

A Survey and Analysis of Chinese Researchers' Awareness and Usage of arXiv

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Abstract

Objective: To understand Chinese users' awareness and usage of the arXiv preprint platform, as well as their suggestions and recommendations for its development.

Method: Based on a questionnaire survey of faculty, researchers, and graduate students from 9 domestic universities and research institutions, the authors obtained 510 valid responses and analyzed the data using SPSS and other analytical tools.

Results: The findings indicate that the level of awareness of arXiv among Chinese researchers is not yet very high; however, domestic researchers familiar with arXiv have recognized that posting papers on arXiv is an important means of establishing priority of discovery and soliciting peer feedback.

Limitations: The survey sampling was limited to member institutions of the China arXiv Service Working Group; arXiv users from non-member institutions were not included.

Conclusion: To enable arXiv to better benefit scientific research in China, the China arXiv Service Working Group needs to take more proactive actions to accelerate and promote broader and deeper adoption of arXiv domestically.

Full Text

Survey and Analysis of Chinese Researchers' Cognition and Usage of arXiv

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Abstract:

[Objective] To understand Chinese users' cognition, usage patterns, and sug-

gestions for the long-term development of the arXiv preprint platform.

[Methods] Based on a questionnaire survey of faculty, researchers, and graduate students from nine domestic universities and research institutions, we obtained 510 valid responses and analyzed the data using SPSS and other analytical tools.

[Limitations] The survey sample was limited to member institutions of the China arXiv Service Working Group; users from non-member institutions were not included.

[Conclusions] To enable arXiv to better benefit Chinese research, the China arXiv Service Working Group needs to take more proactive actions to accelerate and promote broader and deeper adoption of arXiv within China.

Keywords: arXiv; researchers; user survey; cognition; usage intention

Classification Number: G250

1. Research Background and Purpose

As an open access repository providing deposition, retrieval, publication, and communication services for preprint papers, arXiv has attracted significant attention from information technology experts, librarians, research managers, and researchers. To assist developers and administrators in better promoting arXiv's development in China, this user survey investigated researchers' and graduate students' cognition, usage willingness, submission willingness, usage patterns, and problems encountered when using arXiv.

Created by quantum physicist Paul Henry Ginsparg in 1991 and maintained by Cornell University since 2001, arXiv primarily provides deposition, retrieval, publication, and sharing services for preprint papers in physics, mathematics, computer science, quantitative biology, quantitative finance, and statistics, making it an important open access system [1]. Researchers format their papers according to specific guidelines and upload them via Web or email to the appropriate arXiv subject categories, enabling open sharing, avoiding duplication of effort, and increasing the efficiency of information exchange. This has given arXiv significant influence within international scientific communities. A famous international case is Russian mathematician Grigori Perelman, who first published his proof of the Poincaré Conjecture on arXiv in the early 2000s [2]. A notable domestic case is the Daya Bay Reactor Neutrino Experiment collaboration, which first announced its discovery of a new neutrino oscillation mode on arXiv in 2012 [3].

Statistics show that by October 2012, arXiv had stored over 790,000 research papers [4]; by the end of March 2014, this number had reached 927,838 [5]. In approximately one and a half years, about 130,000 new papers were added, averaging over 8,000 papers per month—compared to the 76,578 papers added during 2011-2012, representing an average monthly increase of about 6,380 papers [6]. By the end of December 2013, monthly downloads had reached nearly 5.5 million [7]. As research users have become more familiar with arXiv, schol-

early studies of the platform have gradually increased, providing useful references for future improvements in resource organization and functionality [8].

Existing research on arXiv includes: Davis and Fromerth (2007) analyzed 2,765 articles from four mathematics journals and found that arXiv increased citation rates but reduced downloads from publishers' websites [9]; Moed (2007) analyzed the effect of open access on citation impact and found that arXiv primarily enabled earlier access rather than free access [10]; Mine (2009) analyzed arXiv's role and position in scholarly communication, finding that user submissions were continuously increasing [11]. In China, Sun Yuwei (2010) analyzed arXiv's pathway model and compared it with other scientific communication models [12]; Wang Xin et al. (2011) analyzed arXiv self-archiving in domestic physics journals and found increased citation frequency and download counts, recommending that domestic physics journal publishers strengthen website construction and leverage arXiv to improve journal citation levels [13]; Sun Bin (2011) examined the preprint operation mechanism using arXiv as an example and pointed out the relationship between preprint usage and Ingelfinger editorial policies [14]; Wang Jiajia (2011) compared arXiv with domestic preprint systems, reflecting on development status and problems [15]; and Zhang Zhixiong et al. (2013) discussed arXiv's special position in open research publication and launched work plans for the China arXiv Working Group [16].

