Analysis of Knowledge Output from an Interaction Perspective (Postprint)

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Abstract

For a long time, knowledge output has been regarded as a creative or applicative behavior. From the perspective of knowledge interaction and drawing on second language acquisition theory, this paper argues that knowledge output constitutes an important component of both the process and outcomes of knowledge interaction, holding significant positive implications for promoting and enhancing the quality of knowledge interaction. It not only facilitates the dissemination and innovation of knowledge, but also contributes to the improvement and reconstruction of users' knowledge systems, while helping to stimulate and refine their learning motivation. Therefore, it is necessary to adopt various technological and incentive measures to assist users in outputting knowledge, promote the mutual transformation between explicit and tacit knowledge, and advance the conversion of procedural knowledge to declarative knowledge.

Full Text

An Analysis of Knowledge Output from an Interactive Perspective

Abstract: For a long time, knowledge output has been regarded as either a creative or applicative behavior. This paper, from the perspective of knowledge interaction and drawing on second language acquisition theory, argues that knowledge output constitutes a crucial component of both the process and outcome of knowledge interaction. It plays an extremely positive role in promoting and enhancing the quality of knowledge interaction, not only facilitating the popularization and innovation of knowledge, but also contributing to the improvement and reconstruction of users'knowledge systems and helping to stimulate and refine their learning motivation. Therefore, it is necessary to adopt various technical and motivational measures to assist users in outputting knowledge, promote the mutual transformation between explicit and tacit knowledge, and advance the elevation of procedural knowledge to declarative knowledge.

Keywords: knowledge interaction; output hypothesis; knowledge transformation

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In 1985, Dr. Merrill Swain, a senior professor at the Ontario Institute for Studies in Education at the University of Toronto and vice-chair of the International Association of Applied Linguistics, proposed the "Output Hypothesis" in her research on second language acquisition. She argued that output serves four functions in language learning: increasing fluency of expression, enhancing learners' sensitivity to linguistic features, helping learners test their hypotheses about language, and facilitating learners' reflection, control, and internalization of language. In fact, output is critically important not only for second language learning but for all forms of knowledge acquisition. For learners, output aids in the memorization and mastery of knowledge; helps integrate and reflect upon existing knowledge resources to promote learning efficiency; enhances communication among learners, broadens perspectives, and compensates for deficiencies in one' s own knowledge structure; and facilitates the mutual transformation between explicit and tacit knowledge as well as the conversion of declarative knowledge into procedural knowledge.

From the perspective of knowledge services, knowledge output represents the main component of both the process and outcome of knowledge interaction. Interaction refers to communication and mutual engagement, and knowledge interaction in the field of knowledge services denotes the process of mutual influence among knowledge entities, between humans and knowledge, and among people themselves. Its essence is communication, and its fundamental purpose is to achieve effective knowledge input. The reason knowledge output constitutes the main part of the interaction process is that communication itself is a continuous process of knowledge input and output. Through interactive behaviors such as comparison, debate, and verification between outputted knowledge and inputted knowledge, understanding gradually deepens and connects with one' s existing knowledge system, culminating in higher-level, relatively complete and mature knowledge output. This higher-level, relatively complete and mature knowledge output represents the outcome of knowledge interaction.

Based on its form, knowledge output can be categorized into three types: application, dissemination, and re-creation. Application involves the transformation and enhancement from explicit to tacit knowledge. Dissemination refers to proactive behavior stemming from recognition of the knowledge content, such as various forms of forwarding or sharing. Re-creation occurs when users produce new creations during the process of receiving knowledge. According to the relationship between outputted knowledge pieces, knowledge output can be divided into four types: original, derivative, adaptive, and interpretive. Original works are independently completed by the author. Derivative works are created based on previous works. Adaptive works are created based on existing content; although they involve subsequent creators' contributions, the fundamental mode of expression of the original work' s ideas remains unchanged, including

adaptations, translations, revised editions, anthologies, abstracts, excerpts, and any modifications of previous works that can generate new creations. Interpretive works represent personal understanding of existing knowledge, which may involve debate or commentary, reflection or revision. This paper focuses primarily on adaptive and interpretive knowledge output.

