# Research and Practice on WeChat Mini Programs for Disciplinary Knowledge Services: Postprint

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**Date:** 2023-04-01T16:15:57+00:00

## Abstract

[Purpose/Significance] Through relevant research and practice, this study provides ideas and references for utilizing WeChat Mini Programs to facilitate disciplinary knowledge services.

[Method/Process] This paper analyzes the characteristics and current service status of WeChat Mini Programs, proposes a user-centered framework and model for disciplinary knowledge services featuring "large environment, deep discovery, small front-end, rich ecosystem", and investigates service content from the perspectives of information services, knowledge services, and personalized services. A case study of the "Stem Cell Assistant" WeChat Mini Program demonstrates the feasibility of this approach.

[Results/Conclusion] With reasonable planning and scientific layout, the Mini Program ecosystem can support rich applications of disciplinary knowledge services, thereby supporting users' scientific research and innovation activities from the mobile end.

## Full Text

## Preamble

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**Abstract:** [Purpose/Significance] This study provides ideas and references for leveraging WeChat Mini Programs to enhance subject knowledge services through relevant research and practice. [Method/Process] We analyze the characteristics and current service status of WeChat Mini Programs, propose a user-centered framework and model for subject knowledge services characterized by "big environment, deep discovery, small frontend, and rich ecology," and investigate service content from the perspectives of information services, knowledge services, and personalized services. Using the "Stem Cell Assistant" WeChat Mini Program as a case study, we demonstrate the feasibility of this approach. [Result/Conclusion] With proper planning and scientific layout, the Mini Program ecosystem can support rich subject knowledge service applications, enabling mobile support for users' scientific research and innovation activities.

**Keywords:** subject knowledge service; WeChat Mini Program; knowledge discovery; science and technology big data; knowledge graph
**Classification Number:** G250
**DOI:** 10.13266/j.issn.0252-3116.2020.14.006

The deepening of knowledge services and the rapid proliferation of mobile internet have intensified users' demand for knowledge, driving the transformation of subject service models. Mobile internet has significantly expanded the scope of subject knowledge services, extending service reach beyond temporal and spatial constraints into all user activities. Through mobile terminals, users can conveniently access various explicit and implicit information and knowledge, extract subject knowledge content, and find solutions to problems. Ubiquitous subject knowledge service models have improved service quality and elevated service connotations.

In today's rapidly evolving mobile information technology landscape, ubiquitous subject knowledge services have diversified in form and tool, including APP clients, micro-websites, and WeChat Official Accounts. These differ in service approach, operating platform, development cost, and user experience. On January 9, 2017, WeChat Mini Programs (hereinafter referred to as "Mini Programs") entered the public eye as a strategic product of WeChat—a platform-level innovation of epoch-making significance, designed for massive services and rich applications. Users can access services instantly by scanning or searching, without installation or download, realizing the dream of "apps at your fingertips."

## 2. Value and Necessity of Subject Knowledge Service Mini Programs

Mini Programs efficiently establish links between research users and subject knowledge services. Under this innovative service model, scenario-based requirements are transformed into service entry points, helping users extract information and knowledge from subject knowledge bases to solve research problems. The necessity of developing subject knowledge service Mini Programs is elabo-

rated below from four aspects: user needs fulfillment, knowledge service system, technical development characteristics, and operating platform support.

### 2.1 Meeting the Demand for "Specialized, Fast, and Lightweight" Mobile Knowledge Services

In ubiquitous knowledge environments, user demands continue to upgrade, posing higher requirements and more severe challenges for subject knowledge services. Users not only need problem-solving capabilities but also seek more efficient, lightweight, and professional solutions. Mini Programs, with their scenario-oriented knowledge demand, low consumption, no constraints, and minimal information interference, align well with these new demands and shoulder the mission of new knowledge services.