To fully understand Chinese users' usage patterns and improvement suggestions, and continuing the China mirror site service (arXiv.org) that began in 1998 [17], the China arXiv Service Working Group conducted a survey of Chinese users' knowledge of the arXiv repository in September 2013. The survey targeted over 500 research users from nine member institutions (excluding the National Science Library, Chinese Academy of Sciences).

2. Research Methods and Process

This survey targeted research users primarily including faculty, researchers, and graduate students from universities and research institutions. Through a questionnaire on Chinese users' usage patterns, habits, and suggestions for arXiv's development, we aimed to provide references for arXiv's development in China.

2.1 Questionnaire Design

The survey contained 18 questions (requiring approximately 10 minutes to complete; see appendix for details). It covered two main aspects: (1) Chinese research users' cognition of arXiv, examining overall awareness across different institutions, age groups, disciplines, statuses, and education levels; and (2) usage patterns, including methods of use, submission purposes, post-submission impact, factors influencing submissions, browsing methods, and retrieval problems. The 18 questions included single-choice, skip-logic, multiple-sequence, and open-ended questions. Respondent demographic information included discipline, gender, age, title, and education level.

2.2 Survey Method

Considering arXiv's current development in China, research users from China arXiv Service Working Group member institutions can basically represent the main types of users in domestic education and research institutions, and these member institutions themselves have large numbers of capable research users. Therefore, this survey targeted nine member institutions of the China arXiv Service Working Group. Questionnaires were distributed to responsible persons at each institution, who then selected and identified research users within their institutions. Each institution also considered users' education, title, and discipline to ensure reliable results.

2.3 Questionnaire Distribution and Collection

The survey used both paper and electronic formats. Paper questionnaires were distributed and collected in person by institutional responsible persons, then uniformly coded and sent to the National Science Library, Chinese Academy of Sciences. Electronic questionnaires were collected via email on a one-to-one basis, then uniformly coded and sent by institutional responsible persons. Both types were pooled for unified processing and analysis.

The survey distributed 540 questionnaires to nine service working group institutions (50 per institution, later expanded). We ultimately recovered 510 questionnaires (94.4% response rate), with 509 valid questionnaires (99.8% validity rate). Paper questionnaires accounted for 146 (28.7%) and electronic questionnaires for 363 (71.3%).

2.4 Sample Data Validity Analysis

We first used SPSS reliability analysis to test questionnaire reliability, then KMO and Bartlett's tests for validity, as shown in [Figure 1: see original paper]. Since the questionnaire contained three skip-logic questions, we conducted separate analyses. The nine surveyed institutions were: Institute of Theoretical Physics (Chinese Academy of Sciences), Tsinghua University Library, Peking University Library, Shanghai Jiao Tong University Library, Fudan University Library, Nanjing University Library, Institute of High Energy Physics (Chinese Academy of Sciences), Jilin University Library, and Academy of Mathematics and Systems Science (Chinese Academy of Sciences).

The reliability analysis showed Cronbach's Alpha values exceeding 0.9 both with and without skip-logic questions, indicating high internal reliability and consistency, making the questionnaire suitable for subsequent analysis.

3. Survey Results and Discussion

3.1 Respondent Profile

Respondents were primarily young and middle-aged researchers under 45 (93.3% of total), with the 20-25 age group being the largest at 36%. Some respondents were senior researchers aged 45-55 and over 55. In terms of education, 65.8% held or were pursuing doctoral degrees, 22.4% held master's degrees, and undergraduates were the smallest group. By professional title, graduate students (57.3%), associate researchers (16.3%), and assistant researchers (13.9%) formed the main body. Disciplines primarily included high-energy physics, condensed matter physics, astrophysics, mathematics, computer science, quantitative biology, quantitative economics, and statistics, with mathematics (25.9%) and high-energy physics (20.4%) being the most represented.

