

## Postprint: A Study on Value Co-creation of Knowledge Content in High-Engagement Popular Science Weibo Posts

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### Abstract

[Purpose/Significance] This study investigates how the Weibo platform promotes user participation and co-creates knowledge content value, providing optimization insights for libraries' knowledge services conducted on new media platforms. [Method/Process] Adopting the case study method and taking high-engagement science popularization Weibo posts as examples, this research crawls data including post content, comments, repost counts, like counts, etc., constructs a characteristic description framework to analyze knowledge content expression characteristics, and examines knowledge content interaction features between bloggers and users through means such as indexing and extraction. [Results/Conclusions] High-engagement science popularization Weibo posts exhibit expression characteristics such as concise or rich content with diverse media formats, rich sentence patterns, and emotional connotations, which effectively attract user participation. Among these, six types of interactions including answering user questions and correcting/refuting user viewpoints promote user knowledge contribution and achieve knowledge content value co-creation. The insights summarized for libraries conducting knowledge services on new media platforms include: libraries should identify user needs and enrich knowledge content expression forms, etc.; simultaneously, they should establish interaction mechanisms, actively address user knowledge needs, and establish an opinion leader image, etc.

### Full Text

## Research on Knowledge Content Value Co-creation in High-Engagement Popular Science Microblogs

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**Abstract**

**[Purpose/Significance]** This study examines how the Weibo platform promotes user participation and co-creates knowledge content value, providing optimization insights for libraries conducting knowledge services on new media platforms. **[Method/Process]** Using case analysis, this research crawled data from high-engagement popular science microblogs, including post content, comments, repost counts, and like counts. A feature description framework was constructed to analyze knowledge content expression characteristics, and indexing and extraction methods were employed to examine interactive features of knowledge content between bloggers and users. **[Result/Conclusion]** High-engagement popular science microblogs exhibit expression characteristics such as concise or comprehensive content with diverse media formats, rich sentence patterns, and embedded emotions, which effectively attract user participation. Six types of interactions, including answering user questions and correcting/refuting user viewpoints, promote user knowledge contribution and achieve knowledge content value co-creation. Implications for libraries' knowledge services on new media platforms include: in content construction, libraries should explore user needs and enrich knowledge content expression forms; simultaneously, they should establish interactive mechanisms to actively address user knowledge needs and cultivate opinion leader images.

**Keywords:** high engagement; value co-creation; user participation; library knowledge service; knowledge contribution

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As a virtual community platform incorporating user participation concepts, Weibo maintains a large user base. Despite competition from WeChat, short videos, and other media in recent years, Weibo features rapid information dissemination and timely content updates. As of March 2021, Weibo's monthly active users reached 530 million, accounting for approximately 53.6% of total internet users. Weibo serves as an important gateway for user participation, currently hosting many high-influence users such as People's Daily and China News Service. Recognizing that leveraging Weibo's advantages and influence enables rapid and efficient transmission of information, knowledge, and culture, numerous public and university libraries have opened Weibo accounts to provide knowledge services for the public and university communities.

Promoting resource sharing and providing knowledge services are important goals for libraries. Libraries' enthusiasm for building interactive platforms with users has never waned, as they continuously develop high-quality knowledge service platforms such as Weibo and WeChat official accounts. However, library operations on Weibo remain unsatisfactory, with persistent issues includ-

ing monotonous content, rigid formats, low update frequency, small follower counts, low user interaction levels, and minimal user-contributed knowledge content.

C. Prahalad and V. Ramaswamy proposed the value co-creation theory, arguing that value creation should be jointly achieved by enterprises and consumers. L. Vargo, J. Spohrer, P. Maglio, and Yang Kun have further explored this theory, noting that its essence lies in the process where all stakeholders jointly participate, collaborate closely, and leverage their respective strengths to create, deliver, and diffuse value across all stages. In the library and information science field, scholars such as S. Baron, M. Somerville, Shi Yanxia, Zhang Hui, and Liu Qiaoying have discussed applying this theory to library services through personalized services, collaborative relationships in public cultural systems, and library information resource construction.