### 2.2 Complementing Other Service Methods to Form a Ubiquitous Subject Knowledge Service System

**2.2.1 Mini Programs as Streamlined Versions of APP Applications** Subject knowledge service APPs serve stable user groups and high-frequency application scenarios with "large and comprehensive" services, embodying the "service is king" principle and becoming the mainstream approach for creating "one-stop" mobile knowledge services. In contrast, subject knowledge service Mini Programs target low-frequency scenarios to build long-tail applications that complement APPs. Mini Programs simplify information architecture, opening the shortest path for users to access services. Functionally, they discard complexity for simplicity, focusing on core needs for in-depth development, thereby improving the quality and timeliness of subject knowledge services. They also leverage WeChat's strong dissemination power to drive traffic to APPs.

**2.2.2 Mini Programs Empowering WeChat Official Accounts** Subject service Official Accounts are micro-content platforms "centered on information," providing micro-reading services through short messages, web articles, and short texts. Limiting subject knowledge services to limited information release not only ignores users' diversified needs but also wastes WeChat's technical capabilities and user resources. Subject knowledge service Mini Programs can build rich mobile applications, greatly expanding Official Accounts' service scope. They support more information behaviors such as retrieval, screening, and utilization, enhancing users' ability to process subject information. Leveraging big data environments, they provide deep knowledge services based on subject knowledge bases. The seamless connection between Official Accounts and Mini Programs extends application scenarios and enhances service capabilities.

### 2.3 "Short, Flat, and Fast" Technical Development Characteristics

WeChat's official developer tools serve as the basic platform for Mini Program development, matching front-end UI component libraries and providing rich API

open interfaces. Therefore, compared with APP applications, subject knowledge service Mini Programs have lower development thresholds, smaller economic costs, and shorter development cycles. Mini Programs adapt to different mobile platforms and systems automatically, loading faster than knowledge service micro-websites without repeated page refreshing, thus delivering superior user experiences.

### 2.4 Strong Operating Platform Support

Subject knowledge service Mini Programs reside within WeChat, enjoying vast user resource guarantees that effectively expand knowledge service interpersonal networks and amplify knowledge dissemination effects. With 41 traffic entry points, Mini Programs expand the radius of knowledge services. WeChat's official data analysis tools facilitate developers' grasp of operational data and profiling of subject users, providing a basis for personalized services.

## 3. Related Research and Service Status Analysis

Mini Programs have attracted attention in the information service field. The author selected CNKI as the search database, but direct searches using "WeChat Mini Program" and "subject knowledge service" as themes yielded no effective results. The search strategy was adjusted to combine "WeChat Mini Program" with terms for knowledge service institutions such as "library," "library and information science," "scientific research," "publishing," "journal," "database supplier," and "consulting company." By November 30, 2019, 62 results were obtained, with annual publications peaking at 28 in 2018 and 25 in 2019. This indicates that research on Mini Program-based subject knowledge service theories and methods remains scarce. Further analysis reveals that research focuses on planning service paths for integrating Mini Programs with various knowledge service institutions. In contrast, these institutions have richer practical implementations. Combining web verification and Mini Program searches, this paper lists some typical applications, as shown in Table 1 .

**Table 1. Information and Knowledge Services Based on WeChat Mini Programs**

| Service Type | Representative Cases | Main Functions |
|---|---|---|
| Legal Knowledge Service | "Fa Xin" (People's Court Press) [9] | Legal literature and case data display, one-stop push based on legal knowledge system, association discovery between legal knowledge and cases, intelligent legal Q&A, litigation fee and damage calculation [9] |
| Pharmaceutical Knowledge Service | "Renwei Clinical Assistant" (People's Health Publishing House) [10] | Disease knowledge push based on core knowledge base, typical case display, intelligent medical knowledge query, medical calculation, thematic aggregation, medical dictionary [10] |
| Institutional Knowledge Service | Institutional Repository Mini Program (Xiamen University Library) [17] | Scholar information query, achievement claim and query/correction, highly-cited paper query, academic business card sharing [17] |
| Computer Science Knowledge Service | "Research Vein" (Tsinghua Science and Technology Big Data Research Center) [19] | Intelligent retrieval of papers, news, and experts, academic conferences, personalized intelligent recommendation, expert academic profiling, selection of highly-cited scholars and papers [19] |