3.2 Cognition and Usage Willingness Analysis

(1) Primary awareness channel: recommendations from colleagues and classmates

Among 509 respondents, 342 (67.2%) knew about arXiv. While this exceeds half, it remains relatively low considering arXiv's importance in the aforementioned fields. The primary awareness channel was recommendations from colleagues and classmates. Only 14.9% learned about arXiv through their institution's library promotion and training, as shown in [Figure 2: see original paper].

(2) Primary usage pattern: downloading literature, supplemented by browsing

Among the 342 respondents who knew arXiv, 82.6% had used it, while 16.3% had not, indicating that most knowledgeable users have used the platform. Among users, the primary purpose was downloading literature, as shown in [Figure 3: see original paper].

(3) Reasons for awareness without usage: unclear instructions and lack of library promotion

Among 56 respondents who knew but did not use arXiv, the main reason was the lack of clear, concise, and understandable usage instructions on the arXiv website. Additionally, lack of library training courses and consultation help, and irrelevance of arXiv content to users' disciplines, accounted for 26.8% and 23.2% respectively, further confirming the importance of promotion, as shown in [Figure 4: see original paper].

3.3 Submission Willingness Analysis

(1) Most users submit occasionally rather than for every paper

Among respondents, 123 had submitted papers to arXiv. Submission frequency was primarily occasional (39.0%), followed by every paper (35.8%) and frequent (21.1%). Submission quantity was mostly 1-5 papers (61.0%), as shown in [Figure 5: see original paper].

(2) Primary submission purposes: claiming priority and soliciting peer feedback

Among 123 respondents who submitted papers (mostly unpublished), the primary purposes were clearly to claim priority and solicit more peer feedback. Regarding copyright requirements, 73.1% believed they understood arXiv's requirements, while 22.0% did not, as shown in [Figure 6: see original paper].

(3) Submission effects: connecting with more peers and increasing citation rates

Among 123 respondents who submitted papers, 53.7% reported connecting with more research peers, and 44.7% reported increased citation rates. Only 17.1% believed it made journal publication easier.

(4) Five key factors influencing submission

The top five factors encouraging researchers to upload to arXiv were: publication speed, obtaining more peer feedback, overall arXiv traffic and submission volume, speed of peer feedback, and simple submission procedures, as shown in [Figure 7: see original paper].

3.4 Usage Patterns and Problems Analysis**(1) 91.1% of research users willing to upload their work**

Overall, 91.1% of research users were willing to upload their research to arXiv, 7.4% were unwilling, and 1.5% were uncertain.

(2) Browsing methods and frequency

Most users (92.6%) browsed arXiv via web pages, with low usage of email alerts (8.5%) and RSS subscriptions (6.4%). Browsing frequency was primarily weekly (31.8%), followed by daily (25.4%), monthly (18.0%), biweekly (10.2%), and other times (12.4%).

(3) Primary non-usage reason: retrieval difficulties

Among 283 arXiv users, 48.8% had no problems, but 38.5% reported significant retrieval problems. Only 7.1% had browsing problems, and 6.0% reported other issues like slow updates after system problems.

(4) Retrieval problems: lack of advanced search and inaccurate results

Among 283 users, the most common retrieval problems were: too few search entry points and lack of advanced search (34.6%), inaccurate results (32.9%), and lack of quality metrics in results (24.0%). Few users had problems with result quantity (10.6%) or feedback speed (9.5%), as shown in [Figure 8: see original paper].

(5) Other minor arXiv service issues

Among 283 users, other feedback included issues shown in [Figure 9: see original paper].

4. Research Conclusions and Recommendations

This large-scale survey of Chinese research users' arXiv usage is the first domestic investigation of its kind. Targeting research users from nine member institutions of the China arXiv Service Working Group—including both research institutions and higher education users, students and faculty/researchers, and ages from 20 to over 55—it broadly reflects domestic users' cognition and usage patterns.

4.1 Main Findings

Our investigation revealed: (1) Chinese researchers' cognition of arXiv remains relatively low, with awareness primarily through colleagues/classmates and insufficient library promotion; (2) Researchers familiar with arXiv recognize its important role in scholarly communication, particularly for claiming priority and soliciting peer feedback, which helps connect with peers and increase citation rates; (3) Platform issues, particularly imperfect search functionality and inaccurate results, affect user experience.