According to value co-creation theory, knowledge content value co-creation refers to the process where supply and demand sides jointly participate and contribute knowledge to form comprehensive and systematic knowledge content that better solves problems or creates new knowledge products. Achieving knowledge content value co-creation reflects the value of library knowledge services based on new media platforms, requiring both library efforts and user participation. For years, scholars have explored user motivations, behavioral characteristics, and influencing factors for value creation in virtual communities. Regarding user participation motivations, research has focused on intrinsic and extrinsic motivations and their relationship with behavior, providing insights for virtual community construction. For instance, Hu Lei et al. found that four motivations—self-expression, information value, entertainment value, and celebrity attention—significantly influence Weibo user participation behaviors. Liu Hong et al. identified altruistic motivation, knowledge acquisition motivation, and social relationship motivation. Building on user motivation research, scholars began examining user participation behavioral characteristics and influencing factors to identify effective mechanisms for promoting user knowledge contribution. For example, Zhou Junjie et al. studied user interaction behavior characteristics in virtual communities, including basic and supplementary interactions, proposing methods such as creating active atmospheres and providing customized services to promote participation. Wang Ping'an et al. categorized user behavior characteristics into eight types including greeting/welcoming, regulation, and assistance. Zhang Xin classified user participation types in health virtual communities into ten categories including help-seeking, questioning, and description. Regarding influencing factors, Li Yang et al., based on the unified theory of acceptance and use of technology, found that performance expectancy, effort expectancy, and self-efficacy affect user knowledge contribution. H. M. Lai et al. explored incentive and internal community factors affecting knowledge sharing in virtual communities.

Existing research primarily uses questionnaires and regression analysis to explore value co-creation in virtual communities from the user perspective. Fewer

studies examine the information content level. Liang Wenling et al., based on a conceptual model of information quality's impact on users' continuous participation intention, revealed that information content quality, expression quality, and utility quality all positively influence community users' continuous participation intention, reflecting the important role of information quality in user knowledge contribution. To explore how libraries can achieve knowledge content value co-creation on new media platforms, this study employs case analysis, using social media big data platforms and web crawler technology to collect data from high-engagement popular science microblogs. From the information content level (microblog knowledge content expression characteristics) and user level (interactive characteristics of knowledge content between bloggers and users), this paper investigates how high-engagement popular science microblogs effectively attract user participation, incentivize knowledge contribution from both bloggers and users, and achieve knowledge content value co-creation.

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## 2. Data Acquisition for High-Engagement Popular Science Microblogs

Popular science microblogs are knowledge-sharing platforms where bloggers disseminate scientific spirit and popularize scientific knowledge to the public, attracting substantial follower attention and interaction. They share consistent goals with libraries conducting high-quality knowledge services on new media platforms. Engagement reflects the degree of information and resource sharing, decision-making participation, and organizational collaboration between cooperating parties. In high-engagement popular science microblogs, interactions between bloggers and users enable knowledge sharing and contribution, supplementing and expanding original knowledge to achieve knowledge content value co-creation. This study selects high-engagement popular science microblogs as research subjects, characterized by high user participation, substantial knowledge content contribution, and abundant interactions. Analyzing these microblogs is representative and can provide reference for library knowledge service development.

### 2.1 Screening High-Engagement Microblogs

On Weibo, user participation behaviors include reposting, liking, commenting, @ mentions, comment @ mentions, private messages, and other methods. From a quantitative perspective, these primarily involve like counts, repost counts, and comment counts. To screen high-engagement microblogs, this study references Wang Xincheng's calculation method for user interaction coefficients. To exclude result distortion caused by different bloggers' posting frequencies, this study defines engagement calculation as follows:

$$\text{Engagement} = \frac{\text{Likes}_i \times \alpha + \text{Reposts}_i \times \beta + \text{Comments}_i \times \gamma}{\text{Total Likes} \times \alpha + \text{Total Reposts} \times \beta + \text{Total Comments} \times \gamma} \quad (\text{Formula 1})$$

Referencing Chen Fang et al.'s microblog interaction index (attention, dissemination power, interest value) with weights  $\alpha$ ,  $\beta$ ,  $\gamma$  of 0.0915, 0.1598, and 0.1283 respectively, this study adopts these empirically derived weights and normalizes them so their sum equals 1. Through ratio calculation, the final weights are  $\alpha = 0.24$ ,  $\beta = 0.42$ , and  $\gamma = 0.34$ , enabling calculation of each microblog's engagement value. Microblogs with engagement values exceeding the mean are designated as high-engagement microblogs.

