	0.71	0.49
F	6.43***	14.56***	17.72***	12.56***	15.02***	18.06***	24.68***	22.35***	21.92***	22.28***	14.82***	40.02***	78.5***	30.90***
ΔR ²	0.15	0.17	0.21	0.13	0.23	0.07	0.29	0.13	0.08	0.16	0.28	0.27	0.43	0.21
ΔF	6.43***	54.34***	73.25***	42.33***	27.70***	28.73***	114.94***	53.35***	33.52***	65.40***	14.82***	137.88***	331.86***	91.92***

***p<0.001; *p < 0.05; **p < 0.01.

In table 6, the direct effect test was to test the relationship between independent variables and dependent variables. The dependent variable (knowledge-seeking behavior) was respectively regressed with the control variable and the independent variable (immersion-related gamification, Social-related gamification, achievement-related gamification) (Model 2, Model 3, Model 4), and the regression coefficients were 0.33 (p<0.001), 0.38 (p<0.001), 0.23 (p<0.001), respectively. And they're all significant. Thus, hypothesis HB1a ~ HB1c was supported.

In table 6, The procedure recommended in the literature (Wen et al., 2004) was used for mediating effect test.

Firstly, the relationship between the independent variables (immersion-related gamification, Social-related gamification, achievement-related gamification) and the dependent variable (knowledge-seeking behavior) was tested, and the results showed that the regression coefficients of each variable reached a significant level.

Secondly, the correlation between the mediating variable (self-determination) and the independent variable (immersion-related gamification, Social-related gamification, and achievement-related gamification) was tested (Model 12, Model 13, and Model 14). The regression coefficients were 0.43 (p<0.001), 0.55 (p<0.001), and 0.29 (p<0.001), respectively. To the level of significance. Thus, hypothesis H2a ~ hypothesis H2c was supported.

Thirdly, the relationship between the mediating variable and the dependent variable was tested (Model 7), and the regression coefficient was 0.62 ($p < 0.001$), reaching a significant level. Thus, hypothesis HB3 was supported.

Finally, the relationship between the independent variable, the mediator variable, and the dependent variable was verified. According to the regression results, when the independent variables and mediating variables entered the regression equation together, the relationship between immersion-related gamification, Social-related gamification, achievement-related gamification, and knowledge-seeking behavior was not significant (Model 8, Model 9, and Model 10), indicating that there was a complete mediating effect. Thus, hypothesis HB4a~hypothesis HB4c was supported.

6. Conclusion and Discussion

6.1. Conclusion

Immersion-related gamification, Social-related gamification, and achievement-related gamification have positive and significant effects on knowledge-seeking behavior and knowledge-seeking behavior, respectively, with different intensities. Specifically, the more interaction with immersive gamification features (e.g., changing avatar, personal keywords, and homepage), the more likely it was to promote knowledge-seeking behavior and knowledge-contributing behavior. The higher the degree of interaction with social-related gamification functions (such as answering questions, commenting, replying to private messages, and following), the deeper the participation in the Zhihu social circle. Zhihu users were more likely to show curiosity, eagerness, thirst for knowledge, and behaviors of contributing knowledge. The higher the level of achievement-related gamification (i.e. focus on salt, level, badge), the more likely users were to engage in knowledge-seeking and knowledge-contributing behaviors. Specifically, the level of user interaction with gamified features has a significant impact on knowledge-seeking behavior and knowledge-seeking behavior, respectively.

Immersion-related gamification, Social-related gamification, and achievement-related gamification exert influence on users' knowledge-seeking behavior and knowledge-contributing behavior through self-determined mediation as follows

(i) Self-determination fully mediated the effects of immersion-related gamification, social-related gamification, and achievement-related gamification on users' knowledge-seeking behavior. This suggested that gamification affected knowledge-seeking behavior mainly because it affected the level of self-determination of users. The reason for this result might be that the introduction of immersion-related gamification, Social-related gamification, and achievement-related gamification has greatly enhanced the interaction between users, systems, and users, including changing avatars, home pages, replies, and private messages. Thus, there was forming two-way communication. This was helpful for users to master the knowledge of the search field, provided users with efficient search strategies, helped users to screen out quick search paths, and ask friends with rich search experience for help. These stimuli directly led to changes in users' inner state, such as autonomy, relatedness, competence needs satisfaction, and then led to users' autonomous delivery behavior, that is, knowledge-seeking behavior.