4.2 Research Limitations

Caution is needed when generalizing results, as the survey only covered users within China arXiv Service Working Group member institutions (though these represent primary users). Additionally, results are based solely on questionnaire statistics; due to constraints, we could not conduct deeper interactive exchanges or case studies with respondents.

4.3 Recommendations and Future Work

Despite rising arXiv browsing and download volumes, only a minority of Chinese research users truly understand arXiv. Some remain in a browse-but-don't-submit mode, possibly due to unfamiliarity or copyright concerns. While arXiv development is a long-term endeavor, this survey suggests that to better benefit Chinese research, the China arXiv Service Working Group must take more proactive actions to accelerate broader and deeper domestic adoption.

(1) Increase arXiv Promotion

Only 67.2% of surveyed users knew about arXiv, with only about 10% learning through library promotion or third-party websites. Working group members should develop comprehensive promotion plans, conduct lectures within their institutions, and provide website links and bulletin board introductions to raise awareness. They should also encourage existing users to promote arXiv through formal and informal channels, leveraging user-to-user promotion to unlock arXiv's potential value.

(2) Strengthen arXiv Training

Lack of effective training is a major reason why university and research institution users don't use arXiv. Institutions should increase funding for arXiv training, establish relevant courses, develop training outlines and materials, and

widely implement usage training to guide proper use. Training should cover usage norms, submission guidelines, retrieval strategies, and copyright regulations. Over the long term, the focus should shift to training and problem resolution, potentially inviting experienced personnel from Cornell University Library to conduct in-depth training for physics, computer science, statistics, and other fields.

(3) Improve arXiv Platform Construction

The survey found that unclear usage instructions (35.7%), submission procedure complexity, and formatting issues significantly affect submissions. Platform standardization and improvement directly impact usage. Regular usage surveys should be conducted to collect feedback from physics, mathematics, statistics, and other discipline users to improve platform construction, enhance submission functionality, improve search features, and optimize services to increase submission efficiency. Clear indexing and documentation should guide proper use, while simplified submission processes and clear policies on versions, copyright, and reuse should encourage more submissions.

(4) Enhance User Experience

In the information age, databases and platforms need both extensive resources and good user service experiences. Since researchers have different usage experiences based on their environments and training, arXiv should strengthen content quality, provide high-quality information resources, and learn from successful personalized recommendation systems like My Yahoo! [18], Google AdWords [19], and Baifendian Analytics Engine [20]. This could include personalized information service portals, enhanced RSS and email alert functions for customized databases, and seamless linking with search engines and commercial databases.

(5) Emphasize Effective Incentives

ArXiv development depends on stakeholder enthusiasm. Institutions should encourage researchers to upload to arXiv, create an open sharing environment, and support shifting focus to increasing institutional and research impact. Research performance strategies could link citation metrics to researcher performance to encourage participation and accelerate arXiv development. Journals should also accept for formal publication papers that have undergone peer review and been uploaded to arXiv, ensuring broad knowledge dissemination.

(6) Standardize arXiv Processes

Difficult-to-read formatting is currently users' biggest problem. Detailed submission processes, management mechanisms, and service mechanisms should be established. This includes developing unified, standard, clear promotional materials and courseware for working group members and other institutions; adding usage instructions, clear indexing, and standardized formatting to maximize user convenience; and establishing clear platform management standards to improve utilization.

Acknowledgments

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arXiv Repository User Survey Questionnaire

Hello! Thank you for taking time from your busy schedule to complete this questionnaire. arXiv.org is a world-renowned preprint literature repository, created in August 1991 as a highly automated, active electronic preprint archiving and publishing platform for research papers. It primarily covers: physics, mathematics, computer science, computational biology, econometrics, and statistics. To help Chinese users better utilize this resource, an arXiv mirror site was established in China. In October 2012, the National Science Library of the Chinese Academy of Sciences and Tsinghua University Library, jointly with over a dozen domestic university and research institution libraries, formed the China arXiv Working Group to promote and train users on this resource.

This survey aims to understand Chinese users' usage patterns, habits, and suggestions for arXiv's development, and to feed back results to arXiv. Your responses are extremely important to us. The questionnaire takes approximately 5-10 minutes. Thank you for your support and cooperation!

This survey is completely anonymous. We guarantee that all information and data will be used only for survey analysis, not for commercial or other purposes.

