A Study on User Adoption Behavior of Popular Science Short-form Videos: Postprint

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Date: 2023-03-24T00:00:00+00:00

Abstract

Technological advancements have positioned content sharing via media information technology as an emerging research focus. Grounded in the UTAUT-2 model and the Heuristic-Systematic Model, this study examines science popularization short videos as its research subject, investigating the factors influencing usage intention and usage behavior by considering both content and technological dimensions. Analysis of 1127 valid survey questionnaires reveals that short video usage habits exert a positive influence on both usage intention and usage behavior regarding science popularization short videos, while entertainment motivation demonstrates a stronger effect on user adoption intention than the expectation of acquiring scientific knowledge. These findings suggest that the production of science popularization short videos should align with the media usage habits of short video users, enrich content value within limited durations, and systematize fragmented content through collections and similar formats; enhance account attractiveness and construct emotional connections with users to bolster user stickiness and consolidate fan bases; and leverage international short video platforms to expand overseas markets for technology-related short video content.

Full Text

Exploring User Adoption Behavior of Science Popularization Short Videos

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Abstract: The advancement of technology has made content sharing through media information technology a new research hotspot. Based on the UTAUT-2 model and the Heuristic-Systematic Model, this study examines science popularization short videos as its research object, investigating the factors influencing

users' willingness and behavior to use such videos from both content and technical perspectives. Analysis of 1,127 valid survey questionnaires reveals that short video usage habits positively influence both the willingness and actual behavior to use science popularization short videos. Furthermore, entertainment motivation has a greater impact on user adoption intention than the expectation of acquiring scientific knowledge. This suggests that science popularization short videos should align with users' media consumption habits, enrich content value within limited durations, and systematize fragmented content through series and collections. Enhancing account appeal, building emotional connections with users to strengthen user stickiness, and consolidating fan bases are also recommended. Additionally, leveraging international short video platforms can help expand the overseas market for science and technology short videos.

Keywords: science popularization short videos; UTAUT2.0 model; heuristic-systematic model; adoption behavior

Since 2016, when platforms such as Kuaishou and Douyin entered the internet user landscape, short videos have become an important channel for users to access content and entertainment by utilizing life-relevant scenarios and diverse presentation styles. According to the 50th Statistical Report on China's Internet Development released by CNNIC, as of June 2022, China's short video user base reached 962 million, representing the most significant growth with an increase of 28.05 million users since December 2021, accounting for 91.5% of all internet users [1]. The development of short videos has not only created a new information reception channel but has also substantially transformed users' information consumption habits. The commercialization of 5G technology is bound to further propel the development of short video dissemination. Moreover, as users demand greater value from short videos, the industry is undergoing an ecological transformation from "entertainment-oriented" to "knowledge-oriented" content [2].

Various data indicate that science popularization short videos, as a branch of knowledge-based content, are thriving on the Douyin platform. A joint report by Tsinghua University's School of Journalism and Communication and Douyin, titled *Knowledge Inclusion Report 2.0—Research Report on Short Videos and Knowledge Dissemination*, notes that Douyin's knowledge videos have accumulated over 6.6 trillion views, 146.2 billion likes, over 10 billion comments, and over 8.3 billion shares. In the comment sections of Douyin's knowledge videos, users have expressed "I learned something" 1.36 million times and "I understand" 2.54 million times. Chen Changfeng, Executive Dean of Tsinghua University's School of Journalism and Communication, suggests that these figures reflect users' satisfaction with learning diverse types of knowledge at extremely low time, space, and economic costs without leaving home. They represent users' response to the "DOU Knowledge Initiative" and signify the rising knowledge attribute and declining entertainment attribute of short video platforms [3].

In this context, the dissemination of science popularization content through

short videos has become viable. Science popularization researchers with professional expertise have entered the short video field, presenting scientific content in visualized forms. As an important manifestation of knowledge inclusion, science popularization short videos are becoming the main force in the future short video landscape. Meanwhile, relying on mobile terminals and network platforms, science popularization short videos have developed characteristics such as networked narrative discourse, storied narrative structures, and diversified narrative perspectives [4]. These changes have innovated the logic of knowledge production and communication, created greater possibilities for knowledge sharing, and expanded the space for knowledge dissemination.

