

Research on the Optimization Paths of a Diversified Evaluation Mechanism for Professional Technical Talents in Natural Science Research at Universities under the Background of “Breaking the Five Onlys”

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Abstract: The “Breaking the Five Onlys” reform is a significant initiative in the new era for advancing the integrated development system and mechanisms of education, science and technology, and talent, and it is also a crucial requirement for supporting high-level scientific and technological self-reliance and promoting Chinese modernization. This paper leads into the evaluation of professional natural science researchers in universities and gives a systematic analysis of the deep-seated issues in the present evaluation mechanism: unclear orientation, ambiguous standards, rigid output indicators, the disconnection between research outcomes and applications, and insufficient impact. It proceeds to explore aspects such as formulating classification standards, enriching evaluation subjects, and optimizing the review mechanisms, and to build a diversified and classified evaluation system, based on in-depth research into the laws governing scientific research in natural sciences and the growth of scientific talents. This system strives to break through the stubborn problems and seeks to achieve a fundamental transformation in evaluation: from a “quantity-oriented” approach to a “quality-oriented” one, from an “individual-oriented” approach to a “strategy-oriented” one, and from a “single academic orientation” to a “diversified value orientation”. This transformation aims to inject strong momentum into achieving high-level scientific and technological self-reliance and building a leading nation in science and technology.

Keywords: Evaluation mechanism; Professional technical talents; Natural science research; Breaking the Five Onlys

1. Introduction

China is currently at a critical juncture for advancing high-level scientific and technological self-reliance. The official documents emphasize that “We shall improve the evaluation system for science and technology talent, firmly break away from the inappropriate practices of ‘valuing only papers, professional titles, academic degrees, awards, and talent labels’, and accelerate the establishment of mechanisms conducive to talent development, optimal talent utilization, full demonstration of individual strengths, and the emergence of outstanding talent through fair competition.” As the core force driving scientific innovation and the primary entity of independent talent cultivation, professional researchers in natural sciences at universities play an irreplaceable role. [1]The design and implementation of a well-targeted, scientifically rigorous, and operationally smooth evaluation system for this group will directly determine the effectiveness of promoting the integrated development strategy of “education, science and technology, and talent.”

2. Problems Facing the Evaluation of Natural Science Research Talents in Universities

For a long time, the single quantitative evaluation model guided by the “Five Onlys” (valuing only papers, professional titles, academic degrees, awards, and talent labels) has dominated the field of natural science research. Under this model, researchers are trapped in a developmental dilemma characterized by “prioritizing quantity over quality, form over substance, individual achievements over teamwork, and research over teaching”. Such drawbacks have severely restricted the enhancement of original innovation capabilities and the breakthrough of technological stranglehold. The main manifestations are as follows.

The evaluation system clearly lags behind the requirements of high-quality development, since the quantity-oriented evaluation model does not well identify or reward high-quality contributions. Educational evaluation places undue weight on easily quantifiable indicators such as publication counts, research funding, and talent “labels”, thereby ignoring the fundamental concept of quality. Worse still, evaluation criteria are out of step with the development goals of education, science and technology, and talent, which leads evaluation to become an end in itself rather than a means to an end. Consequently, university faculty tend to adopt a quick-fix mindset and detach from their original mission of serving national strategic needs.

Subsequently, the evaluation orientation weakens the basic task of fostering virtue through education. It is clear that the “Five Onlys” reduce the work value of university teachers to measurable outputs, thus overemphasizing quantifiable research achievements while ignoring their fundamental duty of teaching and educating students.^[2] More seriously, the intrinsic values of education, such as character cultivation and value shaping, are ignored, which leads to the gradual dilution of the fundamental proposition of “what kind of people we should cultivate, how, and for whom”.

