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Research on the Impact of Scientific Research Integrity Mechanism Construction on the High-quality Development of Open Education Scientific Research and Countermeasures

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Abstract: Academic misconduct and scientific research integrity are twin issues. It is necessary to clarify the connotation of scientific research integrity. Through case analysis, explore the development process of the construction of the scientific research integrity mechanism. This article takes the scientific research information and scientific research management in the open education system of Yunnan Province in the past five years as an example, deeply analyze the potential factors of various academic misconduct or academic misconduct behaviors in scientific research integrity and their impact on the high - quality development of scientific research undertakings. This article starts from the information mechanism, system mechanism and supervision mechanism, put forward the countermeasures for the integrated implementation of the three - mechanism scientific research integrity mechanism construction: establish an information - based scientific research integrity file, explore the early warning methods and management mechanisms of scientific research integrity behaviors and states, and the linkage supervision mechanism of scientific research budget and financial budget integration.

1. Introduction

Integrity originates from the phrase "the wise man's sacrifice, to the utmost of his sincerity" in the ancient Chinese text "The Book of Rites - The General Rules of Sacrifices". It generally refers to being practical, honest, trustworthy, not deceitful, not falsifying, and having consistency between words and thoughts. In English, integrity, in addition to meanings such as "uprightness, honesty, not engaging in deception, trickery, hypocrisy, and various superficial tactics", also implies "firmly acting according to morals and standards". With the development of society and history, "integrity" has become a fundamental concept in the category of morality, with extremely rich connotations and extensions. However, its main theme is always to emphasize consistency between words and actions, sincerity, and keeping promises.

In the field of scientific research activities, it generally refers to the integrity of all subjects and objects involved in scientific research activities. Scientific research activities cover a wide range,

including academic activities, paper publication, textbook and book publication, software copyright application, patent application and authorization, project research, and all review, organization, evaluation, and application activities related to the above objects. The process involves applicants, authors, science and technology departments, production departments, application departments, education departments, and evaluation institutions. All subjects and objects are related to scientific research integrity. In the "Opinions on Strengthening the Construction of Scientific Research Integrity in Our Country", it is defined as: scientific and technological personnel promote the scientific spirit with the core of pursuing truth, being practical, advocating innovation, and open cooperation in scientific and technological activities, abide by relevant laws and regulations, adhere to scientific and technological ethics, and follow the widely recognized behavioral norms of the scientific community.

Correctly understanding scientific research integrity is the ideological prerequisite and consciousness foundation for adhering to scientific research integrity. Only by correctly understanding scientific research integrity can one maintain self-discipline and adhere to scientific research integrity in scientific research work.

2. The Current Status of Academic Misconduct Governance in Technical Means at Home and Abroad

2.1. International Status

In terms of the construction of scientific research integrity mechanisms abroad, the use of information technology in scientific research management for academic misconduct detection dates back to the 1970s[1]. Early research focused on text replication, employing techniques such as data fingerprinting, bag-of-words models, and longest common subsequence for character-level detection. Semantic detection methods included the use of ontological trees, fuzzy clustering, or semantic networks. Syntactic detection utilized n-gram models, conditional random fields (CRF), or hidden Markov models (HMM) [2]for sentence-level analysis to identify academic misconduct. These methods have evolved to include vector-based and deep learning approaches for cross-language plagiarism detection. Relevant platforms, in chronological order, include WorkCheck, Turnitin, PaperRate, and PlagTracker.

2.2. Domestic Status

In China, searching for keywords such as "scientific research integrity," "academic misconduct," "big data," and "intelligent detection" through authoritative data sources like CNKI (China National Knowledge Infrastructure) yields the following results:Papers on scientific research integrity is 725，Academic misconduct behaviors is 145， Scientific misconduct behaviors is 109,and Academic misconduct detection is 85.These studies primarily focus on the construction of scientific research integrity systems, academic misconduct detection technologies, policies and literature evolution related to scientific research integrity, classification of dishonest behaviors, and analysis of the causes of dishonesty. Tongfang and CNKI's Academic Misconduct Detection Platforms: These platforms use big data to detect academic text repetition rates and recommend related academic journals based on the field of research. Yipulage Journal Information Network: This network offers powerful system functions, combining digital fingerprinting and other technologies for classification and identification detection. AMLC (CNKI Scientific Research Integrity Management System): Utilizing a vast database of journals and research papers, this system performs text-based plagiarism detection. Wanfang PSDS System, VIP VPCS System: These systems combine digital fingerprinting and other technologies for classification and identification detection. These systems provide big data analysis services from the perspective of researchers, helping individuals and institutions effectively detect

and prevent academic misconduct.