Uses and gratifications theory indicates that users have both instrumental and social purposes when using media [5]. With the development of new media technologies, user experiences have undergone tremendous changes, and usage purposes have evolved accordingly. Based on the UTAUT2.0 model and incorporating the Heuristic-Systematic Model, this study simultaneously considers both technical and content dimensions to explore users' motivations for using science popularization short videos and their socio-psychological needs.

2 Science Popularization Short Videos: Conceptual Definition, Characteristics, and Social Significance

2.1 Concept and Characteristics of Science Popularization Short Videos

Although China's *Law on the Popularization of Science and Technology* (hereinafter referred to as the *Science Popularization Law*), passed and implemented on June 29, 2022, does not directly define science popularization, Article 2 states: "This Law applies to activities conducted by the state and society to popularize scientific and technological knowledge, advocate scientific methods, disseminate scientific thought, and promote the scientific spirit." This indicates that "science popularization" refers to activities aimed at disseminating scientific and technological knowledge, scientific methods, scientific thought, and scientific spirit to the state and society. The *Science Popularization Law* also requires institutions and groups in press and publication, radio, film, television, and culture to fulfill their responsibilities in science popularization publicity. As a primary channel for disseminating information and culture, science popularization short videos have undertaken the mission of promoting knowledge to the public. In 2014, the China Association for Science and Technology defined science popularization short videos as "short films, animations, documentary shorts, and other video works with a duration of 30 seconds to 20 minutes, produced by institutions or individuals with clear copyright and no intellectual property disputes, primarily aimed at popularizing scientific and technological knowledge, disseminating scientific thought, and promoting the scientific spirit" [6].

According to the *Research Report on the Development of China's Science Pop-*

ularization Industry, the main forms of China's science popularization industry with relatively rapid development and certain scale include: science exhibition and education, science popularization publishing, science popularization film and television, science popularization network information services, and science popularization education [7]. Compared with general science popularization forms, science popularization short videos possess the following characteristics: First, for audiences, the cost of accessing science popularization short videos is low. Users can access science popularization information from any location through the internet and mobile terminals without traveling to specific venues. Second, for content, the fragmented narrative of science popularization content aligns with audiences' habits of receiving information quickly and concisely, while science popularization short videos can balance content interestingness and knowledgeability. On one hand, the vivid and entertaining expression methods of short videos can effectively enhance the attractiveness of knowledge dissemination; on the other hand, science popularization short videos always prioritize knowledge popularization, maintaining distinct practical purposes and avoiding excessive entertainment of serious content to a certain extent. Third, for disseminators, science popularization short videos have smaller file sizes and shorter production cycles. Leveraging the highly timely short video platforms facilitates keeping up with current events and hot topics, making it easier to capture audience attention. Fourth, based on mobile network transmission, short videos have an extremely wide dissemination range. Users' forwarding and sharing of high-quality content can also increase the viewership of science popularization short videos and improve dissemination effectiveness.

2.2 Social Significance of Science Popularization Short Videos

Pierre Lévy points out that the development of virtual technology has created a new type of "knowledge space" that is completely different from the old linear, self-contained, and rigidly structured knowledge space [8]. Technological development has triggered a new round of knowledge production revolution, enabling more people to participate in the field of knowledge production, greatly liberating the possibilities of knowledge dissemination. The emergence of "knowledge influencers" is the best proof of this phenomenon. "The empowerment of new media technology provides a good opportunity for the role transformation of intellectuals" [9]. As a new communication technology, short videos have stimulated a new paradigm of science popularization knowledge production with a "civilian" posture, deconstructing the original boundaries between production and reception of science popularization knowledge, thereby making it possible to release new vitality into science popularization knowledge.

The development of new technology has enabled "the social dissemination capacity of knowledge and the level of knowledge sharing across society to be significantly enhanced" [10]. The development of science popularization short videos provides new possibilities for the sharing of science popularization knowledge. The emergence of science popularization short videos can, to a certain

extent, meet the needs of sharing, disseminating the achievements created by the science popularization community in a more timely and effective manner, thereby enhancing the science popularization literacy of the entire society and contributing to the goal of building a scientifically strong nation.

