RESEARCH ARTICLE

Research Integrity in China: System Construction, Current Challenges and Future Trends

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ABSTRACT

With the rapid advancement of scientific research and the increasing complexity of global collaboration, research integrity has emerged as a pivotal concern among the global science and technology community. This article aims to delve into the nuanced construction of the research integrity system in China, examining its foundational principles, current frameworks, and the ethical guidelines that underpin scholarly activities. It highlights the multifaceted challenges faced, including issues of academic misconduct, data fabrication, and authorship disputes, as well as cultural factors that may influence perceptions of integrity in research practices. Through a comprehensive analysis, this study seeks to identify existing gaps within the current system and propose strategic recommendations for its improvement. Additionally, it explores future development trends that may shape the landscape of research integrity, such as the impact of emerging technologies, interdisciplinary collaborations, and global partnerships. By offering insights and practical guidance, this article aspires to not only inform the ongoing discourse surrounding research integrity in China but also provide valuable reference points for researchers and policymakers worldwide committed to fostering a culture of ethical scholarship and accountability in the research community. Ultimately, the goal is to inspire collective action towards the enhancement of research integrity on a global scale.

1 | Introduction

In the contemporary era of rapid technological progress and globalization, scientific research has become an increasingly complex and collaborative endeavor. As the cornerstone of scientific research, research integrity is crucial for the reliable generation and dissemination of knowledge, which in turn is crucial for driving technological progress and enhancing national competitiveness.

Over the past few decades, research integrity has become a prominent topic in the scientific community. Previous studies have explored various aspects related to it. For example, investigations have been carried out on the identification and prevention of academic misconduct, such as plagiarism and data fraud [1, 2]. The impact of different evaluation systems on research integrity has also been examined, along with the role of institutions and policies in promoting integrity in research.

In China, with the continuous expansion of its scientific and technological capabilities, research integrity has become a critical issue. The Chinese government and research institutions have recognized its importance and have taken a series of measures to strengthen research integrity [3-5]. These measures include policy formulation, education and training, technology application, and international cooperation.

However, despite these efforts, the construction of research integrity in China still faces challenges. It is necessary to further deepen the reform of the scientific research management system and implement the construction of research integrity in aspects such as project review, process management, project completion, and funding supervision to break through the bottlenecks that restrict technological innovation and the enthusiasm of researchers [6]. In addition, it is necessary to strengthen departmental cooperation and form a joint force, focusing on achieving breakthroughs in practical cultivation and investigation and treatment, improving integrity awareness and optimizing the research environment.

The future development trends should include perfecting the management system of research integrity, strengthening management systems such as education and publicity, investigation and treatment of integrity cases, information collection, and classified evaluation. At the same time, international cooperation should be strengthened to jointly address the new situations and challenges of research integrity [7, 8]. Through these measures, China is expected to establish a more sound, transparent, and sustainable development research integrity system.

2 | Methods

Utilizing policy text analysis, this article provides a summary of the relevant regulations and guidelines on research integrity from Chinese ministries and the Chinese Academy of Sciences, as well as the governance measures adopted by certain research institutes [9]. It also offers a brief examination of domestic and international studies on research integrity, along with initiatives from related academic associations. The article outlines the measures and approaches China has taken in constructing a framework for research integrity, including the effective identification and prevention of misconduct, reforms to the research evaluation system, and the optimization of the overall research culture and environment. It clarifies the institutional norms surrounding research integrity through the identification and prevention of research misconduct and the establishment of a reformed research evaluation system. Additionally, it predicts that China will further improve its research integrity system through strengthened education and training, the use of information technology for management improvements, innovations in the research evaluation system, and enhanced international cooperation, aiming to establish a multi-layered and holistic evaluation and prevention system for research integrity.

2.1 | Establishment of China's scientific research integrity system

The establishment of a robust scientific research integrity system in China is a complex, multi-faceted process that encompasses various considerations, including policy development, educational initiatives, technological integration, and global collaboration. Key players in this endeavor include institutions such as the Ministry of Science and Technology, the National Natural Science Foundation of China (NSFC), and the China Association for Science and Technology (CAST), all of which play crucial roles in shaping and enforcing integrity standards within the research community.