2.3. The Three Stages of the Development of Scientific Research Integrity System Construction

The construction of the scientific research integrity system is synchronized with the development and changes of academic misconduct issues in scientific research integrity. In China, it has gone through the early stage, the stage focusing on system improvement, and the collaborative governance stage.

As early as 1981, Academician Zou Chenglu proposed to carry out discussions on spiritual civilization in scientific research work. Later, the Chinese Academy of Sciences (CAS), the Chinese Academy of Engineering (CAE), and the National Natural Science Foundation of China (NSFC) established institutions. The first joint conference system for the construction of scientific research integrity was composed of six departments: the Ministry of Science and Technology, the Ministry of Education, CAS, CAE, NSFC, and the China Association for Science and Technology (CAST). Later, the Ministry of Finance, the Ministry of Human Resources and Social Security, the Ministry of Health, and the General Armament Department of the People's Liberation Army were added, making a total of ten departments. This was the state of the early stage of the construction of the scientific research integrity system.

In the history of Chinese academia, in 2003, the "Hanxin Incident" at Shanghai Jiao Tong University occurred. A "Yangtze River Scholar" claimed that the team had developed the "Hanxin No. 1" chip. However, during the demonstration, a Motorola chip was used, with its logo erased and replaced with the "Hanxin" logo. Other chips in the series also had issues of exaggeration and deception. In 2012, Elsevier's "Optics and Laser Technology" retracted 11 articles after discovering that hackers had stolen editor accounts and sent articles to inappropriate "experts" for review. However, the authors were not held responsible, indicating peer review fraud. In the "Journal of Enzyme Inhibition and Medicinal Chemistry," an author submitted a paper, and the reviewer completed the review in less than 24 hours. Upon investigation, it was found that the author exploited a loophole in the journal's self-recommendation policy, forged emails and the names of false scientists with the same name, and sent review emails to themselves or colleagues for review. This incident ultimately led to the retraction of 28 papers, involving multiple parties in peer fraud. From 2015 to 2017, BioMedCentral and Springer's "Tumor Biology" and other journals retracted hundreds of papers, most of which were written by Chinese authors. The reason for retraction was that the authors fabricated reviewers and peer review comments. Springer, Talor & Francis, SAGE, Wiley, Informa, and other publishers' academic journals also retracted 110 papers due to six cases of peer review fraud. Various means were used by researchers, evaluators, managers, and even academic publishers to gain academic, professional, and economic benefits. The aforementioned academic misconduct seriously disrupted the academic ecosystem and was an absolute contradiction and shock to the spirit of scientific research. For three consecutive years, various incidents occurred frequently, with serious impacts. In May 2018, the "Several Opinions on Further Strengthening the Construction of Scientific Research Integrity" was issued. In 2019, the government work report for the first time included keywords such as "scientific research ethics" and "punishment of academic misconduct"[3]. Subsequently, in 2019, the "Opinions on Further Promoting the Spirit of Scientists and Strengthening the Construction of Scientific Research Style and Academic Style," the "Implementation Measures for the Construction of Scientific Research Integrity in Philosophy and Social Sciences," and the "Notice on the Rules for the Investigation and Handling of Scientific Research Integrity Cases (Trial)" were released. However, academic paper fraud in the medical industry was particularly prominent and continued to occur frequently. In 2020, the Ministry of Education specifically targeted the medical industry for self - inspection and cleanup of scientific research integrity, and at the same time, foreign

- language journal reviews in various fields were conducted, with academic misconduct incidents being continuously exposed. During this period, various departments issued a variety of systems from different perspectives such as teacher ethics, academic style, and scientific research integrity, and the construction of the scientific research integrity system developed to the stage of focusing on system construction.

