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Review article

Research and perspectives on criteria for evaluation of nursing research achievements☆

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ABSTRACT

This paper introduces concepts related to scientific research achievements, analyzes current evaluation methods with regard to nursing research achievements and their application at home and abroad, and summarizes findings from the investigation of obstacles to the application of nursing research results in China, aiming to provide reference points for the evaluation and application of nursing research results in China.

1. Introduction

The evaluation of nursing research results consists of the examination and determination of the scientificity, creativity, and scientific value of these results and the assessment of the specific quality and benefits of these results. With the ongoing development of the subspecialties of nursing, the cultivation of high-level talents, and increased funding support of nursing research by national governments, nursing research has achieved increasingly notable results. The evaluation of nursing research results has thus become a topic of critical interest that is receiving pointed attention from the current management agency and related researchers. Gennaro et al[1] believe that effective application of nursing research results in practice is not only beneficial to the healthcare of patients but also to promoting the development of nursing as an independent discipline. Therefore, evaluation of nursing research results requires greater attention. At present, few studies on the evaluation criteria of nursing research results have been conducted in China, which limits the transformation of nursing research results into practice. This paper provides an overview of progress in research on the evaluation criteria of nursing research results at home and abroad.

2. Concepts related to nursing research results

2.1. Research results

Scientific research results refer to the results of research on the objective law of a problem in a certain research field.[2] They are expressed in different forms, such as papers, books, patents, standards, products, or drawings by scientific researchers based on their research and understanding of a problem.[3]

Scientific research results are characterized by four basic elements: basic research results must be evaluated by an authorized agency, while applied research results must be proven by practice; scientific research results must have a social impact and economic benefits; they must be expressed in a generally accepted format, such as papers, books, or reports; and they must have clear conclusions, such as the establishment of new theories, new hypotheses, new concepts, or new strategies.[4]

2.2. Nursing research results

Nursing research results refer to the results of research on the objective law of a problem in the nursing research field. Nursing

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research results are expressed in the form of nursing monographs, papers, investigation reports, or research reports. They have three attributes: innovation, scientificity, and transformability. They are the main driving force in the development of nursing science.[5]

2.3. Application of research results

The application of research results is termed research utilization (RU) in foreign countries. RU is derived from early exploratory research by Rodgers[6] and refers to the process of applying research-based knowledge to clinical practice.

2.4. Evaluation of scientific research results

Evaluation is a cognitive activity aimed at understanding the objective world and assessing the value of an object/matter. Its essence is to reveal the value relationship between the subject and the object. Evaluation is an organized whole composite of different levels of evaluation criteria according to the logical structure of the object/matter that is being evaluated. A system of evaluation guidelines is a set of systematic and closely related criteria or specific criteria that reflect the whole object/matter being evaluated. The establishment of a system of evaluation guidelines is the process of transforming value standards into a system of guidelines.[7] According to Weinberg's rules,[8] establishing a system of evaluation guidelines for basic research results should be based on internal guidelines regarding scientific contribution and external criteria regarding potential social and economic value.

3. Study on the guidelines for the evaluation of nursing research results in other countries

The evaluation criteria commonly used in other countries mainly include three aspects: the quality, quantity, and impact of research results.[7] The evaluation of scientific research results in other countries has the following characteristics: (1) legal protection; (2) funded but not directly evaluated by government; (3) quality of results is the most important evaluation criterion; (4) includes a combination of quantitative and qualitative evaluation methods; and (5) undergoes an open and transparent assessment process.[9] When systems of evaluation guidelines have been established in foreign countries, indicators gauging the quality of results have received particular attention. For example, the research assessment exercise (RAE) in England does not require a large quantity of scientific research results but only requires researchers to provide four pieces of representative scientific research results. In the Netherlands, in addition to a list of publications, the basic scientific research evaluation guidelines also require researchers to provide five key publications and indicators of their quality and reputation.[7]