3 Literature Review

3.1 Science Popularization Short Videos: A Vertical Category of Knowledge Short Videos

Since 2014, with the popularization of mobile terminals and the development of 5G, big data, and algorithm technologies, science popularization short videos have attracted significant academic attention and become a hot topic for many scholars, yielding numerous research results in science and technology popularization and publicity. Regarding the development dilemmas and strategic explorations of science popularization short videos, Li Juxing et al. (2022) argue that current science popularization short videos face issues such as scattered content distribution, insufficient breadth and depth, and copyright disputes, proposing measures such as precise distribution and systematic production [11]. Li Xuedan (2022) suggests that while science popularization short videos have become an important carrier of knowledge dissemination, they have also triggered problems such as knowledge fragmentation, poor knowledge acquisition rates, and limited development models, proposing a series of measures to rebuild a sound knowledge production and dissemination order [12]. Yang Lin and Zhang Haoyun (2020), from the perspective of digital publishing, analyze the advantages and limitations of short videos in the digital upgrading of science popularization publishing, offering development suggestions for the next stage of content production and dissemination of science popularization short videos from three perspectives: divergent topic selection thinking, establishing and improving review and supervision mechanisms, and raising awareness of digital copyright [13].

Following the COVID-19 pandemic, responses to public health emergencies and health-related science popularization short videos have attracted high academic attention, with public health emergencies and health short video accounts becoming research hotspots. Yu Qianhui (2022) finds that science popularization communication during the COVID-19 pandemic exhibits characteristics of socialized communication channels, serious content, and diversified communication subjects, with an "online + offline" integrated communication mechanism becoming an effective form for promoting public participation in scientific processes [14]. Zhu Tong (2022), through analysis of the account characteristics and communication patterns of the Douyin account "Southern Health," points out that for health science popularization short videos to truly serve the people and improve national health literacy, they must strengthen information gatekeeping, create high-quality content, enrich content sections, and diversify discourse forms [15].

Existing research primarily explores production and communication strategies from the producer's perspective, without paying attention to audience acceptance habits and content preferences for science popularization short videos. Bernal pointed out that science communication must seriously consider the overall issue, which is not only a matter of communication among scientists but also includes communication with the public [16]. As a popular knowledge dissemination method, science popularization short videos can only achieve their popularization purpose and maximize communication effectiveness when audiences are willing to accept and adopt them and further deepen their understanding of scientific and technological knowledge through this medium.

3.2 User Adoption Process: Technology Acceptance and Information Processing

3.2.1 UTAUT2.0 Model: Technology Acceptance and Use Venkatesh's Unified Theory of Acceptance and Use of Technology (UTAUT) synthesizes eight theoretical models from sociology and psychology, including innovation diffusion theory, theory of reasoned action, motivational model, and theory of planned behavior. It proposes four factors influencing technology use: performance expectancy, effort expectancy, social influence, and facilitating conditions. The first three factors affect usage intention, while the last affects usage behavior, moderated by gender, age, experience, and voluntariness of use [17]. This theory has been widely applied to research on the acceptance and use of various new technologies, such as tourism information service platforms, science popularization social networking sites, and mobile learning apps. However, since UTAUT only considers external motivations and use value without accounting for users' own perceptual factors, Venkatesh extended UTAUT to better adapt to user behavior, proposing UTAUT-2 by introducing three new variables: hedonic motivation, price value, and habit [18].

UTAUT-2 redesigns the factors affecting technology acceptance and use, expanding on the original model. It posits that performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit influence technology use intention, while use intention, facilitating conditions, and habit are significantly correlated with actual technology use behavior (as shown in Figure 1 [Figure 1: see original paper]).