With the in - depth application of information technology and artificial intelligence in the field of scientific research and the use of big data models, academic fraud behaviors have become more and more hidden and blurred. In 2022, Order No. 19 of the Ministry of Science and Technology, in the spirit of the "Science and Technology Progress Law of the People's Republic of China" and various scientific research integrity governance cases, it can be seen that the construction of scientific research integrity is becoming more and more important. The Ministry of Science and Technology and 21 other departments issued the "Notice on the Rules for the Investigation and Handling of Scientific Research Dishonesty" (Guo Ke Fa Jian [2022] No. 221). At the same time, the "Science and Technology Progress Law of the People's Republic of China" was issued on January 1, 2022, and scientific research integrity was managed in the form of formal legislation. In January 2023, the newly revised "Methods for the Investigation and Handling of Scientific Research Dishonesty in National Natural Science Fund Projects" was officially implemented. In February 2023, the National Health Commission, the Ministry of Education, the Ministry of Science and Technology, and the National Administration of Traditional Chinese Medicine jointly issued the "Notice on the Ethical Review Measures for Life Science and Medical Research Involving Human Beings." In July, they jointly issued the "Pilot Measures for Scientific and Technological Ethics Review" with the Ministry of Science and Technology, the Ministry of Education, the Ministry of Industry and Information Technology, the Ministry of Agriculture, the National Health Commission, the Chinese Academy of Sciences, the Chinese Academy of Social Sciences, and the Chinese Academy of Engineering, among ten other ministries. In April of the same year, multiple departments jointly issued the "Key Points of National Scientific Morality and Academic Style Construction Propaganda and Education Work in 2023." In July 2023, the National Standard Information Public Service Platform released the newly revised "Rules for the Compilation of Academic Papers." In December 2023, the National Natural Science Fund Commission released the "Scientific Research Integrity Norms Manual." The above actions indicate that the construction pattern of China's scientific research integrity system has evolved from the stage of system improvement to the collaborative governance stage.

3. The Current Status and Outstanding Issues of Scientific Research Integrity Governance in Open Education Environments

Taking the Yunnan Open Education System as an example, Yunnan Open Education serves not only the province but also extends its influence to South and Southeast Asia. In 2022, multiple departments including the Yunnan Provincial Department of Education, Department of Finance, Department of Human Resources and Social Security, and the Rural Revitalization Bureau jointly issued the "Guiding Opinions on the High-quality Development of Yunnan Open Education." This document clearly outlines the goal of building an integrated development system that spans from secondary to graduate levels. Currently, open education serves more than 200,000 people in non-degree education across various industries. The open education system has approximately 800 staff members, of which 420 hold a master's degree or higher, and 234 hold a senior professional title or above. There are about 300 dual-qualified teachers who engage in practical work on the front lines of enterprises, accounting for approximately 50% of the total. This indicates a reasonably structured scientific research talent team. The outstanding issues in the development of scientific research in Open education environments is:

3.1. Lack of Cohesion in the Research Talent Team

Inadequate Team Dynamics and Outcomes: Although the proportion and age distribution of research personnel appear reasonable, there is a significant issue of individual project responsibility without collective effort. Members are often listed in name only, contributing minimally to the actual work, and sharing research outcomes for evaluation purposes. Project leaders, due to concerns over technical confidentiality or personnel turnover, are reluctant to lead teams in in-depth academic discussions, leading to a poor academic atmosphere. Overall, the research talent team lacks cohesion and has not formed a results advantage that can provide a solid team foundation for professional shaping or enhancing professional influence.

3.2. High Funding Allocation but Low Execution, Insufficient Supervision in Scientific Management

Budget and Execution Discrepancies: There is a separation between project budgeting and execution, resulting in poor project implementation and low funding execution rates. Delays in project completion lead to various management issues, increased management costs, and damage to the reputation of research management. The sharing of research outcomes and information is poor, making it difficult to verify the authenticity and innovation of results, and the effectiveness of democratic supervision is not realized. The dispersion of research focuses and poor sharing of research outcomes and information, lead to the wastage or unreasonable configuration of talent and research resources. This also results in a disconnect between research content and societal needs, preventing the timely conversion of scientific and technological achievements into theoretical value and production processes.

3.3. Diverse Publication Channels and Lack of Stable Criteria for Defining Research Outcomes

Unstable Standards and Value Orientation: The publication channels for research outcomes are diverse, and there is no relatively stable standard for defining outcomes. The sole focus on titles has led to widespread practices of buying and selling papers, books, and patents, with non-authentic research outcomes driving out the social benefits of positive results.