Last but not least, the core goal of scientific research has departed from its proper direction during the critical period of tackling technological stranglehold, since the persistent issue of the “Five Onlys” has led to the neglect of cultivating basic research capabilities and original innovation capabilities, hence weakening the overall effectiveness of the national innovation system. Even worse, researchers have forsaken the inherent value of academia in seeking mere accumulations of achievement, which therefore hinders the development of the composure and competence required to address major strategic challenges, and ultimately blocks progress in key restricted areas.^[3]

3. Main Factors Influencing the Evaluation of Natural Science Research Talents in Universities

The scientific rigor, standardization, and fairness of evaluating natural science research professionals in universities hinge critically on the design quality and operational effectiveness of each component within the evaluation mechanism. Broadly speaking, the evaluation system for professional research talents mainly comprises five interrelated dimensions: objects, criteria, subjects, procedures, and results. Therefore, clarifying these five dimensions and constructing a sound evaluation system for scientific and technological talents is the key to obtaining high-quality evaluation results.

3.1. Evaluation Objects

Presently, universities, research institutions, and enterprises constitute the principal actors in conducting scientific research within society. With their unique advantages in talent aggregation and academic ecology, universities have formed a relatively complete scientific research output process. High-level talents with professional qualities are required to ensure connection and drive progress. Based on the content and type of scientific research activities, natural science research talents in universities can be classified into the basic research category, applied research category, and scientific service category. According to job positions, they can be classified into research-oriented, teaching-research-oriented, teaching-oriented, and technology transformation-oriented types.

3.2. Evaluation Criteria

Evaluation criteria are closely linked to the quality of evaluation results and serve as a key indicator of the competence of natural science researchers.^[4] The criteria should be guided by innovation capacity, quality, effectiveness, and contribution, while reflecting the characteristics of university researchers and natural science research. First-level evaluation indicators should be designed based on dimensions such as ideological quality, education quality, research competence, achievement contribution, academic influence, and development potential. To systematically measure the overall quality of natural science researchers, an evaluation index system that is comprehensively covered horizontally and detailed vertically should be constructed.

3.3. Evaluation Subjects

The outputs of natural science research talents cover a wide range of fields and application scenarios. The quality of their achievements and the competence of researchers require evaluation by professionals in relevant fields. According to evaluation objects and the types of achievements, evaluation subjects

should include domestic and foreign colleagues and experts, third-party evaluation institutions, government departments, and market users. With evaluation judgments delivered by multiple subjects, the quality and practical value of achievement contributions can be objectively assessed, hence the evaluation conclusions will be scientific and fair.

3.4. Evaluation Procedures

A scientific and reasonable evaluation procedure is a fundamental prerequisite for conducting effective evaluations and obtaining objective results. The evaluations of various scientific research activities vary in content, and thus, there are also differences in the design of the evaluation procedures. However, the procedures generally share a common, well-established framework: evaluation initiation, individual application, document review, expert assessment, result formulation, and record filing. Since the competence, expertise, and professionalism of the experts concerned are the fundamental factors determining the quality of the final evaluation results.

3.5. Evaluation Results

The evaluation results are the final stage of the evaluation system, and are usually regarded as an important reference for the promotion and development of natural science researchers, the distribution of performance rewards, and the assessment of talent qualifications. Hence, the proper application of evaluation results is essential for guiding natural science researchers toward the right research orientation. Since creating a favorable academic environment is conducive to the high-quality development of scientific research work, it is therefore very natural and necessary to design the content and form of evaluation results so that they more accurately reflect the quality of research achievements and the capabilities of scientific talents, thereby making the evaluation results more objective, fair, and credible.