3.2.2 Heuristic-Systematic Model: Individual Information Processing Modes Psychologist Chaiken proposed the "Heuristic-Systematic Model" to explain two different information processing modes individuals employ when receiving information: heuristic and systematic [19]. "Heuristic cues" refer to intuitive judgments based on non-content, contextual clues that require less cognitive effort to assess information usefulness, while "systematic cues" refer to rational judgments based on content characteristics that require greater cognitive effort [20]. The Heuristic-Systematic Model provides theoretical explanations for individual information processing patterns in different contexts. For exam-

ple, Chen Minghong et al. (2015) argue that knowledge sharing satisfaction is simultaneously influenced by systematic and heuristic factors and has a significant positive correlation with continuous sharing intention [21]. Pan Xiaobo et al. (2015) suggest that consumers with high initial attitudinal ambivalence are more inclined to adopt systematic processing of word-of-mouth information, investing more effort in elaborately processing the content [22].

4 Theoretical Framework and Research Design

4.1 Science Popularization Short Video Usage Model

As a new type of scientific knowledge sharing platform, science popularization short videos possess strong technological affordance, reflecting the interaction between technology and individuals while considering satisfaction from both technical and content dimensions. Therefore, this study builds upon the Unified Theory of Acceptance and Use of Technology, combined with the Heuristic-Systematic Model and the characteristics of science popularization short videos, to develop a model for science popularization short video usage (as shown in Figure 2 [Figure 2: see original paper]).

Venkatesh et al. introduced the price-value factor in UTAUT-2, referring to consumers' cognitive trade-off between perceived benefits and monetary costs [17]. However, current network technology development has made access to science popularization short videos virtually cost-free, rendering this variable inapplicable to research on user adoption behavior of science popularization short videos. Therefore, this factor is removed from this study. Meanwhile, science popularization short videos essentially transmit information, with users accepting science popularization content based on network technology. According to the Heuristic-Systematic Model, different information processing modes also influence adoption to a certain extent. One is a heuristic-based intuitive processing mode, where users evaluate science popularization short videos through surface features such as account authority, video covers, situational contexts, and content duration. The other is a systematic-based rational processing mode, where users evaluate videos through content attributes such as richness and professionalism. Differences in account-content characteristics may influence user adoption of science popularization short videos, so this study incorporates it as a research variable in the user adoption behavior model. Integrating these factors, this study proposes a science popularization short video usage model.

The model primarily consists of three parts: factors influencing the adoption of science popularization short videos, individual attributes, and science popularization short video usage intention and behavior, with usage intention and behavior viewed as users' adoption intention toward science popularization short videos. In these three components, factors influencing the adoption of science popularization short videos serve as independent variables, individual attributes as control variables, and science popularization short video usage intention as the dependent variable. The factors influencing users' adoption intention to-

ward science popularization short videos include seven core independent variables: performance expectancy, effort expectancy, facilitating conditions, social influence, account-content, hedonic motivation, and habit. Individual attributes include three control variables: gender, age, and education level.

4.2 Variable Definitions for Science Popularization Short Video Influencing Factors

Combining the characteristics of science popularization short videos, this study extends the original definitions of influencing factors in the UTAUT-2 model to better fit the context of science popularization short video usage, improving the precision in describing factors influencing user adoption intention and facilitating further understanding and research. The variable definitions are shown in Table 1 .

Table 1 Variable Definitions

Variable	Definition in this study
Performance Expectancy	The degree to which an individual believes that using the system can improve work performance.
Effort Expectancy	The degree of ease associated with the use of the system.
Facilitating Conditions	The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.
Social Influence	The degree to which an individual perceives that important others believe he or she should use the new system.
Hedonic Motivation	The fun or pleasure derived from using a technology.
Habit	The extent to which people tend to perform behaviors automatically due to learning.
Account-Content	Extended from the Heuristic-Systematic Model. "Heuristic cues" refer to intuitive judgments based on non-content, contextual clues with less cognitive cost; "Systematic cues" refer to rational judgments based on content characteristics with more cognitive cost.

Additionally, individual attributes also influence the use of science popularization short videos to a certain extent, so personal attributes are categorized as non-core factors affecting science popularization short video usage.