| Service Type | Representative Cases | Main Functions |
|---|---|---|
| Agricultural Knowledge Service | "Agricultural Professional Knowledge Service" (Agricultural Information Institute) [20] | Display of agricultural scientific achievements, release of authoritative data reports, agricultural knowledge search, agricultural knowledge service topics [20] |
| Research and Collaborative Learning Knowledge Service | "CNKI Research Platform" [22] | Dynamic, interactive, graph-based reading, research-based inquiry deep learning, one-stop creation and submission, academic social networking, personal knowledge management [22] |
| Digital Resource Supplier | Paper detection, paper search | CNKI "Paper Detection," Wanfang "Paper Detection," "PaperYY Paper Check," "iDATA Literature Search" [21], "WOS Core Journals" [21] |
| Publishing Institution | Previous reading, promotion, online marketing, information release | "Robotics and Intelligent Systems" [5], "Qingdao Gardens" [8], "China Medical Science" [5], "Gardening World" [5], "China Standardization" [6], "CNKI JAS Journal" [6] |
| Library | Basic services | University libraries: "Peking University Library," "East China Normal University"; Public libraries: "National Agricultural Library," "Shanghai Huangpu District Library" [12-16] |

| Service Type | Representative Cases | Main Functions |
|---|---|---|
| Scientific Research Management | Research management, academic exchange, instrument management | "Xueshi Cloud," "Research Travel," "Academic Conference PLUS," "Kexiu," "Lab Manager," "Research Circle" |

Publishing institutions' knowledge services focus on original content production and knowledge supply, market-oriented and balancing economic benefits. Therefore, most publishing institution Mini Programs provide information services such as previous reading, promotion, online marketing, and information release [5]. Meanwhile, some authoritative publishers integrate professional publishing resources to develop subject knowledge service Mini Program products, such as "Fa Xin" by People's Court Press [9] and "Renwei Clinical Assistant" by People's Health Publishing House [10].

As academic information service institutions, libraries implement knowledge services based on professional service capabilities and rich existing literature resources [11]. Due to their public welfare and service nature, library Mini Programs typically offer basic services such as collection inquiry, reservation and renewal, information reading, and book recommendation [12]. Some libraries map knowledge services onto traditional services—for example, Xiamen University Library built an institutional repository Mini Program for knowledge asset management, laying a foundation for data mining and value-added services [17].

Research institutions have launched mobile knowledge service products to meet information service needs in research management, conference information release, achievement transformation, and academic exchange, while focusing more on providing distributed and embedded knowledge services for scientific innovation and strategic decision-making [18], such as "Research Vein" by Tsinghua University's Science and Technology Big Data Research Center [19] and "Agricultural Professional Knowledge Service" by the Agricultural Information Institute of the Chinese Academy of Agricultural Sciences [20].

Digital resource suppliers' Mini Programs mostly provide tool-type applications based on literature digital resources, effectively used for routine businesses like paper detection and search, such as the "iDATA Literature Search" Mini Program [21]. CNKI launched the "Research Platform" knowledge service Mini Program, extending literature and knowledge services into readers' personal research and learning activities. However, CNKI and Wanfang have built numerous industry and subject knowledge service platforms whose service layers are almost exclusively PC-based applications or APP software, with few Mini Program applications [22].

Through investigation and analysis, although the above institutions have devel-

oped some knowledge service Mini Program demonstrations, most applications remain resource-based, information-based, and tool-based, with literature and information services at their core, making it difficult to support users' knowledge application and innovation processes. The author believes that providing quality subject knowledge services through Mini Programs requires focusing on key issues such as service models, application strategies, and service content, and clarifying macro-level thinking to effectively guide application practice.

## 4. Service Framework and Model

Guided by fundamental theories of knowledge services and knowledge organization, and addressing the demand for "specialized, fast, and lightweight" ubiquitous subject knowledge services, we construct a subject knowledge service framework based on WeChat Mini Programs characterized by "big environment, deep discovery, small frontend, and rich ecology." The framework emphasizes the diversity of subject resources in big data environments, integrates generic knowledge discovery process models with knowledge service application modules, incorporates mobile knowledge services into research activity processes, establishes connections between services and users [23], designs multi-level service content, fully utilizes Mini Program technical characteristics, adopts a "decentralized" service model, and outputs information and knowledge.