2.2 | Policy formulation

In recent years, the Chinese government has actively implemented a series of policies and regulations to intensify its efforts against scientific research misconduct. For instance, the "Several Opinions on Further Strengthening the Construction of Scientific Research Integrity," issued by the General Office of the CPC Central Committee and the General Office of the State Council in 2018 [9], outlines the overall requirements, procedures, responsibilities, key tasks, and major initiatives for establishing research integrity. This initiative aims to create a new framework characterized by co-construction, sharing, and co-governance in research integrity. Additionally, the "Several Measures (Trial) on Eliminating the Unhealthy 'Paper-Centric' Orientation in Scientific and Technological Evaluation," released by the Ministry of Science and Technology in 2020 [10], seeks to address the excessive focus on publications in evaluating scientific work, encouraging researchers to prioritize the quality and genuine contributions of their research.

In terms of specific implementation, the Ministry of Science and Technology issued the "Interim Provisions on Handling Violations of Scientific and Technological Activities" in 2020 [11], which clearly delineates the scope of violations and the procedures for addressing them, thereby enhancing the supervision and management of scientific and technological activities. In 2022, the "Rules for Investigating and Handling Scientific Research Dishonesty Behaviors," revised and released by 22 departments, including the Ministry of Science and Technology [12], provided clear definitions of scientific research dishonesty, outlined specific behaviors, and established investigation and treatment requirements. These rules serve as a comprehensive guide for all departments and localities in addressing issues of scientific research dishonesty.

The introduction and implementation of these policies underscore the Chinese government's strong commitment to upholding the integrity of scientific research. Through various initiatives—such as enhancing institutional norms, strengthening education and guidance, and enforcing strict supervision and penalties—China is progressively establishing a comprehensive scientific research integrity management system. This effort aims to foster a clean and principled research environment while promoting the healthy development of scientific and technological innovation.

For instance, in response to the "paper-centric" phenomenon, the policy encourages researchers to prioritize the quality of their work over sheer publication numbers, highlighting the practical application and social benefits of research outcomes. Additionally, the policy enforces stringent penalties for violations of research integrity, including plagiarism, data falsification, and appropriation of others' results, ensuring fairness and transparency in scientific activities.

Through these initiatives, China has cultivated a positive image for its scientific research on both domestic and international fronts while also providing valuable insights and benchmarks for the global advancement of research integrity. This commitment enhances the overall quality and competitiveness of Chinese scientific research, fosters innovation and the dissemination of scientific knowledge, and ultimately contributes to achieving sustainable development goals.

2.3 | Education and training

To enhance the awareness and standards of integrity among scientific researchers, institutions such as the Chinese Academy of Sciences, the Chinese Academy of Engineering, and the China Association for Science and Technology have strengthened supervision and management requirements for academicians. They have also reinforced the integrity review process for academician recommendations and nominations [13, 14]. Additionally, sectors like education, healthcare, and academic publishing have improved their

internal control systems, further bolstering the construction of research integrity [15].

In terms of education and training, the Chinese Academy of Sciences has implemented the "Implementation Measures of the Party Leadership Group of the Chinese Academy of Sciences for Strengthening the Construction of Scientific Research Integrity." These measures emphasize the establishment of a responsibility system, enhanced process management, prioritization of education, and rigorous investigation of scientific misconduct [16]. Additionally, the School of Information Technology has launched a special initiative called "Publicity of Scientific Research Integrity," aimed at engaging all faculty members. By organizing regular training sessions on research integrity, reinforcing guidance and supervision, and fostering a culture of integrity, the school has created a clean, honest, and pragmatic academic environment [17].