3.4. Lack of an Established Integrity Awareness in the Research Talent Team

Lack of Understanding and Awareness: Our school's research team is unfamiliar with the research integrity systems and requirements from higher authorities, schools, or industries. The signing of various integrity commitment letters is merely formalistic, and the awareness is weak[4]. On the other hand, there is a vague understanding of common violations of research integrity or academic ethics, such as false authorship, impersonation, improper authorship, and authorship without substantial contribution. The responsibility awareness of the research-reliant units is poor, and basic integrity checks, such as verifying the authenticity of the applicant's achievements, are not conducted. The cost of violating research integrity is low. Most management institutions do not adequately hold accountable research projects and their leaders for causing adverse effects, leading to low costs of dishonest and a lack of awareness of responsibility and dishonest behavior in research tasks.

4. Countermeasures for the Construction of Scientific Research Integrity Mechanism in Open Education

Preventing and supervising early signs of misconduct in research is a necessary measure to curb

academic dishonesty. The development of research talent is the driving force behind the high-quality development of educational endeavors, and a positive and honest research environment is the cradle for cultivating and shaping research talent. A recent survey by the China Association for Science and Technology (CAST) revealed that only about 40% of research funds are used for the projects themselves, with a significant amount of research funding being lost outside of the projects. Researchers and individuals involved in the research management process exploit systemic loopholes to illegally obtain economic benefits through research projects. Methods include issuing false invoices, plagiarism, forging contracts, creating fake seals, fabricating official letters, improper authorship, impersonation, and manipulating projects in various ways. This has caused severe pollution and destruction to the research ecosystem, especially under the premise of increased investment in research across various national fields.

Utilizing big data decision-making information to track and supervise research behavior, particularly during the funding execution phase, can provide early warnings and monitor unethical events related to the identity of researchers and their funding behavior. This can help reduce or avoid the aforementioned harms and form a positive potential benefit in reducing the loss of national fiscal investment through technological means.

In recent years, including in our province, universities across the country have faced investigations into suspected research paper misconduct, causing significant harm to the reputation of schools, individual careers, management costs, and the normal order of society. Under the background of deregulation, decentralization, and improved services, the objectivity, fairness, and standardized efficiency of research management behavior are requirements for the academic ecological environment of school research talent team building and research innovation drive. How to use all available information resources and data means in a complex information environment to create a research innovation service platform and establish a collaborative governance mechanism for the right development of the research talent team is an urgent requirement for the integrity construction of all universities and research institutions.

From the perspectives of managers, applicants, reviewers, and data users, a questionnaire survey on research integrity was conducted. Conduct an in-depth analysis of the problems in the process of building the scientific research integrity mechanism. The following three countermeasures are suggested:

4.1. Construction and Supervision of Research Integrity Files Based on Research Platform Construction

The management department builds a basic database based on information technology data management. Based on research results and management process data, form a big data information database with complete and available information fields for studying integrity documents. This provides a digital and standardized data foundation for data-driven decision-making in academic behavior and funding warnings. Management workers collect various management and material data in detail during the research of management processes, carefully organize the business processes of the management process, and form a complete research data base. This includes research projects, research outcome applications, talent resource libraries, research infrastructure, expert databases, research outcome information libraries, and funding income and expenditure subject libraries[5].

4.2. Exploration of Early Warning Methods and Management Mechanisms for Research Integrity Behavior and Status

Combine business processes and problem sets to tease and form a problem list. This provides early warnings for research behavior risks and topic guidance for researchers, as well as warnings for

management decisions. It offers scientific decision-making criteria for research organization management activities such as project initiation, project review, project optimization, and project completion. It also provides convenient and reliable data information services for business activities that require basic research management data, such as title review, funding execution warnings, project initiation judgments (such as multiple initiations of the same topic, multiple reports of the same project, non-compliant budgets), article publication, and other related activities.

4.3. Exploration of Data Authorization and Information Sharing Methods Based on Multi-platform Block-chain, and Research on the Linked Supervision Mechanism of Research Budget and Financial Budget Integration

Before the initiation of research projects, the main focus is on verifying the authenticity of achievements and team members in various supporting materials. During the execution phase, it involves verifying the authenticity and innovation of published content and channels, as well as the expenditure items and destinations of funding. These processes involve multiple departments such as human resources and finance, and even the relevant project management authorities. Information on multiple platforms is generally reviewed based on institutional checks, with unified registration and management of information for identification and authentication. However, limited human resources often fail to grasp the complete set of relevant information. Through data authorization based on multi-platform block-chain, joint reviews of personnel, achievements, and funding execution can be achieved to a certain extent, which is a way to build integrity in research behavior.

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