As shown in Figure 1 [Figure 1: see original paper], the framework consists of three organizational layers: data layer, discovery layer, and Mini Program service layer. The data layer collects subject resources and sequences data; the discovery layer organizes data resources and performs knowledge mining to achieve data knowledgeization and knowledge regeneration, forming subject knowledge bases; the Mini Program service layer pushes knowledge discovery results to mobile terminals and interacts effectively with users. As the top-level application of the knowledge service system, Mini Programs must be based on subject resource databases and supported by subject knowledge bases to meet users' multi-level knowledge needs and effectively integrate users, resources, and services on mobile terminals.

### 4.1 Big Data Environment Layer Provides Data Guarantee for Mini Programs

The wheels of big data have propelled us into the era of data-intensive scientific research, where data has become the knowledge foundation for all disciplines [24]. Big data-driven deep knowledge services with subject knowledge as content and problem-solving as goals have emerged as a new engine for knowledge service innovation. Subject knowledge service Mini Programs should take big data thinking and concepts as the main thread, use science and technology big data resources as conditional guarantees, and accurately capture knowledge service demands [25]. The knowledge discovery system should integrate literature data, scientific data, industrial data, professional subject data, and network data released by research institutes, universities, technology enterprises, government

agencies, and the internet to collectively constitute a subject resource system that provides data support for the Mini Program service ecosystem. Mini Programs collect user behavior information to establish a mobile behavior analysis knowledge base, providing a data foundation for achieving precise services.

In practice, seamless connection and unified scheduling of Mini Programs with existing underlying databases is challenging. Since Mini Program frontends must use Tencent's own WeChat developer tools and be implemented based on the MINA framework, developers need to build a decoupled system architecture with front-end and back-end separation to maintain data and logic independence and achieve seamless connection between layers. Currently, RESTful-style APIs have become the best practice for front-end and back-end separation. For unified database scheduling, we can learn from the solution adopted by Xiamen University's institutional repository Mini Program, whose underlying database consists of multiple subsystems without consistent database architecture. Therefore, the Mini Program's data server application was developed using the Laravel framework to query and obtain required data from different databases of subsystems, thereby achieving unified scheduling of data from different sub-databases [17].

### 4.2 Deep Knowledge Discovery Layer Provides Technical and Methodological Support for Mini Programs

The knowledge discovery layer is the core of the entire framework, performing deep mining and association of resources from the data layer and pushing knowledge discovery results to the service layer to provide deep knowledge discovery service guarantees for Mini Programs. The knowledge discovery layer in the framework adopts key technologies and construction methods of knowledge graphs to support new services. Knowledge graphs provide effective methods for the expression, organization, management, and utilization of massive, heterogeneous, and dynamic big data [26]. Knowledge bases established through knowledge graphs, with semantic processing capabilities and open interconnection capabilities, generate high application value in specialized and intelligent subject knowledge services, as exemplified by the "Research Vein" WeChat Mini Program based on the AMiner computer science knowledge graph.

The system extracts and transforms multi-source heterogeneous data, extracting entities, relationships, and attributes from structured, semi-structured, and unstructured data to form knowledge, and performs symbolic, formalized, and patterned knowledge representation. Through knowledge fusion, knowledge is disambiguated and linked to enhance logicality and expressiveness. Knowledge reasoning rules and methods are applied to further mine and discover implicit knowledge about entities, attributes, relationships, and concepts. Automatic detection and manual assistance are used for knowledge verification and quality assessment. Finally, through knowledge association and mapping processing, professional subject knowledge graphs are constructed according to knowledge representation characteristics and service requirements, providing an engine for Mini Program knowledge services.