## 2.2 Data Collection and Preprocessing

This study searched for “popular science bloggers” on Weibo to obtain a recommended blogger list (which updates dynamically). Considering the bloggers' fields, follower counts, and interaction volumes, seven microblog accounts were selected across seven domains: medicine, biology, technology, history, geography, astronomy, and food. Original microblog data from September 1, 2019 to September 1, 2020 was crawled, including like counts, repost counts, comment counts, post content, and user comment content. “Dingxiang Doctor” had a “visible only for half a year” setting, but due to rich content and high interaction volume within that period, it was retained, resulting in 5,801 microblog data entries.

Next, crawled posts were manually screened, and the following categories were processed: 1. **Non-science content:** Posts containing personal daily life or mood sharing unrelated to science were removed. 2. **Promotional posts:** Lottery draws, advertisements, and other meaningless promotional activity posts were removed. Although such activities attract followers and 热度, they contain little substantive content and minimal knowledge contribution. However, “Sandi Ji” incorporated lottery draws while promoting science books, using them as attraction mechanisms with user interaction content that aligns with this study's objectives, so these were retained. 3. **Reposted content:** Bloggers sometimes repost others' or their own original posts for supplementary explanation or to express opinions. Relative to original posts, reposted content contains more uncertainty, mixing science and non-science content. To ensure accurate results, the crawler was set to collect only original posts, though a few reposts were still captured and subsequently deleted.

After screening, 5,759 microblog entries were retained. Using the engagement concept defined above, engagement values were calculated and sorted for each microblog. The mean engagement value was approximately 0.0003, so the top 1,871 entries with engagement values greater than 0.0003 were selected as high-engagement popular science microblog data for subsequent analysis. Statistics are shown in .

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### 3. Knowledge Content Value Co-creation in High-Engagement Popular Science Microblogs

#### 3.1 Analysis of Knowledge Content Expression Features

**3.1.1 Feature Framework Construction and Descriptive Statistics** Y. Zhang et al. established a content expression feature framework for WeChat official articles when studying factors influencing user participation. Referencing this framework and considering microblogs' diverse formats, high content freedom, and limited length, this study constructed a microblog knowledge content expression feature description framework. The framework analyzes six dimensions: post length, sentence pattern, media type, temporal characteristics, content creation method, and emotional expression, encompassing 26 secondary features. Specific definitions are provided in .

Based on this framework, 1,871 high-engagement popular science microblog entries were annotated to characterize their knowledge content expression features. Overall statistics are shown in .

**Post Length (A):**

- A1: Within 50 characters
- A2: 50-100 characters
- A3: 101-200 characters
- A4: 201+ characters

**Sentence Pattern Richness (B):**

- B1: Declarative sentences (subject-predicate-object structure, typically ending with periods, stating facts)
- B2: Exclamatory sentences (ending with exclamation marks to strengthen tone)
- B3: Interrogative sentences (ending with question marks)
- B4: Imperative sentences (with interactive calls or implications)

**Media Type (C):**

- C1: Text
- C2: Images
- C3: Videos
- C4: Audio
- C5: Topics (with double “#” symbols or topic tags)
- C6: Links

**Temporal Characteristics (D):**

- D1: Working hours (9:00-11:30 or 14:00-17:00)
- D2: Non-working hours

**Content Creation Method (E):**

- E1: Pure original content (scientific knowledge obtained through blogger's

research or study)

- E2: Reposting/quoting others (knowledge from other researchers shared on the platform)
- E3: Citing authoritative figures (materials from established experts, authors, or organizations)
- E4: Mentioning celebrities (connecting celebrities to described events)
- E5: Referencing hot topics (using social hot topics from internet or real life)
- E6: Quoting famous sayings/classical poetry

**Emotional Expression (F):**

- F1: Raising questions/doubts (questioning or correcting widely circulated viewpoints to stimulate discussion)
- F2: Positive emotions (humor through emojis or witty language; conveying hope and excitement through positive examples)
- F3: Negative emotions (words with sadness, dissatisfaction, opposition, aiming to lament, criticize, or condemn events)
- F4: Neutral emotions (content without obvious emotional characteristics)

**3.1.2 Discussion of Knowledge Expression Features Enabling Value Co-creation**

Analysis reveals that microblog content expression features distinct characteristics in text length, sentence patterns, and media types, playing important roles in promoting user participation. This study summarizes the following features:

1. **Concise or Comprehensive Content with Diverse Media Formats.** In the era of fragmented reading, concise content allows users to immediately focus and grasp core knowledge. Supplementing with multimedia such as topics, images, and audio enhances visual experience and quickly captures interest. Conversely, comprehensive popular science content combined with videos, animations, or knowledge expansion links can more thoroughly present knowledge, helping users understand content and meet their knowledge needs. Based on comprehensive understanding, users are prompted to think, repost, like, and comment, achieving knowledge content value co-creation.
2. **Rich Sentence Patterns with Embedded Emotion.** Knowledge learning is often dry; simple declarative sentences make content more tedious. Using interrogative, exclamatory, or imperative sentences enriches emotional expression and adds interest. Interrogative sentences raise questions that stimulate user thinking and questioning; exclamatory sentences highlight key points to attract attention; imperative sentences create calls to action. Rich sentence patterns combined with positive, humorous language create a harmonious atmosphere that fully mobilizes user participation activity.
3. **Diverse Content Creation Methods.** Original content dominates (88.88%), offering novelty and uniqueness derived from the blogger's learn-

ing and thinking, providing new perspectives. Appropriately citing authoritative figures, celebrities, high-quality content from others, and famous sayings enhances content authority and quality. High-quality content better attracts user participation and builds trust.

Additionally, most posts are published during non-working hours, enabling users to access latest content during leisure time and join knowledge exchanges.

### 3.2 Analysis of Knowledge Content Interaction Features

The previous section examined knowledge content expression features at the information level to explore how high-engagement popular science microblogs attract participation. This section analyzes interaction features at the user level to examine how interactions between bloggers and users promote joint participation and knowledge contribution.

Interaction behaviors include liking, reposting, and commenting. While liking and reposting increase post 热度 and express appreciation, from a knowledge content perspective, blogger-user interactions primarily occur through comments. Liking and reposting don't involve knowledge content exchange, so this analysis focuses on comment content.

**3.2.1 Interaction Types: Description and Statistics** In Weibo comments, interactions between bloggers and users fall into four categories: blogger comment supplementation, blogger reply to users, user comment on blogger, and user reply to users, as shown in [Figure 2: see original paper].

The dominant interaction is user comments on bloggers, followed by user-to-user comments, with blogger comment supplementation being the least frequent. Analyzing communication patterns revealed that five bloggers (“NASA Enthusiast,” “China National Geography,” “Salzburg’s Fish,” “Heritage Master,” and “Constantine”) primarily use images, text, and videos with relatively simple interactions. In contrast, “Dingxiang Doctor” and “Sandi Ji,” focusing on medicine and biology, generate multi-type interactions. Therefore, interaction types for these two bloggers were classified and statistically analyzed:

#### **Blogger Interaction Types:**

1. Answering user questions
2. Correcting/refuting users
3. Supplementing knowledge content
4. Polite replies
5. Other

#### **User Interaction Types:**

1. Asking questions
2. Answering other users' questions
3. Refuting or questioning viewpoints

4. Disseminating microblog content
5. Other

Detailed interaction type definitions are provided in .

Overall, bloggers primarily answer user questions (56.83% of replies), followed by polite replies (24.75%). Among user interactions, the “other” category is large, mainly comprising emotional expressions or experience recollections (approximately 55% of comments based on Baidu AI sentiment analysis). “Disseminating microblog content” is also common, mostly generated when users select “comment while reposting.” Additionally, “answering other users’ questions” shows moderate volume, while “refuting/questioning viewpoints” is relatively low, indicating users prefer answering questions over refuting others.

Comparing Dingxiang Doctor and Sandi Ji: Dingxiang Doctor, despite fewer posts, shows high interaction because content relates to daily life and health, easily attracting discussion. When content contradicts users’ existing knowledge, they raise questions, resulting in 1,351 instances of “users refuting blogger or other users.” This interaction type effectively stimulates user exchange and knowledge contribution. Conversely, Sandi Ji, though posting more content, generates relatively less user-contributed knowledge, possibly because the blogger answers many questions and focuses on professional biological knowledge that some users lack expertise to question.