Many universities in China are actively enhancing research integrity through diverse educational initiatives. Baoding University has initiated the "Scientific Research Integrity Construction Year," which integrates research integrity education into pre-employment training for new hires, making it a key component of their development. Jiangsu University has achieved comprehensive coverage of scientific integrity training through staff-wide training, departmental sessions, and timely reminder talks for those facing issues [18]. Sichuan University emphasizes academic integrity by developing a robust educational framework for freshmen and new faculty while refining its curriculum [19]. Meanwhile, Southern University of Science and Technology hosted a training conference that featured a keynote speech from Zhengke Ye of the National Natural Science Foundation of China, aimed at raising awareness of research integrity and academic ethics among researchers.

These measures reflect the systematic and comprehensive approach China is taking in constructing its scientific research integrity framework. By addressing institutional norms, education and training, internal management, and external supervision, a multi-level and holistic scientific research integrity system has been established.

2.4 | Application of technology

In the realm of technical application for building China's scientific research integrity system, the Sanjiangyuan National Park Research Institute of the Chinese Academy of Sciences and other affiliated institutions have implemented measures to establish a responsibility system, strengthen process management, enhance education, and rigorously investigate and penalize scientific misconduct. These measures not only raise researchers' awareness of integrity but also effectively manage instances of scientific misconduct.

To further advance the construction of scientific research integrity, the Ministry of Science and Technology and the Chinese Academy of Social Sciences are collaborating to enhance the integrity system. This includes improving management systems for education and publicity, the investigation and handling of integrity cases, information collection, and classified evaluation [21]. For instance, the Ministry of Science and Technology has developed the "Management Measures for the Construction of Scientific Research Integrity," which standardizes the procedures for investigating and addressing scientific

misconduct, encourages real-name reporting, and establishes a research integrity construction office to oversee daily integrity initiatives.

Additionally, the Ministry of Education has issued the "Guiding Opinions on Strengthening the Construction of Scientific Research Integrity and the Governance of Academic Misconduct in Colleges and Universities," highlighting the importance of addressing academic misconduct seriously. This directive requires colleges and universities to promote integrity awareness among teachers, researchers, and students, encouraging adherence to academic norms. It also mandates the strict implementation of the "three implementations and three disclosures" approach: establishing a dedicated section on academic integrity on their websites, publishing annual reports, disclosing investigation outcomes, and regularly conducting warning campaigns for both faculty and students.

In terms of specific cases, the National Natural Science Foundation of China has reported several typical instances of scientific research misconduct, demonstrating that stringent penalties can serve as a deterrent. Additionally, the implementation of the updated Science and Technology Progress Law and the Provisions on the Investigation and Treatment of Scientific Research Dishonesty has clarified the consequences of integrity violations on the rights and interests of scientific and technological personnel. These measures have strengthened penalties for research dishonesty, established a database for serious integrity violations, and directly linked this database to the joint disciplinary system.

These measures demonstrate that China has adopted systematic and institutionalized approaches in constructing its scientific research integrity system. The comprehensive deployment and implementation of policies and regulations at the practical level aim to foster an environment characterized by honesty and trustworthiness in scientific research, ultimately promoting scientific and technological innovation and ensuring healthy development.

2.5 | International cooperation

In the realm of international cooperation, China actively engages in the global construction of scientific research integrity and has implemented a series of important measures to enhance the internationalization of its scientific research integrity system.

1) International Initiatives: China actively participates in the global construction of scientific research integrity, engaging in discussions and promoting integrity issues through international cooperation. For instance, at the 5th WLA Forum, Chinese scientists and researchers issued the "Initiative on International Cooperative Research Behaviors," calling on researchers to uphold eight core values, including research excellence, scientific integrity, and academic freedom [22].

2) Exchanges and Cooperation: China actively engages in exchanges and collaborations with international organizations and relevant countries, participating in the development of international research behavior standards and scientific integrity norms. This cooperation also extends to addressing cross-border scientific research integrity cases [16]. For example, the China National Institute of Standardization

has issued the "Management Measures for Scientific Research Integrity," which clearly outlines regulations for investigating and handling cases of research dishonesty [23].

3) Case Sharing and Learning: The Chinese Academy of Sciences, in collaboration with the International Association of Scientific, Technical and Medical Publishers (STM), hosted the "2023 Symposium on Scientific Research Integrity Construction." This event provided a platform to share the experiences of the STM in addressing common integrity challenges in the research community [24].