### 4.3 Service Layer Outputs Knowledge Discovery Results and Interacts with Users

**Small Frontend:** Focusing on core user needs to build lightweight applications in the service layer. To comprehensively meet user needs, subject knowledge service platforms or APPs typically provide full-chain knowledge services covering resource integration, knowledge integration, technology integration, and service integration to form complete solutions. However, the lightweight application characteristics of Mini Programs and the "use-and-go" service philosophy determine that a single Mini Program cannot carry overly complex applications. In mobile environments with fragmented time, users cannot immersively traverse all functions of the knowledge discovery system; information and function overload 反而会 reduce user stickiness. Therefore, individual Mini Programs should focus on performance rather than scale of subject knowledge services, concentrating on core needs of research users with simple functions and clear logic, avoiding the pursuit of comprehensiveness [6]. Complex knowledge services should be decomposed into small, simple task units for specific scenarios or needs, forming small and specialized [27], loosely coupled, and highly autonomous individual Mini Programs to achieve microservices.

**Rich Ecology:** Connecting services to layout a matrix of subject knowledge service Mini Programs. Layout of the Mini Program matrix essentially means assembling microservices, perfecting the service chain, building a multi-level Mini Program knowledge service product system, and constructing a service ecosystem. Within the Mini Program ecosystem, subject knowledge services are integrated and centralized to achieve the service goals of integrating resources, discovering knowledge, and pushing results. The subject knowledge service Mini Program matrix offers advantages such as multi-point reach, service connection, territory expansion, risk distribution, and increased exposure. The Mini Program matrix is not simply interconnection between applications; more importantly, it enables each Mini Program to carry different functions around specific businesses, with services coordinating and cooperating with each other, communicating through lightweight mechanisms according to business logic. For example, the Zhihu Mini Program ecosystem uses the "Zhihu Live" Mini Program as the core, connecting original website content transplanted Mini Programs ("Zhihu Hot List," "Zhihu University," "Zhihu Daily," "Zhihu Training Camp") and service extension Mini Programs ("Zhihu Quiz King," "A Place to Talk") to form the "Zhihu" knowledge service Mini Program product system.

## 5. Service Content

In mobile information space, we can use characteristics of users' knowledge utilization behavior to determine scenario-based needs, thereby mapping service content. The user knowledge utilization process includes acquisition, selection, absorption, utilization, and innovation from information to knowledge. User knowledge utilization behavior manifests as browsing, searching, selecting, and utilizing. Based on different service depths, this paper categorizes subject knowl-

edge service content into three types: information services, knowledge discovery services, and personalized services, enriching service content according to different user behavior patterns.

### 5.1 Subject Domain Information Services

**Subject Resource Integration:** Subject knowledge service Mini Programs should emphasize specialization and academic characteristics, integrating various data resources in specific subject domains and performing detailed information organization and classification according to subject knowledge organization systems for convenient user browsing.

**Subject Knowledge Retrieval:** Under the "use-and-go" service philosophy of Mini Programs, mobile retrieval naturally becomes a high-frequency application that significantly improves performance. Mobile retrieval for subject knowledge services differs from conventional information retrieval, emphasizing not only compliance with mobile retrieval behavior patterns but more importantly demonstrating intelligent and knowledge-based retrieval value. Mini Programs perform semantic retrieval based on subject knowledge bases, improving recall and precision rates.

### 5.2 Subject Knowledge Discovery Services

**Subject Knowledge Navigation:** Subject knowledge navigation breaks traditional knowledge classification and organization methods, collecting and analyzing information to cluster and reorganize knowledge by discipline or theme, providing links and guidance services for users. Mini Programs display knowledge navigation maps and knowledge maps for user interaction, guiding them to obtain knowledge efficiently and conveniently.

**Subject Knowledge Graphs:** By establishing associative links between knowledge, fragmented data is organically organized, and visualization and knowledge representation technologies present large amounts of data in multiple forms to help research users find structures, features, patterns, trends, anomalies, or relationships in data [28].

**Subject Trend Tracking:** Subject knowledge service Mini Programs effectively integrate, display, and depict subject development dynamics and trends to form more targeted and directed knowledge service products, meeting research users' deep, forward-looking, and predictive knowledge needs and inspiring innovative research thinking.