(ii) Self-determination partially mediated the influence of immersion-related gamification, social-related gamification, and achievement-related gamification on users' knowledge contribution behavior. As expected, linked to the interactive user generated by gaming sense, independent sense, feeling and sense of purpose, and indirectly by basic psychological needs the autonomic motivation (Bravo, Catalan, and Pina, 2021), the research also concluded that gamification not only directly affects the knowledge contribution behavior but affected the knowledge contribution behavior of users through the intermediary mechanism. The possible reason was that in Zhihu, a platform where people freely expressed their opinions, users were encouraged by three aspects of gamification to answer other people's questions without restraint, and they won praises and comments. Likes and comments stimulated the inner changes of users, such as making users feel supported by others, that is, meeting the relatedness needs in self-determination. Users made knowledge contributions after chasing medals, and the stimulation of medals made users feel that they have performed well, which led to the satisfaction of independent achievement needs and then stimulated the behavioral results of knowledge contributions. Zhihu's gamification also inspired unfettered expression among users. In the process of contributing knowledge free of charge, users feel that themselves. This stimulated the satisfaction of users' autonomous needs and promoted more knowledge contribution behaviors.

6.2. Research Contribution and Practical Implication

The theoretical significance mainly lies in enriching the mechanism of gamification affecting user knowledge search behavior and knowledge sharing behavior. A new mediator variable was introduced to explore the effectiveness of gamification from the perspective of user-autonomous decision-making.

As pointed out by Koivisto and Hamari (Koivisto and Hamari, 2019), gamification research mainly focused on the fields of education/learning and health/exercise, which led to imbalanced views on the actual working ways of gamification. In particular, the application of gamification research on social Q&A platforms in China is insufficient. The research filled the gap by providing empirical evidence of gamification effects in the context of the Zhihu platform.

In this area, most of the existing research focused solely on the impact of badges or used a small number of game elements -- primarily points, badges, and leaderboards -- as limitations to general gamification research (Banerjee, Bhattacharyya, and Bose, 2017). Therefore, the research improved the understanding of the gamification theme by examining three gamification dimensions, including a more diverse set of game elements (i.e., avatar, the home page, points, badges, likes, and attention).

Despite various measures taken by platform operators, users of social Q&A platforms tend to contribute insufficient knowledge of Q&A platforms. Facing this challenge, platform managers focused on finding ways to incentivize solvers to make voluntary knowledge contributions. The research proposed and empirically tested hypotheses about the effectiveness of gamification mechanisms on user knowledge-seeking and knowledge contribution through self-determination. The results have shown that the combination of platform and gamification explained the knowledge-seeking behavior and knowledge contribution behavior of users on gamified social question-answering platforms. In addition, according to Wang Nan (Wang et al., 2022), the relationship between knowledge contribution and knowledge search was also explored. The results have shown that the knowledge-seeking behavior of online community users has a positive impact on their social capital, which was further positively correlated with their knowledge-contribution behavior and helped platform managers to promote knowledge-contribution behavior from the perspective of promoting knowledge-seeking. In the research, the models validated contributed to future research in this research area.

6.3. Limitation and Future Research

Limitations and future research directions were mainly reflected in the following aspects: First, this study did not explore the interaction between the dimensions of immersion-related gamification, Social-related gamification, and achievement-related gamification. Future research further explored the impact of different combinations of the three gamification on knowledge-seeking behavior and knowledge-contribution behavior. Secondly, the research mainly data collected by questionnaire survey based on the principle of availability, which affected the applicability of the research conclusions. Future research could expand the survey scope and realize the diversification of samples to obtain more abundant and comprehensive information. Thirdly, the cross-sectional research design used in this study to verify the causal relationship between variables has certain limitations. In the future, longitudinal studies could be conducted to further explore the changes in the long-term application of gamification on knowledge-seeking behavior and knowledge-contribution behavior after some time. Finally, self-determination was a multidimensional concept, including autonomy and belongingness needs and motivations. Each dimension has different effects on knowledge-seeking behavior and knowledge-contribution behavior. Future research could explore the role of each dimension of self-determination separately.

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