Through these measures, China has not only established a relatively comprehensive scientific research integrity system domestically but has also learned from and integrated advanced international concepts and experiences in scientific research integrity through global cooperation. This has further enhanced the internationalization of China's scientific research integrity system.

The construction of China's scientific research integrity system is a comprehensive, multi-level process that encompasses various aspects, including policy formulation, education and training, technology application, and international cooperation. Through coordinated efforts across these areas, China has gradually established a relatively complete system of scientific research integrity, providing a robust foundation for scientific and technological innovation.

3 | Present challenges of scientific research integrity

Despite the significant progress China has made in scientific research integrity, it still faces numerous challenges [25]. These include effectively identifying and preventing misconduct, reforming the scientific research evaluation system, and optimizing the overall research culture and environment.

3.1 | Identification and prevention of scientific research misconduct

Identifying and preventing scientific research misconduct is crucial for establishing a robust system of scientific integrity. Currently, prevalent forms of misconduct in China include plagiarism and data fraud. Such behaviors not only tarnish the reputation of individual researchers but also negatively impact the international perception of Chinese scientific research. To effectively prevent and address academic misconduct, colleges and universities should develop a comprehensive academic integrity system that integrates education, prevention, supervision, and enforcement.

According to the "Measures for Preventing and Handling Academic Misconduct in Colleges and Universities" (Order No. 40 of the Ministry of Education), colleges and universities are responsible for preventing and addressing academic misconduct. They should establish a work mechanism for fostering academic integrity, clarify the assignment of responsibilities, and enhance the rules and procedures for managing misconduct in accordance with these measures [26]. Additionally, it is essential to strengthen awareness and

education among undergraduate and graduate students, as well as researchers, to enhance their understanding of scientific research ethics.

For example, Tsinghua University has developed its own measures for preventing and handling academic misconduct, aligned with the "Measures for Preventing and Handling Academic Misconduct" and relevant regulations such as the "Constitution of Tsinghua University" and the "Constitution of the Academic Committee of Tsinghua University." These measures aim to maintain academic integrity, standardize academic behavior, and promote the sustainable and healthy development of academic research activities [27].

Specific measures include:

1) Establish a Working Mechanism for Academic Integrity: Under the leadership of the primary responsible individual, clearly delineate responsibilities to ensure the effective implementation of all related activities [26].

2) Strengthen Publicity and Education: Foster students' understanding of scientific ethics and awareness of academic norms through a variety of activities, including lectures, symposia, site visits, and learning exchanges [28].

3) Enhance System Development: Establish and refine the rules and procedures for preventing and addressing academic misconduct. Leverage the role of the academic committee in promoting academic integrity, and support its efforts in investigating and identifying instances of misconduct.

4) Sign Commitment Letters: For instance, organize all graduate students to sign the Letter of Commitment on Research Integrity and Academic Norms at Soochow University. This initiative encourages students to cultivate proper scientific ethics and adhere to academic standards [29].

5) Application of Information Technology: Utilize information technology to establish an intellectual property inquiry system, enhancing the mechanisms for preventing and addressing academic misconduct.

Through these measures, we can effectively prevent and address academic misconduct, foster a positive academic environment, and promote innovation and development in academia.

3.2 | Reform of the scientific research evaluation system

The reform of the scientific research evaluation system is a critical component of promoting scientific research integrity. In recent years, China has engaged in various explorations and practices in this area. For instance, South China Normal University has developed an implementation plan aimed at deepening the reform of scientific research evaluation. This plan seeks to enhance the intensity of reform through measures such as optimizing the evaluation methods for professional and technical personnel and reducing repetitive evaluations [30].

Additionally, the State Council has initiated actions to "break the five

onlys," which refers to the prevailing focus on "only papers, only talent titles, only professional titles, only educational backgrounds, and only awards." This initiative aims to foster a new academic culture and optimize the academic ecosystem [31].