4.3 Research Hypotheses

Based on the science popularization short video usage model, this study explores the influencing factors of science popularization short video usage and the degree

to which individual attributes affect user adoption, thereby proposing effective pathways for the development of science popularization short videos. The following hypotheses are formulated:

H1: Performance expectancy is related to adoption intention.
H2: Effort expectancy is related to adoption intention.
H3: Facilitating conditions are related to adoption intention.
H4: Social environment is related to adoption intention.
H5: Hedonic motivation is related to adoption intention.
H6: Usage habit is related to adoption intention.
H7: Account-content is related to adoption intention.
H8: Individual attributes are related to adoption intention.
H9: Adoption intention is related to adoption willingness.

Table 2 Variable Item Design

Variable	Item	Reference Source
Performance Expectancy	(I believe that following science popularization short videos) can provide a lot of additional knowledge. (I believe that following science popularization short videos) can broaden learning channels.	Venkatesh V. (2003) [18]; Bernal (2003) [16]

Variable	Item	Reference Source
	(I believe that following science popularization short videos) can help me better connect with other scholars.	
	(I believe that following science popularization short videos) can satisfy my fragmented learning needs.	
Effort Expectancy	The content of science popularization short videos is easy to obtain.	Venkatesh V. (2003) [18]
	Learning how to use science popularization short videos is easy.	
	The functions of science popularization short video platforms are easy to operate.	

Variable	Item	Reference Source
Facilitating Conditions	I have devices that support my access to and following of science popularization short videos.	Venkatesh V. (2003) [18]; Chen Changfeng (2022) [2]
	My devices can connect to the internet to support my use of science popularization short videos.	
	My current knowledge level supports my access to science popularization short videos.	
	Science popularization short videos are compatible with the use of other programs or applications.	
	I can obtain help from others when I encounter difficulties accessing science popularization short videos.	

Variable	Item	Reference Source
Social Influence	People around me are accessing and using science popularization short videos. The platform automatically recommends science popularization short videos to me. I believe this is a new learning method. Social development necessitates acquiring knowledge through multiple channels.	Venkatesh V. (2003) [18]; Kevin Robins et al. (2003) [8]
Hedonic Motivation	I find science popularization short videos interesting. Science popularization short videos reduce the difficulty of knowledge.	Venkatesh V. (2003) [18]; Yang Lin, Zhang Haoyun (2020) [13]

Variable	Item	Reference Source
	The way science popularization short videos transmit knowledge is comfortable.	
	Science popularization short videos transmit knowledge similarly to other entertainment short videos.	
Habit	I have a habit of using short videos.	Venkatesh V. (2003) [18]
	I feel it is necessary to access science popularization short video content.	
	I approve of using science popularization short videos to acquire knowledge.	
	It feels natural for me to acquire science popularization knowledge through short video platforms.	

Variable	Item	Reference Source
Account-Content	The science popularization achievements of account subjects influence following intention and behavior. Account follower count influences following intention and behavior. Video length influences following intention and behavior. Content richness and professionalism influence following intention and behavior. Video style influences following intention and behavior.	Li Yongning et al. (2019) [20]; Punj, G. (2012) [21]

Variable	Item	Reference Source
Adoption Intention	I am willing to access and follow academic short videos. I will recommend others to follow academic short videos. I believe short video platforms should feature richer and more diverse academic short videos.	Venkatesh V. (2003) [18]
Adoption Behavior	I will follow academic short videos. I will recommend academic short videos to people around me. I will frequently use academic short videos in the future.	Venkatesh V. (2003) [18]

5 Questionnaire Survey and Data Analysis

5.1 Questionnaire Design

Based on UTAUT-2 and the Heuristic-Systematic Model, a questionnaire survey on science popularization short video adoption behavior was designed for science popularization researchers. The questionnaire contains 38 items covering

individual attributes, influencing factors, usage intention, and usage behavior. Individual attributes use multiple-choice questions, primarily including gender, age, and education level. Usage intention and behavior adopt a five-point Likert scale, with 1 representing "strongly disagree" and 5 representing "strongly agree," statistically analyzed in ascending order from 1 to 5.