China arXiv Working Group
September 16, 2013

Please mark your selected options with a check ($\checkmark$) in the boxes, or fill in as indicated in parentheses.

I. arXiv Cognition and Usage Behavior Survey

1. Have you heard of arXiv?
Yes
No (Please skip to question 18)
2. How did you learn about arXiv? (Multiple choice)
arXiv website
Third-party websites or promotional training
My institution library's promotion/training
Recommendation from colleagues, classmates, or teachers
Other (please specify)
3. Have you used arXiv? (Multiple choice)
Used (Please skip to question 5)
Not used
4. Why haven't you used arXiv despite knowing about it? (Multiple choice)
arXiv website lacks clear, concise, and understandable usage instructions
My library lacks relevant training courses and consultation help
arXiv content is not relevant to my discipline
Other (please specify)
5. How do you use arXiv? (Multiple choice)
Submit papers (Please answer questions 6-12)
Download literature (Please skip to question 12)
Browse (Please skip to question 12)
6. How frequently do you submit to arXiv? (Single choice)
For every paper
Frequently
Occasionally
7. How many papers have you submitted to arXiv? (Single choice)
1-5 papers
5-10 papers
11-15 papers
15-20 papers
Over 20 papers
8. What are your purposes for submitting to arXiv? (Multiple choice; please rank your selections by importance: 1, 2, 3...where 1 is most important)
Unpublished, to solicit more peer review comments before formal publication
Unpublished, using arXiv as a publication channel to claim priority
Already published, to let more peers know about my research (when author retains distribution rights)
Other (please specify)
9. What impact has submitting to arXiv had on your research? (Multiple

- choice)
- Increased paper citation rates
 - Made formal journal publication easier
 - Journal refused formal publication of the paper
 - Connected with more research peers
 - Other (please specify)
10. When submitting, do you understand arXiv' s copyright requirements?
(Note: arXiv requires submitters to grant distribution rights)
- Understand
 - Don' t understand
11. What factors influence your decision to submit to arXiv? (Multiple choice;
please rank by importance: 1, 2, 3...where 1 is most important)
- Obtaining more peer feedback
 - Publication speed
 - Speed of peer feedback
 - Simple submission procedures
 - Easy replacement of revised manuscripts in arXiv system
 - Overall arXiv traffic and submission volume
 - Single sorting method for search results
 - Other (please specify)
12. Do you plan to submit (if you haven' t before) or continue submitting (if
you have) to arXiv? (Single choice)
- Yes
 - No
13. How do you browse arXiv? (Multiple choice)
- Web browsing
 - RSS subscription
 - Email alerts for new articles
14. How often do you browse arXiv? (Single choice)
- Daily
 - Weekly
 - Biweekly
 - Monthly
 - Other (please specify)
15. What problems have you encountered using arXiv? (Multiple choice)
- Retrieval problems
 - Browsing problems
 - Other problems (please specify)
 - No problems
16. What retrieval problems have you encountered? (Multiple choice)
- Slow retrieval feedback
 - Inaccurate results

Too few results
 Too few search entry points, lack of advanced search
 Retrieval results should include article quality metrics
 Other (please specify)

17. Other arXiv service problems? (Multiple choice)
 - Slow or no response to email inquiries
 - Some articles have difficult-to-read formatting
 - File upload format restrictions
 - Other (please specify)
18. Your opinions and suggestions for arXiv? (Your opinions are very important for us to propose functional and service improvements to arXiv. Please provide your valuable feedback.)
19. For survey statistics and further communication, please provide the following information (all information will be used only for statistical analysis).
 - (1) Research field/discipline (Multiple choice)
 - Physics (Please specify: High-energy physics; Condensed matter physics; Astrophysics)
 - Mathematics
 - Computer science
 - Quantitative biology
 - Quantitative economics
 - Statistics
 - Other (please specify)
 - (2) Gender: Male; Female
 - (3) Age: 20-25; 25-30; 30-35; 35-45; 45-55; Over 55
 - (4) Title: Researcher/Professor; Associate Researcher/Associate Professor; Assistant Researcher/Lecturer; Research Assistant/Teaching Assistant; Student
 - (5) Education: PhD or PhD candidate; Master's or Master's candidate; Undergraduate
 - (6) Email: (If you would like to know survey results or are willing to discuss related issues further, please leave your email)

Thank you for your participation and support. We wish you success in your work and studies!

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

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