The reform of science and technology evaluation also emphasizes granting greater autonomy to scientific research institutions and implementing a medium- and long-term performance evaluation system. For example, a medium- and long-term performance evaluation framework should be established, with corresponding indicators and methods tailored to the specific types of scientific research activities conducted by these institutions. This approach aims to avoid the simplistic evaluation of institutions based solely on the number of high-level talents [21].

Additionally, the frequency of evaluations should be reduced, and a system of exemption from evaluation should be introduced for institutions that consistently achieve excellent results over a specified period.

These reform measures not only emphasize individual scientific research achievements but also highlight the importance of teamwork, integrating both individual and team evaluations. They aim to establish a performance evaluation system that prioritizes innovation quality and contributions [29]. For example, the implementation plan from South China Normal University outlines the need for representative achievement evaluations, the exploration of long-term evaluations, and improvements to the peer expert review mechanism [10]. These initiatives will contribute to building a more scientific, rational, and transparent research evaluation system, encouraging researchers to focus on original innovation and high-quality research [32, 33].

In summary, the reform of the scientific research evaluation system is a systematic endeavor that requires comprehensive consideration and design across multiple levels. Through these reform measures, we can effectively enhance the level of scientific research integrity and promote the healthy development of China's scientific and technological initiatives [34, 35].

3.3 | Optimization of scientific research culture and environment

Optimizing the scientific research culture and environment is fundamental to building research integrity, as evidenced by the actions of the National Natural Science Foundation of China. For instance, the Foundation has underscored the critical role of scientific research funding institutions in fostering research integrity and has issued the "Handbook of Norms for Research Integrity" [36]. This manual aims to clarify the integrity responsibilities of the "four main parties"—researchers, reviewers, affiliated institutions, and staff of the National Natural Science Foundation of China. It provides systematic and instructive guidelines to eliminate confusion in scientific research, research management, and funding activities. Accordingly, targeted education and training should be implemented to reinforce these principles [36].

Additionally, the Ministry of Education has issued the "Measures for Preventing and Handling Academic Misconduct in Colleges and Universities" (Decree No. 40), which has been in effect since September 1, 2016. This initiative aims to effectively prevent and thoroughly investigate academic misconduct in colleges and universities, uphold academic integrity, and promote innovation and development in academia. The approach emphasizes the priority of prevention and the integration of education with disciplinary measures. It requires colleges and universities to establish and enhance a long-term mechanism for educating students about academic ethics and norms, treating the prevention and management of academic misconduct as a critical component of their daily operations [25].

Although China has made remarkable progress in scientific research integrity, further efforts are needed in identifying and preventing research misconduct, reforming the research evaluation system, and optimizing the scientific research culture and environment. These steps are essential for building a more scientific and rational integrity system [29, 32, 37].

For example, South China Normal University has implemented a plan to deepen the reform of scientific research evaluation, aiming to enhance the academic ecosystem by eliminating mechanical and quantitative evaluation methods that rely solely on metrics like the number of papers, awards, titles, and projects [29]. Similarly, Tsinghua University has issued the "Several Opinions on Improving the Academic Evaluation System," which aligns with President Xi Jinping's directives on reforming the scientific and technological evaluation framework, as well as the guidelines from the General Office of the CPC Central Committee and the General Office of the State Council regarding the reform of project review, talent evaluation, and institutional evaluation [37].

In summary, optimizing the scientific research culture and environment is fundamental to building research integrity. This requires a multifaceted approach, addressing aspects such as educational guidance, the rigor of investigations, the development of effective working mechanisms, and the implementation of technical solutions. Additionally, reforming the scientific research evaluation system is a critical component of this process. It is essential to eliminate the "five onlys"—that is, the focus on "only papers, only talent titles, only professional titles, only degrees, and only awards"—to enhance the academic ecosystem and foster scientific research and innovation [38].

Research integrity is the cornerstone of scientific inquiry and plays a vital role in building an innovative country. While China has made significant strides in establishing research integrity, there is still a need for ongoing efforts to address emerging challenges, keep pace with development trends, and contribute to the global framework of research integrity.