1.1 Knowledge Output in Knowledge-Knowledge Interaction: Facilitating Popularization and Innovation

As the term suggests, knowledge-knowledge interaction refers to the process of treating knowledge as the main agent of interaction, wherein knowledge entities mutually influence each other through communication, exchange, creation, and sharing. The interacting knowledge pieces may or may not have inherent relationships, and they interact through "humans" as translators, triggering various changes in different knowledge entities—whether correction, development, validation, or the establishment of relationships. For example, establishing the association between migraines and magnesium deficiency can be seen as a case of knowledge interaction. Throughout this continuous process of knowledge system reconstruction and integration, boundaries are further expanded, promoting the development of the entire knowledge system.

At this level, the process of knowledge interaction is also a continuous process of knowledge output, manifesting as the transformation from explicit to tacit knowledge. Adaptive knowledge output provides readers with contextualized expression, truly meeting users' intellectual and expressive needs, improving their efficiency in knowledge reception, and achieving knowledge popularization. Interpretive knowledge output conducts multi-faceted commentary, verification (confirmation or falsification), explanation, or extension of knowledge in original works, enhancing accuracy, deepening internalization, and promoting further development and continuous innovation of knowledge.

1.2 Knowledge Output in Human-Knowledge Interaction: Promoting User Knowledge System Improvement and Reconstruction

Human-knowledge interaction refers to the totality of learners' responses to knowledge and the subsequent series of interpretations, analyses, evaluations, and inferences triggered in knowledge itself, along with explanations of the evidence, concepts, methods, standards, and contexts underlying such judgments. These changes in knowledge, through internalization, establish new connections with learners' existing knowledge, causing shifts in their original knowledge systems and thereby establishing new organizational procedures for acquired knowledge, leading to knowledge reconstruction. Through human-knowledge interaction, the transformation from explicit to tacit knowledge is further facilitated, laying a solid foundation for human-human interaction. Simultaneously, it helps knowledge providers adjust their forms of expression, correct flawed knowledge, and extend and develop new knowledge, thereby enhancing the providers' own knowledge level.

At this level, knowledge interaction manifests as a form of cognitive interaction, within which knowledge output involves two modes of thinking: divergent thinking and convergent thinking. The former manifests as questioning, clarifying, citing, defending, and refuting, while the latter manifests as supporting, negotiating, synthesizing, evaluating, and reflecting. Knowledge output at this level directly examines knowledge itself from different perspectives—whether for verification, updating, or correction—establishing connections with existing knowledge, promoting the improvement of users' knowledge systems, and achieving reconstruction of their own knowledge frameworks.

1.3 Knowledge Output in Human-Human Interaction: Stimulating and Refining User Learning Motivation

In knowledge services, human-human knowledge interaction is the most complex form. Individuals differ vastly in learning and comprehension abilities, knowledge structure and level, knowledge background, social relationships, and personality traits, resulting in tremendous variation in interaction methods, effectiveness, and output results. For instance, interactions between individuals with similar knowledge levels but different knowledge densities can yield substantial gains for both parties, though their respective gains differ—the party with lower density is more susceptible to assimilation by the party with higher density. Interactions between individuals with similar knowledge levels and densities produce the most intense collision effects, yielding the fastest knowledge enhancement for both parties. Interactions between individuals at adjacent levels provide greater benefits for the lower-level party, such as teacher-student interactions.

The complexity of human-human knowledge interaction determines that knowledge output in this process exhibits characteristics of diversity, immediacy, and fragmentation. Diversity is reflected in output forms including emotional output, information output, and behavioral output. Immediacy is reflected in the predominance of real-time output in both synchronous and asynchronous interactions. Fragmentation is reflected in the limited and piecemeal nature of output content during interaction, with these characteristics of immediacy and fragmentation being most evident in WeChat groups. Knowledge output at this level, through direct communication among users, more easily facilitates knowledge sharing, collaboration, and evaluation with other users, and more readily enhances cohesion among learning community members, thereby stimulating and refining users' learning motivation.

2. Measures to Enhance Knowledge Output

2.1 Enhancing Comprehensible Input

American language educator Krashen first proposed the Input Hypothesis in his research on second language acquisition, arguing that comprehensible input is a crucial condition for language acquisition. "Language input is the foundation

of language output," and "only with sufficient input can appropriate output be produced." Input should possess four characteristics: comprehensibility, interest and relevance, non-grammatical sequencing, and sufficient quantity. Therefore, providing users with adequate comprehensible input is the prerequisite for achieving high-quality knowledge output.