**3.2.2 Discussion of Knowledge Interaction Features Enabling Value Co-creation** Table 6 shows that users contribute high-quality knowledge during interactions. The following six interaction types involve knowledge content exchange and promote participation and contribution, summarized in :

1. **User Questioning → Blogger/User Reply:** When users ask questions, bloggers provide answers, supplement new knowledge, meet knowledge needs, and encourage users to actively raise doubts.
2. **Blogger Correcting/Refuting User Viewpoints:** During knowledge exchange, user 质疑 attracts blogger attention. As science content initiators, bloggers sometimes correct/refute user viewpoints, sharing more knowledge.
3. **Blogger Polite Reply:** Bloggers play “knowledge producers” roles, but sometimes provide inaccurate content. When users point out errors, polite replies give psychological satisfaction and incentivize repeated participation.
4. **User Answering Other Users’ Questions:** In user-to-user interactions, users act not only as knowledge recipients but also as contributors, answering questions and expanding knowledge.
5. **User Supplementing Knowledge Content:** When blogger content is incomplete, users supplement relevant knowledge, playing “knowledge

expanders.”

6. **User Refuting Other Users:** Users refute questionable viewpoints from other users, promoting knowledge exchange and sharing.

To verify, Dingxiang Doctor’s microblog on eye health knowledge was analyzed. Regular font indicates original blogger knowledge, bold italics represent new knowledge created through user-blogger comments, and underlined portions represent new knowledge from user-user exchanges, as shown in [Figure 3: see original paper]. This demonstrates that blogger-user knowledge exchange effectively promotes knowledge content value co-creation.

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## 4. Implications for Library Knowledge Service Development

Existing research primarily uses questionnaires and regression analysis to explore strategies for promoting user participation and knowledge contribution from the user perspective, with limited research on the information content level. Based on extensive microblog and comment content, this study analyzes from the information content level (through the constructed microblog knowledge content expression feature framework) and user level (through six interaction types), finding that rich expression forms attract participation and interest, and that these interaction types incentivize knowledge contribution, thereby achieving knowledge content value co-creation. Bloggers primarily play knowledge content producers, disseminating culture and knowledge based on available resources to continuously enhance knowledge content value. Users play not only knowledge recipients but also contributors and expanders. This section summarizes implications for library knowledge services on new media platforms from content construction and interaction mechanism perspectives.

### 4.1 Implications for Knowledge Service Content Construction

1. **Explore User Needs and Select Appropriate Themes.** Library knowledge services cover broad content, currently including event promotion, routine notifications, book recommendations, and resource recommendations on Weibo. Users show particular interest in collection recommendations and reading promotion themes, while WeChat focuses more on resources, services, and work dynamics, with users paying attention to specific activity content. Theme selection largely determines participation enthusiasm. In popular science microblogs, life-relevant themes like health and diet better stimulate user exchange and discussion. Maslow’s hierarchy of needs indicates that human needs continuously grow. Libraries should fully explore user needs, develop user profiles, understand user preferences through identity, interaction behavior characteristics, and comment content to identify knowledge demands. Using subject librari-

ans' expertise to conduct interviews and surveys helps identify knowledge service themes that align with user needs.

- 2. Enrich Knowledge Content Expression Forms to Attract Participation.** Knowledge is professional and abstract; plain narrative expression reduces user acceptance. Analysis of high-engagement popular science microblogs shows that knowledge content expression features—concise/comprehensive length with media assistance, rich sentence patterns with embedded emotions—enrich article emotions, add interest, reduce dryness, attract interest, make knowledge easier to absorb, lower knowledge acquisition costs, enhance emotional experience, and incentivize thinking and participation.
- 3. Deepen Knowledge Content and Improve Content Quality.** Popular science microblogs attract substantial followers and interaction mainly because they disseminate rich, meaningful knowledge. Library knowledge services are often limited to library work-related scopes with insufficient depth, poorly attracting participation and knowledge contribution. Deep knowledge mining increases novelty. Advances in natural language processing, machine learning, and text mining provide effective means for libraries to conduct knowledge mining. Through knowledge organization and indexing of collected resources, implicit knowledge can be deeply analyzed and maximally externalized, discovering “knowledge islands,” establishing knowledge associations, and providing users with deeper, more valuable knowledge content to attract participation. Additionally, cited knowledge must be well-founded; referencing authoritative figures and celebrities enhances accuracy and credibility, building user trust.