5.2 Questionnaire Distribution

Since the dissemination of science popularization short videos is built upon short video platforms, only audiences who access short video platforms will encounter science popularization short videos. To ensure questionnaire validity, the survey targeted short video users and employed online distribution. A total of 1,258 questionnaires were collected. After excluding questionnaires indicating no short video usage, 1,127 valid questionnaires were obtained.

5.3 Data Analysis

SPSS 22.0 software was used to conduct reliability analysis and regression analysis on the 1,127 valid questionnaires to ensure the credibility and validity of the survey data.

5.3.1 Reliability Analysis The reliability coefficient value is 0.872, greater than 0.8, indicating high reliability quality of the research data. Regarding "CITC values," the CITC values of all analysis items are greater than 0.4, demonstrating good correlation between analysis items and satisfactory reliability levels. In summary, the reliability coefficient of the research data is above 0.8, comprehensively indicating high data reliability quality suitable for further analysis.

5.3.2 Regression Analysis Through analysis of control variables, influencing factors, and usage intention, as well as analysis of usage intention, habit, and facilitating conditions on usage behavior, regression coefficients between control variables, independent variables, and dependent variables were calculated to demonstrate correlations among various factors.

(1) Regression Analysis of Demographic Variables on Student Short Video Usage

The model formula is: Usage Behavior = 3.918 - 0.075*Gender* + *0.198*Age - 0.171*Education. The model R^2 value is 0.088, meaning gender, age, and education can explain 8.8% of the variance in usage behavior. Multicollinearity testing reveals VIF values below 5, indicating no collinearity issues. The D-W value is near 2, suggesting no autocorrelation and that sample data are independent, indicating a good model.

Specific analysis shows: Gender has a regression coefficient of -0.075 ($t = -0.565$, $p = 0.573 > 0.05$), meaning gender does not significantly affect usage

behavior. Age has a regression coefficient of 0.198 (t = 3.083, p = 0.003 < 0.01), meaning age has a significant positive effect on usage behavior. Education has a regression coefficient of -0.171 (t = -1.681, p = 0.095 > 0.05), meaning education does not significantly affect usage behavior.

(2) Regression Analysis of Predictor Variables on Science Popularization Short Video Usage Intention

The model formula is: Usage Intention = 1.057 + 0.164*Facilitating Conditions + 0.346*Habit - 0.034*Account-Content + 0.137*Hedonic Motivation + 0.057*Social Influence + 0.022*Effort Expectancy + 0.078*Performance Expectancy. The model R^2 value is 0.390, meaning facilitating conditions, habit, account-content, hedonic motivation, social influence, effort expectancy, and performance expectancy can explain 39.0% of the variance in usage intention. Multicollinearity testing reveals VIF values below 5, indicating no collinearity issues. The D-W value is near 2, suggesting no autocorrelation and that sample data are independent, indicating a good model.

Specific analysis shows: Habit of using science popularization short videos (0.346) has a significant positive effect on usage intention, while facilitating conditions, account-content, hedonic motivation, social influence, effort expectancy, and performance expectancy do not significantly affect usage intention. Notably, facilitating conditions (0.164) and hedonic motivation (0.137) have greater influence on audience adoption intention than other factors. Since facilitating conditions and hedonic motivation are common characteristics of short video platform users, this indicates that more users encounter science popularization short videos based on their habits of using short video platforms.

(3) Regression Analysis of Usage Intention, Habit, and Facilitating Conditions on Science Popularization Short Video Usage Behavior

The model formula is: Usage Behavior = -0.370 + 0.683*Usage Intention* - *0.021*Facilitating Conditions + 0.413*Habit. The model R^2 value is 0.712, meaning usage intention, facilitating conditions, and habit can explain 71.2% of the variance in usage behavior. Multicollinearity testing reveals VIF values below 5, indicating no collinearity issues. The D-W value is near 2, suggesting no autocorrelation and that sample data are independent, indicating a good model.

Specific analysis shows: Usage intention (0.683) and habit (0.413) of science popularization short videos have significant positive effects on usage behavior, while facilitating conditions (-0.021) do not significantly affect usage behavior.