The provision of comprehensible input in knowledge services primarily involves three aspects. First is user profiling. In terms of user data collection, it is essential to value not only relatively stable static information such as basic attributes and commercial attributes, but also constantly changing dynamic information, including reading behavior, writing behavior, interaction behavior, and payment behavior—particularly interaction data (mainly time, behavior, and output data). Based on this foundation, user tagging should be performed by analyzing user identifiers, time (timestamps + duration), behavior types, and touchpoints (URLs + content) to determine tags and corresponding weights, adjusting them dynamically according to changes in dynamic information data to complete precise analysis of user characteristics. Through user profiling, the knowledge content of comprehensible input required by users can be determined.

Second is scenario-based expression. Building upon precise user profiling, this involves determining the expression methods required by users for different application scenarios. Users' static data determines their intellectual needs (mental images, concepts, and propositions), while dynamic data determines their required forms of expression. Taking *Journey to the West* as an example, for child users, the text should be adapted according to children' s basic cognition, highlighting Sun Wukong' s fearlessness or the perseverance of the four pilgrims. For adults with certain religious knowledge, the original text can be presented as is, allowing users to fully understand the propositions of the Daoist internal alchemy school. Immersive reading of paper books requires presenting not only the original text but also all poems, annotations, prefaces, and postscripts to provide readers with complete content. Conversely, companion listening to audiobooks not only eliminates the need for such complete presentation of the original text but also requires certain adaptations to facilitate users' superficial comprehension.

Finally is knowledge association, which refers to the totality of various relationships among knowledge points. By establishing a knowledge indexing system that covers all attributes of knowledge, knowledge resources can be integrated to construct three-level knowledge association systems: between knowledge and knowledge, between knowledge and people, and among people themselves. This effectively addresses issues of information overload, knowledge fragmentation, and information silos, while simultaneously achieving knowledge navigation and providing users with complete knowledge systems to promote effective internalization and absorption of knowledge.

2.2 Enhancing Multi-Level Interaction System Design

From the perspective of knowledge service operations, interaction includes knowledge interaction and platform interaction. Knowledge interaction refers to the process of mutual influence among knowledge entities, between humans and knowledge, and among relevant individuals, with communication as its essence and effective knowledge input as its goal. Platform interaction, a concept specific to the Internet domain, refers to the behavioral process where two or more parties alternately input and output, with experience as its essence and enhanced user satisfaction as its goal. As mentioned above, knowledge output constitutes the main component of both the process and outcome of knowledge interaction; therefore, the prerequisite for enhancing knowledge output is the design of a multi-level interaction system.

First, the knowledge interaction system should be designed according to the three levels of knowledge-knowledge, human-knowledge, and relevant human-human interaction. The prerequisite for designing this system is proper knowledge indexing, covering both knowledge and human dimensions. Through complete knowledge indexing, various indicators such as co-citation, coupling, relevance, word co-occurrence, breadth, and depth can be used to determine potential relationships between knowledge pieces—including equivalence, hierarchical, graded, containment, causal, sequential, co-citation, coupling, parallel, and contradictory relationships—as well as their strength, closeness, and distance. This enables the construction of diverse knowledge association systems with centralized, vertical, and planar dimensions. Through indexing of knowledge-related users, their roles in knowledge learning (e.g., contributors, participants, or observers) can be determined, and user characteristics can be accurately analyzed based on interaction data, constructing a human-human association system based on knowledge. This lays the foundation for constructing a human-knowledge association system while creating conditions for successful community operations. Upon establishing knowledge-knowledge and human-human association systems, the relationships between knowledge and people can be explored to further improve the human-knowledge association system. Leveraging the navigation function of knowledge association, this helps users improve their knowledge systems, stimulates proximity or collision effects of knowledge, promotes more interactive behaviors, strengthens users' internalization, absorption, verification, or falsification of new knowledge, and enhances interaction quality.

Second is friendly platform interaction design, which should consider four main aspects: (1) understanding user group characteristics and product usage features, including users' learning abilities, consumption motivations, usage habits, relevant skills, usage frequency, competitor product usage, and goal achievement pathways; (2) optimizing user experience by fully understanding user needs and pathways to need fulfillment to satisfy both psychological and practical requirements; (3) establishing effective user feedback and response mechanisms to provide timely emergency solutions; and (4) implementing error-tolerant design to reduce users' unconscious erroneous operations and facilitate error correction.