### 5.3 Personalized Services

**Knowledge Space Management:** Subject knowledge service Mini Programs provide each user with a virtual space. Users can freely and quickly filter and aggregate data according to their needs, create topics of interest, and achieve personalized information self-organization to improve research work efficiency.

**Academic Profiling:** Subject knowledge service Mini Programs understand users' habits and interests from their characteristic data (such as usage history, behavior mining, feature classification, and feedback analysis) to build user profile models, tagging users with academic labels.

**Personalized Recommendation:** Academic profiling drives proactive services represented by personalized recommendations. Based on this, through pattern recognition and machine learning, the system analyzes and predicts users' interested knowledge domains, pushing relevant knowledge to research users according to their interest models [29], or finding users with similar interests through clustering, analysis, and association rules to push knowledge to users with similar needs [30]. Mini Programs improve support for user needs by providing personalized customization services. For example, the "Scientist Online" Mini Program supports users in subscribing to research fields of interest and proactively recommends expert information.

**Intelligent Q&A:** Deep intelligent Q&A systems at the knowledge level have become an indispensable part of artificial intelligence development [31]. Intelligent Q&A is a typical application of knowledge graphs, which provide high-quality knowledge sources for Q&A system implementation. Mini Programs provide more convenient Q&A entry points. The system accurately captures user search intentions, understands natural language questions, and returns answers directly to users through the Mini Program layer, such as the "Fa Xin Smart Answer" Mini Program launched by the People's Court.

## 6. "Stem Cell Assistant" Mobile Knowledge Service Practice

Stem cells are a hot topic and frontier in today's life science research, 孕育着 significant scientific breakthroughs and enormous industrial potential [32]. Big data-driven knowledge discovery and technological breakthroughs in the stem cell field are becoming new engines of scientific and technological innovation. To better utilize stem cell research big data, the Chengdu Library and Information Center of the Chinese Academy of Sciences and the Guangzhou Institute of Biomedicine and Health jointly developed the "Stem Cell Knowledge Discovery Platform" (URL: http://stemcell.kmcloud.ac.cn), providing "one-stop" knowledge services integrating science and technology big data aggregation, knowledge computing, and stem cell knowledge discovery for stem cell field users.

The Stem Cell Knowledge Discovery project team conducted a user experience survey of the platform at the "11th Guangzhou International Stem Cell and Regenerative Medicine Forum" on November 26, 2018. Statistics from 120 questionnaires showed that 72% of users believed the platform integrated rich subject data and provided powerful functions, but the existing service approach was single, supporting only PC desktop applications and failing to effectively meet users' ubiquitous knowledge service needs, such as: (1) timely access to stem cell field information and knowledge during fragmented time like experi-

ments and teaching intervals; (2) selective use of platform functions according to individual needs; (3) active information and service push to mobile terminals; and (4) knowledge sharing through WeChat dissemination. Addressing these urgent user needs, the research team applied the "big environment, deep discovery, small frontend, rich ecology" service model to develop the "Stem Cell Assistant" WeChat Mini Program as a mobile extension of the "Stem Cell Knowledge Discovery Platform." The Mini Program interface and entry are shown in Figure 2 [Figure 2: see original paper].

The "Stem Cell Assistant" Mini Program adopts a front-end and back-end separated architecture. Its front-end is built based on the MINA framework using WXML, WXSS, and JavaScript languages. The back-end system is implemented using the Python-based Flask framework, with RESTful-style APIs serving as back-end interfaces to transmit JSON data and achieve front-end and back-end response. The system uses Solr as the search engine and MySQL as the storage database.

### 6.1 Data Layer: Stem Cell Research Big Data Environment Provides Data Support for Mini Programs

In the stem cell field, scientific research big data is growing "explosively," characterized by huge volume, diverse types, complex relationships, and scattered sources. The system integrates multi-source data to build a stem cell research big database, integrating 16 types of research data including: (1) scientific literature such as papers, patents, standards, reports, and journals; (2) scientific activity information such as news, scholars, projects, and conferences; (3) industrial information such as policies, regulations, and pharmaceutical products; and (4) scientific data including scientific experiments, clinical trials, scientific instruments, experimental animals, and experimental reagents. Stem cell research involves multiple fields including "government, industry, academia, research, medicine, and application." Currently, the stem cell research database contains over 420,000 data entries, creating a big data environment and providing rich, high-quality data support for subject knowledge services based on Mini Programs.