6 Conclusions and Reflections

The above research indicates that age and usage habit influence the willingness to use science popularization short videos, while both usage intention and habit positively affect usage behavior. Other factors do not significantly influence science popularization short video usage. The development of internet technology, the popularization of smart technology, and the low threshold of short video

platforms have enabled more people to access short videos, which explains why effort expectancy and facilitating conditions do not affect science popularization researchers' willingness to use science popularization short videos. Additionally, the research results show that among the influencing factors, hedonic motivation has a greater impact value than performance expectancy. This demonstrates that entertainment motivation influences user adoption intention more than the expectation of acquiring scientific knowledge, which is inseparable from the inherently entertaining nature of short video platforms. The limitations of past communication effects research centered on content dissemination suggest that the characteristics of communication technology itself significantly influence user motivation, reaffirming the validity of McLuhan's proposition that "the medium is the message."

Furthermore, the results show that age influences the willingness to use science popularization short videos, as people of different age groups have different habits regarding short video usage. Short video usage habits are positively related to both the usage intention and usage behavior of science popularization short videos. This implies that science popularization short videos can serve as an "entry point" to in-depth scientific knowledge, attracting short video users to participate in deeper content. This not only further demonstrates the value of short videos in "knowledge innovation" but also facilitates the dissemination of more in-depth scientific knowledge, thereby alleviating the problem of scientific knowledge "overload" to some extent.

These findings have enlightening implications for the dissemination of science popularization short videos. They should optimize themselves according to the characteristics of short video platforms and users' usage habits. The "short" duration characteristic of short videos is both a disadvantage and an advantage. Short duration does not mean content lacks value. On the contrary, for science popularization short videos, providing valuable points within fragmented time is key to attracting users. This characteristic should be leveraged to disseminate a valuable knowledge point within users' limited attention spans. For example, posing a question in one sentence, stating the application scenario in another, and presenting the solution in three sentences ensures the video length remains under 30 seconds while providing value in the solution. Using science popularization short videos as a "stepping stone" for knowledge popularization can enhance their appeal, enabling users to actively seek deeper understanding driven by interest and improving knowledge popularization effectiveness. Additionally, recognizing that science popularization short videos can lead to fragmented knowledge systems, content consolidation and optimization should be strengthened by publishing series videos and creating collections to systematically and completely present knowledge systems.

Content should cater to audience entertainment motivation by "softening" scientific knowledge through a more relaxed tone, enhancing account appeal and improving dissemination effectiveness. Account names, avatars, and video cover aesthetics can be unified based on content and narrative style to establish a

"persona" and enhance situational attributes. Alternatively, entertainment elements such as animations and background music can be incorporated, and small theater formats can be used to engage multiple senses in interpreting scientific knowledge, enriching content richness. Moreover, the immediacy and interactivity of short video platforms promote interaction between disseminators and users. Timely communication and question-answering can help users better understand scientific knowledge while further deepening their interest. For example, virtual singer characters like Luo Tianyi, Yuezheng Ling, and Yanhe interact with audiences through anthropomorphic images and interactive games, involving users in the communication process. Science popularization short videos can emulate this model by constructing virtual images to further break through circles and solidify fan bases. Virtual characters come with their own topic traffic, and the virtual characters in videos can both enhance interactive entertainment and easily establish emotional connections with users, making users develop feelings for the characters. This transforms passive acquisition into active attention, enhances users' enthusiasm for acquiring science popularization knowledge, and strengthens user stickiness through interaction with the characters.

In recent years, the thriving international short video markets of platforms like Snapchat, Instagram, and TikTok have also provided opportunities and stages for the external dissemination of science popularization short videos. TikTok has reached 3 billion global downloads, with monthly active users exceeding 1 billion [24]. Based on users' willingness and habits regarding short video platform usage, overseas short video platforms have opened new channels for the global dissemination of science popularization short videos, accelerating the speed of disseminating China's scientific research achievements to overseas audiences and helping to further optimize China's international image and enhance its international influence.

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Received Date:
Funding Project:
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Note: Figure translations are in progress. See original paper for figures.