2.3 Properly Handling and Balancing the UGC-PGC Relationship

UGC refers to User-Generated Content, while PGC denotes Professionally Generated Content. Each production method has distinct advantages: UGC features high user participation, low production costs, and broad content coverage, but suffers from uneven quality and potential copyright risks; PGC involves higher production costs but ensures content quality and easier copyright control. From an interaction perspective, UGC content production is highly random with obvious fragmentation characteristics and close relationships to original works, whereas PGC content production is relatively systematic with stable supply but looser connections to original works compared to UGC. As the content industry develops, some high-quality UGC is evolving toward PGC, while PGC producers encourage or even directly engage in UGC production to expand the audience and interaction volume for professional content. Therefore, to improve the quantity and quality of knowledge output, it is essential to properly handle and balance the relationship between these two production methods from the perspective of their respective advantages, disadvantages, and development trends.

First, encourage UGC production through three approaches: (1) designing friendly interaction functions, content production assistance features, and collaborative promotion functions to provide greater convenience for user content production; (2) implementing sound copyright management methods that support user copyright authorization within a controllable scope, encouraging users to produce adaptive and interpretive works without concerns; and (3) establishing reasonable incentive and benefit distribution mechanisms to stimulate user production enthusiasm.

Second, select and cultivate promising UGC content producers to transition toward PGC production, enhancing their content professionalism and stability. This requires regular comprehensive analysis of content output during knowledge interaction processes to identify potential content producers, provide targeted guidance and necessary knowledge resources, and improve their production capabilities.

Third, assist PGC content producers in creating more UGC content by providing conveniences such as screening mechanisms, promotional resources, and external association resources to expand content influence.

2.4 Constructing Reasonable Incentive and Benefit Distribution Mechanisms

Knowledge output modes roughly include application, dissemination, and re-creation. Application focuses on practical operation, manifesting as the transformation from explicit to tacit knowledge—this stage of output does not appear in knowledge services. Dissemination behavior does not produce new knowledge but helps expand the influence of knowledge, such as sharing to third-party media platforms or forwarding to friends. Re-creation emerges after users' in-

ternalization, absorption, and reflection, formally manifesting as adaptation or interpretation of original works and essentially representing the mutual transformation between explicit and tacit knowledge.

Output content forms include systematic content and fragmented content. The former features strong systematicity and professionalism, weak dependence on original works, and low output frequency. The latter has high output frequency, strong dependence on original works, but weak systematicity and professionalism.

Due to differences in output modes and content presentation forms, users' contributions to knowledge value enhancement and their invested costs vary significantly. Therefore, it is essential to establish reasonable incentive and benefit distribution mechanisms to increase users' output enthusiasm, ensure fair treatment based on different levels of investment, and enhance both the quantity and quality of user interactions.

First, establish diverse cash revenue pathways and marketing promotion methods for systematically outputted content, along with corresponding resource support, to directly create and expand users' profit income. Cash revenue pathways include advertising revenue, subscription revenue, and sales-sharing revenue (i.e., sharing profits from driving sales of original works). Resource support includes both knowledge service platform resources and relevant partner resources, with corresponding resource investment allocated according to output content quality and user investment to maximize user benefits.

Second, provide reinforcement incentives and support measures for fragmented output content. The former includes point systems, cash discounts, special privilege designs, and interactive feedback, while the latter determines corresponding support measures based on the quality and quantity of fragmented output to guide improvements in output quality and stability.

Implement targeted differentiated measures for the three knowledge output modes to promote mutual transformation between explicit and tacit knowledge, improve users' knowledge structures, and expand knowledge dissemination scope. For application-oriented knowledge output behavior, encourage and assist users in organizing their insights to transform tacit knowledge gained through practice into explicit knowledge, further enhancing their knowledge literacy. For dissemination-oriented knowledge output behavior, provide corresponding rights or cash rewards (e.g., revenue sharing) based on dissemination efficiency to encourage more dissemination output. For re-creation behavior, provide rich and diverse cash revenue pathways, marketing promotion methods, and supporting promotional resources to stimulate more creative behavior.

As both process and outcome of knowledge interaction, knowledge output holds significant importance for both users and knowledge service platforms. It helps stimulate and refine users' learning motivation, contributes to the improvement and reconstruction of users'knowledge systems, and facilitates the popularization and innovation of knowledge itself. For knowledge service platforms, knowledge

output serves not only as a means of user acquisition and retention but also as a way to integrate content production and operational advantages across different media—including books, journals, newspapers, the Internet, and radio and television—to truly achieve integrated transformation and development. Therefore, from the perspective of knowledge service platform operations, multiple measures should be adopted to promote knowledge output.

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