### 6.2 Discovery Layer: "Stem Cell Knowledge Graph" Provides Deep Knowledge Discovery Service Guarantee for Mini Programs

The "Stem Cell Knowledge Graph," as a subject knowledge base, aims at knowledge application and service, delivering knowledge discovery results to the "Stem Cell Assistant" Mini Program. The discovery layer employs knowledge acquisition, representation, fusion, and verification technologies to provide deep knowledge discovery service guarantees from two aspects: knowledge connotation mining and knowledge semantic association. (1) Knowledge connotation mining guarantees knowledge point output at the Mini Program end: the system uses knowledge mining technology to extract domain knowledge entities from perspectives of concern to researchers such as scientific instruments, animal

models, experimental techniques, cell organs, and disease genes, revealing the knowledge connotation contained in stem cell field scientific and technological information in multi-dimensional and fine-grained ways. (2) Knowledge semantic association guarantees output of relationships between various information or entities at the Mini Program end: the system integrates scientometrics indicators and text mining technologies to establish semantic associations among various scientific and technological information and knowledge entities in the knowledge graph based on citation, acknowledgment, cooperation networks, and knowledge entity co-occurrence relationships.

### 6.3 Service Layer: Presenting Stem Cell Knowledge Discovery Results

**6.3.1 Streamlined and Clear Mobile Display and Release** The "Stem Cell Assistant" WeChat Mini Program presents integrated, associated, semantic, visualized, and personalized displays of data, results, and services based on the "Stem Cell Knowledge Graph" on mobile terminals. As a mobile application, the "Stem Cell Assistant" Mini Program emphasizes the value of lightweight applications, focusing on core needs of research data discovery and data acquisition. It provides three major functions: data display, intelligent retrieval, and personalized knowledge services (see Table 3 ), delivering "small, refined, specialized, and fast" subject knowledge services for researchers.

**Table 3. Functions of the "Stem Cell Assistant" WeChat Mini Program**

| Function Module | Description |
|---|---|
| Research Data Categorized Display | Provides categorized display of 16 types of stem cell field research data including papers, patents, scientific instruments, experimental animals, experts, institutions, policies, and products; supports WeChat sharing and collection management of interested data, directing users to the PC 端 to view original texts |

| Function Module | Description |
|---|---|
| Knowledge Graph Display | Provides multi-dimensional (e.g., scientific instruments, experimental animals, experimental protocols, experimental reagents, methods and techniques, cells, organs, diseases, genes) and fine-grained (knowledge entities) knowledge profiling of research data, enabling users to quickly grasp knowledge points contained in data without viewing original texts; provides precise filtering and visualized display functions |
| Personalized Services | Hot Topic Display, Visualized Search Results, Personalized Data Management, Personalized Intelligent Recommendation |

**6.3.2 Enriching Mini Program Applications to Build a Stem Cell Knowledge Service Ecosystem** In the future, the research team plans to build richer Mini Program applications based on the "Stem Cell Knowledge Graph" to form a Mini Program application ecosystem, including: exploring and expanding the "Stem Cell Frontier Hotspot Detection" Mini Program to display stem cell frontier topics from different levels such as international and national R&D priorities and key breakthrough directions of the Chinese Academy of Sciences; expanding the "Stem Cell Researcher Profile" Mini Program to create research output profiles for research institutions, scholars, and other innovation entities; and expanding the "Stem Cell Science Popularization" Mini Program to aggregate and display stem cell science popularization resources and information including popular science news, experimental videos, research images, and courseware. Through subsequent exploration and practice, we hope to achieve an entire Mini Program product system where stem cell series Mini Programs mutually drive traffic, forming a traffic pool, building a subject knowledge service brand, and providing more efficient and convenient services for stem cell research innovation activities and research management.