4. Reconstruction of the Evaluation System for Natural Science Research Talents in Universities in the New Era

Since it is necessary to establish a talent evaluation system oriented toward innovation value, capabilities, and contributions, this paper first analyzes the growth patterns of natural science researchers and the distinguishing characteristics of research in different fields: basic research, applied research, and technological services, thereby naturally leading to the construction of a diversified evaluation system that is “distinctly strategic in orientation, scientifically defined in classification standards, diverse in evaluation subjects, inclusive in outcome recognition, precise in result application, and strongly supported by an ecosystem”. This system implements systematic reforms along the six dimensions: calibration orientation, redefinition of standards, optimization of entities, innovation in recognition, strengthening of application, and fostering of an ecosystem. This paper further elaborately refines talent classification, strengthens academic evaluation, expands evaluation methods, enriches development channels, and thus helps scientific and technological talents to determine their position, clarify their direction, and plan their path, thereby leading to the construction of a scientific and technological talent evaluation system based on innovation value, capability and contribution, which provides theoretical and practical support for evaluating natural science research talents.

4.1. Calibrating Evaluation Orientation: Anchoring National Strategies and Quality Core to Establish the Critical Basis for Evaluation Decisions

This paper gives a very clear, logical exposition of the fact that serving the “Four Orientations” and supporting high-level scientific and technological self-reliance are the fundamental evaluation criteria, hence it naturally steers researchers to align their personal academic research with national strategic needs and to pursue the coordinated development of “personal growth” and “national development”. In addition, this paper proposes evaluation dimensions based on a well-articulated value orientation of “quality priority and contribution orientation”, and treats basic research talents and applied research talents quite differently: for the former, original innovation capabilities, the academic value of scientific discoveries, and the practical disciplinary impact of research outcomes are given greater weight, while for the latter, the efficacy of technological development and the industrial transformation value of research outputs are the focus. It highlights practical achievements in solving major technological bottlenecks and the breakthroughs in fundamental technical fields. For scientific and technological service talents, we focus on the evaluation of the efficiency of social public services and the value of

industry empowerment, with concrete examples of scientific results applied to regional development and people's livelihood. Meanwhile, we take scientific research integrity as the "first standard" for evaluation, and establish a negative list system for academic misconduct, which clarifies 12 types of "one-vote veto" situations, such as plagiarism and data fraud. A full-chain integrity governance system of "pre-warning, in-process supervision, and post-accountability" is constructed, thus consolidating the bottom line of ideological morality and academic norms for researchers.

4.2. Reconstructing Evaluation Criteria: Implementing Classified Policies and Dynamic Adaptation to Break the "One-Size-Fits-All" Dilemma

Scientific evaluation criteria are the core support of a diversified evaluation system, with the key lying in achieving "precise classification, adaptive standards, and dynamic adjustment."^[5] Based on disciplinary differences in the field of natural science research, classified evaluation criteria should be constructed according to post types and disciplinary characteristics. First, positions should be divided into four categories by research type: basic research, applied research, technology development, and interdisciplinary research. Second, disciplinary groups should be categorized by disciplinary attributes, such as natural sciences, engineering, agriculture, and medicine, forming a differentiated evaluation system with "one standard per category, one requirement per level, and one characteristic per discipline."

In a specific implementation, the formulation of diversified indicators should be emphasized. For basic disciplines, "theoretical innovation and academic influence" should be highlighted, with qualitative indicators such as "original achievements and disciplinary leading role" set up, while quantitative requirements such as the number of papers and impact factors should be weakened. For engineering and technology disciplines, "technological breakthroughs and transformation effectiveness" should be emphasized, with core indicators including "income from patent transformation, formulation of technical standards, and application in major projects." For interdisciplinary disciplines, "cross-border integration and innovation value" should be focused on, with characteristic indicators such as "interdisciplinary collaborative achievements and contributions to the development of emerging directions" established.

Meanwhile, a strategy-oriented dynamic adjustment mechanism should be established. Evaluation criteria should be optimized and updated regularly based on national major strategic deployments (such as the "dual carbon goals", artificial intelligence, and biological manufacturing) and disciplinary development trends (such as the rise of interdisciplinary disciplines and the transformation of basic research paradigms), ensuring that evaluation criteria always align with national needs, disciplinary development, and talent growth.