4 | Future Trends of Research Integrity

In recent years, the Chinese Academy of Sciences and its branches have conducted numerous specialized training courses on research integrity to enhance researchers' awareness and management capabilities. For instance, from March 27 to 29, 2023, the Guangzhou

Branch of the Chinese Academy of Sciences hosted an annual training course on scientific research integrity in Shenzhen, featuring a lecture by Feng Chujian, Deputy Director of the Department of Science and Technology Supervision and Integrity Construction at the Ministry of Science and Technology [39]. Additionally, on June 13, 2024, the Chinese Academy of Sciences organized a special training course in Beijing focused on research integrity and the governance of scientific and technological ethics, further reinforcing education in this critical area [40].

China is gradually establishing a robust research integrity information system to record the integrity status of researchers, relevant institutions, and organizations. This system aims to promote interconnectivity with the national credit information sharing platform [41]. Additionally, the application of blockchain technology has been proposed to objectively document the actions of research subjects, reduce disputes over questionable behaviors, and enhance the integrity of the research environment [42].

Reforming the research evaluation system is currently a key focus. Nanjing University has been actively exploring ways to optimize its evaluation framework, aiming to avoid a one-size-fits-all approach [43]. The university emphasizes the importance of classification-based evaluations that cater to the unique characteristics of different disciplines [43]. Furthermore, there is a consistent call for enhancing the science and technology evaluation system to prioritize innovation. This requires adhering to the principles of scientific research and effectively balancing foundational principles with innovative outcomes during the evaluation of basic research [44, 45].

China has initiated international science and technology cooperation initiatives that promote an open, fair, just, and non-discriminatory approach. Upholding the principle that "science knows no borders and benefits all humanity," China aims to build a global scientific and technological community [8]. Furthermore, collaborations between international institutions, such as Wiley and the Institute of Scientific and Technical Information of China, as well as the STM Association, underscore China's commitment to addressing the issue of scientific research integrity in the context of international cooperation [46].

To sum up, the future development trend of research integrity in China will be achieved through efforts in multiple aspects such as strengthening education and training, using information technology to improve management, innovating the research evaluation system, and strengthening international cooperation. These measures will help improve the integrity and transparency of the overall research environment and promote the healthy development of scientific innovation.

In short, the construction of research integrity in China is a long-term and complex process that requires the joint efforts of the government, scientific research institutions, universities, and researchers. By strengthening research integrity education and training, using information technology to improve research integrity management, promoting the innovation of the research evaluation system, and strengthening international cooperation, China will continuously improve the level of research integrity building and contribute to the construction of global research integrity.

5 | Conclusion

In summary, scientific integrity is of paramount importance in the scientific community, and China has made significant efforts to build and improve its scientific integrity system.

The achievements China has made in this regard deserve attention. Through policy formulation, for example, issuing the "Opinions on Further Strengthening Scientific Research Integrity Construction," a comprehensive framework covering various aspects of scientific research integrity has been established. Educational and training initiatives have been widely implemented in institutions, raising the awareness and standards of researchers on integrity. The application of technology has also played a key role in managing and monitoring scientific research integrity. Furthermore, international cooperation has enabled China to draw on global experience and contribute to international discussions on scientific research integrity.

However, challenges still exist. Identification and prevention of scientific misconduct, especially forms such as plagiarism and data fabrication, require further attention. The reform of the scientific evaluation system is a continuous process aimed at eliminating bias and focusing on the true quality and innovation of research. Optimizing the scientific culture and environment is also crucial for cultivating a scientific community with stronger ethical awareness.

Looking ahead, future trends indicate that China will continue to strengthen its scientific integrity system. This may include developing more complex information systems to track and manage integrity, further innovating evaluation systems to better reflect research quality, and enhancing international cooperation to address global integrity challenges. By addressing these challenges and following these trends, China can ensure the continuous improvement of its scientific integrity system, thereby contributing to scientific growth and credibility both domestically and globally. This will not only benefit China's scientific community, but also have a positive impact on the international scientific landscape.

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