### 6.4 Mini Program Usage and User Evaluation

The "Stem Cell Assistant" Mini Program is promoted through two main methods: mass communication via internet media and targeted communication by subject librarians. Current target users are primarily researchers and graduate students from the Guangzhou Institute of Biomedicine and Health. According to statistics from WeChat's official "Mini Program Data Assistant": since the

trial operation of the "Stem Cell Assistant" Mini Program was announced on the Chinese Academy of Sciences official website on April 23, 2019, it has accumulated 479 users, 69 of whom have added "Stem Cell Assistant" to "My Mini Programs"; 33.9% of users have visited for more than 100 seconds; the Personal Center module's visit volume is second only to the homepage, making personalized functions a user focus; active users come from multiple regions including Guangzhou, Chengdu, Beijing, and Shanghai. The "Stem Cell Assistant" Mini Program has received positive reviews from numerous research users, who believe it provides "convenient, professional, precise, and efficient" data acquisition, information push, and knowledge discovery services for their research activities. It has become not only an "ubiquitous and accessible" research assistant but also an application demonstration of ubiquitous subject knowledge services.

## 7. Conclusion

This paper analyzes the necessity of providing subject knowledge services based on WeChat Mini Programs. Building on investigations of related research and service status, it identifies five urgent issues from the perspectives of service content, service audience, service depth, service approach, and service model. Targeted research is conducted around these key issues.

The article attempts to construct an innovative subject knowledge service framework based on the "small, refined, and specialized" characteristics of Mini Programs. Its features include: serving subject users oriented toward scientific research innovation; service content encompassing information services, knowledge services, and personalized services to meet users' multi-level needs; and in terms of service model, breaking the cognitive barrier that Mini Programs can only build small applications and tools, using Mini Program matrices to create service ecosystems and provide diverse services. This paper proposes a service strategy integrating Mini Programs with subject knowledge services—"big environment, deep discovery, small frontend, rich ecology"—which both reflects the value of lightweight applications and provides new perspectives and ideas for ubiquitous knowledge service theory and practice. The author abstracts and refines the basic elements, macro-level thinking, and application strategies of the service framework to be compatible with different subjects' knowledge service needs, giving it certain universality. Finally, the research team applies the research results to guide the development of the "Stem Cell Assistant" Mini Program, further proving the feasibility and practicality of the service framework, model, and strategies, with the aim of providing references for constructing similar knowledge service Mini Programs.

Through research and practice, the author finds that: (1) subject knowledge services need Mini Programs to help improve ubiquitous service systems; (2) with proper planning and scientific layout, the Mini Program ecosystem can also support rich subject knowledge services; (3) currently, similar research and typical demonstrations remain scarce, requiring extensive exploration and prac-

tice to continuously refine research conclusions. It is believed that in the near future, WeChat Mini Program-based subject knowledge services will become one of the important models of ubiquitous knowledge services, effectively supporting scientific research innovation activities.

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## Author Contributions

**Xu Yuan:** Proposed research methods, designed research scheme, wrote paper, designed case architecture, and discussed research ideas and plans.
**Hu Zhengyin:** Designed case architecture and discussed research ideas and plans, revised and finalized paper.
**Song Yibing:** Designed case architecture.
**Wu Xuan:** Designed case architecture.

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**Research and Practice on WeChat Mini Programs for Subject Knowledge Service**

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**Abstract:** [Purpose/significance] Through related research and practice, this paper provides ideas and references for using WeChat Mini Programs to promote subject knowledge service. [Method/process] This paper analyzes the characteristics and service status of WeChat Mini Programs, proposes a mobile knowledge service framework and model of "big environment, deep discovery, small frontend and rich ecology" centered on users based on WeChat Mini Programs, and studies service content from the perspectives of information service, knowledge service and personalized service. Taking the WeChat Mini Program "Stem Cell Helper" as an example for case practice, the feasibility of the method is proved. [Result/conclusion] It believes that, with proper planning and scientific layout, the Mini Program ecology can also carry a wealth of subject knowledge service applications and support the user's scientific and innovative activities from the mobile terminal.

**Keywords:** mobile knowledge service; WeChat Mini Programs; knowledge discovery; science and technology big data; knowledge graph

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