#### 4.2 Implications for Knowledge Service Interaction Mechanism Establishment

- 1. Actively Address User Knowledge Needs to Enhance User Relationships.** Analysis shows that when bloggers answer user questions and politely reply to users (who correct or supplement knowledge), they improve knowledge systems and promote user contribution, achieving value co-creation. In library knowledge services on new media platforms, staff should constantly monitor user feedback, actively answer questions, and encourage users who contribute knowledge. This satisfies users' knowledge needs during learning while also meeting psychological needs and self-value experiences, making users feel they are both knowledge recipients and expanders/contributors, creating harmonious exchange atmospheres, enhancing librarian-user relationships, and promoting knowledge contribution.
- 2. Cultivate Opinion Leader Images to Incentivize Participation.** Users sometimes express inaccurate or erroneous viewpoints. Libraries have responsibilities to correct and refute these, creating authoritative

knowledge service platforms. In new media platforms, users may, due to conformity psychology, first review others' comments before expressing personal views, potentially being misled by incorrect knowledge. Libraries should promptly refute erroneous viewpoints, contributing knowledge while establishing opinion leader images that influence users and incentivize them to participate in knowledge discussions, express personal views, refute others, and share knowledge.

- 3. Appropriately Guide Topics to Stimulate User-to-User Exchange.** On the foundation of fostering good discussion atmospheres, guiding civil and polite user exchanges reinforces the image of high-quality knowledge service platforms. Libraries can appropriately guide topics, initiate questions and discussions, encouraging users to think deeply. Active user participation and exchange can spark intellectual 碰撞, stimulating communication enthusiasm. Through knowledge exchange, each participant's knowledge breadth expands, creating a virtuous cycle across the platform and achieving knowledge content value co-creation.

Additionally, the "Heritage Master" blogger often combines field investigations with platform content publication, integrating online and offline activities to 拉近 user distance and enhance user stickiness. Many libraries have achieved excellent knowledge service results through online-offline integration. For example, Nanjing University Library's "September Welcome Season" and "October Reading Festival" activities integrated official Weibo promotion with offline events, attracting thousands of student participants and effectively expanding the audience for library knowledge education. Beijing Normal University's "Reading Time: The Beauty of Twenty-Four Solar Terms" activity integrated online-offline approaches with "intangible cultural heritage" themes, promoting Chinese traditional culture and attracting many users. Online-offline integration creates multiple interaction channels that better promote user participation and knowledge exchange.

However, this study has limitations. User participation also includes private message exchanges and private reposts, which cannot be accessed by researchers. Many participation behaviors are invisible to other users, such as "friends-only viewing." Therefore, not all participation methods were discussed, representing a limitation. Future research will explore more perspectives on attracting and promoting library user knowledge contribution for value co-creation.

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## Author Contributions

Cui Jingfeng: Data collection, indexing, analysis, and paper writing  
Zheng Dejun: Paper concept and framework design, paper revision  
Hong Cheng: Data collection and indexing  
Xia Wenjuan: Data indexing

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## English Abstract

**[Purpose/Significance]** Studying how the microblog platform promotes user participation and co-creates knowledge content value can provide optimization enlightenment for libraries' knowledge services on new media platforms. **[Method/Process]** This article adopts case analysis, taking high-engagement popular science microblogs as examples, crawling data including post content, comments, reposts, and likes, constructing a feature description framework to

analyze knowledge content expression characteristics, and analyzing interactive features between bloggers and users through indexing and extraction. **[Result/Conclusion]** High-engagement popular science microblogs have expression characteristics of concise or full content with diverse media forms, rich sentence patterns, and embedded emotions, effectively attracting user participation. Six interaction types including answering user questions and correcting/refuting user viewpoints promote user knowledge contribution and realize knowledge content value co-creation. Enlightenment for libraries' knowledge services on new media platforms includes: in content construction, libraries should explore user needs and enrich knowledge content expression forms; simultaneously, they should establish interactive mechanisms, actively solve users' knowledge needs, and establish opinion leader images, etc.

**Keywords:** high engagement; value co-creation; user participation; library knowledge service; knowledge contribution

*Note: Figure translations are in progress. See original paper for figures.*

*Source: ChinaXiv — Machine translation. Verify with original.*