4.3. Optimizing Evaluation Subjects: Improving Peer Review and Diversified Participation to Enhance Evaluation Professionalism

The diversification of evaluation subjects is the key to ensuring evaluation fairness, with the core lying in constructing an evaluation pattern of "peer-led, multi-party participation, standardized and orderly." Breaking the limitation of a single internal evaluation, a "three-level peer review system" should be built. The first level is internal peers within sub-disciplines (experts in secondary disciplines), focusing on professional review of research details. The second level is domestic peers (authoritative experts in the same field across institutions), expanding the comprehensiveness of evaluation perspectives. The third level is international top peers (academicians, distinguished young scholars, etc. from renowned overseas universities and research institutions), enhancing the internationality of evaluation standards.

To ensure the quality of review, an age structure ratio of 3:5:2 for senior, middle-aged, and young experts should be implemented, ensuring that the review has both accumulated experience and innovative perspectives. Besides, channels for diversified evaluation participation should be broadened. In the field of applied technology, we invite industrial experts such as technical directors of leading enterprises, national industry standard setters, and chief engineers of major projects to participate in evaluation, focusing on examining the engineering and industrialization value of achievements. In the field of social services, we introduce relevant government departments, service recipients, and third-party evaluation institutions to participate, with "service effectiveness, user feedback, and social impact" as the core evaluation basis. In the interdisciplinary field, we form a joint review team composed of experts from different disciplines, industrial representatives, and policy researchers to achieve a comprehensive evaluation of "academic value, industrial value, and social value," forming a multi-party collaborative evaluation network of "academic peers + industrial experts + policy departments + third-party institutions." The tenure system, avoidance system, and accountability system for review experts should

be implemented, fundamentally eliminating problems such as “human relationship-based review” and “interest-related review” through institutional design.

4.4. Innovating Achievement Recognition: Promoting Diversity, Inclusivity, and Team Orientation to Highlight the Core of “Innovation Value”

Diversifying achievement recognition is crucial for moving beyond the “publication-only” mindset, with the core objectives of embracing diverse output formats, focusing on substantive value, and acknowledging team contributions. A representative achievements evaluation system should be comprehensively implemented to replace the traditional model of “quantitative accumulation.” A “3+3” achievement declaration mechanism can be adopted: researchers independently submit three representative achievements, which may encompass diverse forms such as research papers, patents, technical reports, technology transfer agreements, developed standards, major engineering applications, and science popularization outputs. Each achievement should be accompanied by three supporting items (e.g., citation data, peer review comments, evidence of transformation impact), with the evaluation focusing on the achievement’s core innovation, academic influence, practical value, and overall contribution.

For basic research achievements, the evaluation should prioritize originality, the degree of recognition by international authorities, and breakthrough contributions that may lead to paradigm shifts within the discipline. For applied research achievements, the evaluation should focus on tangible outcomes, such as implementation effects in major engineering projects, revenue generated from patented inventions, and leadership in developing industry standards. Besides, the evaluation of team-based achievements must be strengthened. A Principal Investigator (PI) responsibility system should be established, where the university-level academic committee recognizes collective outcomes, such as major research projects and breakthroughs in core technologies in key fields accomplished by teams. The PI should be authorized to allocate credit quantitatively among team members based on their respective contributions, with this allocation serving as a significant basis for individual performance assessment. Furthermore, exploring the establishment of a “greenway” for significant original achievements is recommended. Outcomes achieving “from 0 to 1” original innovation, solving critical technological stranglehold, or generating significant international impact could, upon recommendation by internationally renowned peers and subsequent approval by the academic committee, be directly considered as the primary basis for professional promotion or selection into talent programs, exempt from conventional restrictions related to years of service, seniority, or standard quantitative indicators.

4.5. Strengthening the Application of Evaluation Results: Achieving Targeted Incentives and Resource Allocation to Activate “Innovation Power”

The scientific application of evaluation results is the final link in the evaluation system, with the key objective of achieving “targeted incentives, optimized resource allocation, and empowerment for development.” An integrated mechanism linking “evaluation-incentives-resource allocation” should be established to deeply connect evaluation results with individual career progression, team building, and disciplinary development. In terms of professional promotion, an “exceptional promotion channel for innovative contributions” should be created. Individuals who achieve significant original innovations or breakthroughs in key core technologies may apply for senior professional titles directly, exempt from conventional restrictions such as years of service or publication counts.

Regarding resource allocation, a “strategy-oriented resource prioritization mechanism” should be constructed. Evaluation results should serve as the primary basis for allocating research funding, student recruitment quotas, and platform development resources. These resources should give priority to basic research, critical core technology fields, outstanding teams, and core talents. High-performing teams should be granted lump-sum research funding with autonomy over its use. Teams led by strategic scientists should be prioritized for access to national-level research platforms and major project application quotas, with “one-person-one-plan” resource support schemes developed.

From the standpoint of disciplinary development, it is clear and logical that the evaluation results should serve as the basis for decisions on disciplinary structure adjustment and talent recruitment. Therefore, disciplines with outstanding evaluation performance and major strategic contributions deserve intensified support for talent recruitment and the construction of interdisciplinary platforms. Conversely, disciplines poorly aligned with national strategic needs or with unsatisfactory evaluation results should be subject to “time-limited rectification and resource reallocation” measures to ensure disciplinary

development remains tightly coupled with national priorities.

4.6. Cultivating a Robust Evaluation Ecology: Completing Support Systems and Fostering an Inclusive Environment to Nurture Innovation

A favorable evaluation ecology is essential for the successful implementation of a multi-dimensional evaluation system. Therefore, the fundamental step is to create a positive environment with clear "institutional guarantee, technical support, and cultural guidance". Hence, institutional guarantees should be strengthened by defining the evaluation process, standards, and responsibilities in a concrete manner, while evaluation policies, standards, procedures, and results should all be transparent. It is also advisable to introduce a third-party supervision mechanism and an academic observer system to ensure the evaluation process is truly open, transparent, standardized, and orderly.

To strengthen technical support, it is essential to build an intelligent evaluation platform based on big data and artificial intelligence technologies, integrating multi-source data such as paper citation data, patent conversion information, project acceptance results, and industry evaluation feedback. Then, by constructing an intelligent analysis model that combines qualitative indicators with quantitative data, the platform can automatically generate an objective, reliable report on the evaluation of achievement value, thus improving evaluation efficiency while reducing human subjective bias.

Since promoting cultural guidance requires the deliberate cultivation of a system culture that combines "fault tolerance and error correction with encouragement of innovation", it is scientific to state that failures arising from unintentional non-malicious actions in scientific research, which do not seek personal gain, will be tolerated and exempt from liability, without affecting individual evaluations. An annual "innovation contribution award" should be held to recognize major original achievements and teams that have made breakthroughs in key technologies. Publicizing the heroic deeds of outstanding role models and cases of academic misconduct will help foster a healthy ecosystem that "values innovation, tolerates failure, advocates practical action, and rewards contribution", which is conducive to researchers concentrating on their work.

5. Conclusions

The transformation of the evaluation system for university-based natural science researchers is a fundamental and necessary change in the context of scientific research and talent development in China. "Breaking the Five-Onlys" is not only an administrative adjustment but a deliberate realignment of values and incentives.^[6] The paper proposes a six-dimensional framework—recalibrating orientation, reconstructing criteria, diversifying subjects, innovating recognition, strengthening application, and cultivating ecology—that constitutes a complete, logically structured plan for the transformation. The clear and admirable goal is to create a research environment in which quality outranks quantity, collaborative and strategically planned work is given due weight alongside individual academic achievements, and different forms of excellence can all thrive. Hence, such a reformed ecosystem is precisely the soil in which original innovation and major breakthroughs are most likely to grow, which in turn is essential for achieving high-level scientific and technological self-reliance and for securing China's position as a global leader in science and technology. While the path is not easy, the destination is certainly worth the effort.

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