3.1. US

Scientific and technological evaluation started in the 1920s in the United States. The “Technology Assessment Law” was passed in 1972, and the “Government Performance and Results Act” was passed in 1993 by the 103rd Congress,[9,10] providing legal protection in the form of legislation for scientific and technological assessment activities. Under the impetus of this Act, assessment strategies have played a significant role in science and technology performance evaluation activities.[11] Evaluation indicators commonly used in the United States currently include citation, direct products based on the research, long-term indirect results of a project, humanistic development, rate of return, and other economic indicators as well as the international status of the research results.[12,13]

Two independent subsystems have been formed for scientific research innovation evaluation in the US: one is the evaluation subsystem based on peer review of papers in academia, while the other is the evaluation subsystem based on transformation of productivity in industry.

3.2. UK

The evaluation agency in the UK is composed of the government, research institutions, and technology intermediaries. The assessment of national scientific and technological development is performed by the government, while the evaluation of specific research results and scientific research institutions is conducted by specific research institutes and intermediaries.[11,14] To evaluate basic science research results, the UK has been using as the evaluation criteria the quantity and quality of scientific publications by the scientific researchers responsible for the results in journals of different levels internationally and domestically. To reduce the emotional factors present among individuals and objectively evaluate scientific and technological results, all the papers reviewed by the British Science Policy Research Unit are anonymous, with contact between the authors and the reviewers was prohibited during the review.[7] Evaluation criteria commonly used in the UK currently include peer review, citation in literature, quality and impact of publications, invitations to present at domestic and international academic conferences (the main indicator for recognition by peers in the UK and the world), and awards.[15]

3.3. Germany

Scientific and technological evaluation started in the 1940s in Germany and originated from the science motion submitted to the parliament by the original West German government.[16] Evaluation criteria commonly used in Germany currently include the number of achieved scientific results, number of published papers, domestic and international awards, and reputation. The most important measure is the leading position of specific scientific and technological results domestically and internationally and their role in international organizations.[17]

3.4. Japan

In Japan, the factors considered in the evaluation of scientific research results include published papers, books, recognition in the field, number of invitations to present, involvement in personnel training and exchanges, research innovation and guidance capability, application in technology development, and supplement to theoretical basis.[18]

3.5. Other

In recent years, foreign scholars in the field of scientific research evaluation have conducted an active exploration to promote the application of the critical realism method in the field of nursing research. McEvoy and Richards[19] showed that critical realism is a new philosophical perspective, which combines ontological realism and epistemological relativism and develops into a mature form of relativism. The potential benefits of adopting critical realism can be considered from two aspects in scientific research evaluation: theory-oriented program evaluation and policy evaluation. Clark et al[20] showed that critical realism is conducive to understanding complex conclusions, which ensures the optimization of the intervention and is applicable to studies in the field of biological psychology and social medicine. In 2005, Professor Jorge Hirsch, a physicist at the University of California, San Diego,

proposed the h-index. A person's h index indicates that this person has at most h papers, among his n papers, that have been cited at least h times, which is a method to quantitatively evaluate the quality of a person's publications. The h-index is an indicator of both publication productivity and citation impact. According to its definition, the h-index can be used to evaluate the academic achievements of scientific researchers and the scientific research level of scientific research institutions or a specific scientific research project, which is useful in the review process of academic journals.[21] A number of scholars have suggested that the scientific citation index SCI) can be used not only as a literature search tool but also as a basis for scientific research evaluation.[3]

4. Studies on the guidelines for evaluation of nursing research results in China

4.1. Studies on evaluation criteria of scientific and technological research results in China

Evaluation of scientific and technological results is an important part of scientific research management. The evaluation of science and technology has long adopted qualitative evaluation methods. Qualitative evaluation involves evaluating an object and drawing non-quantitative conclusions, and its major form in practice is peer review. With the rise of scientific metrology (including bibliometrics, patent analysis, econometrics, cost-benefit analysis, etc.), quantification is also applied in scientific and technological evaluation. Quantitative evaluation involves performing calculations using data relevant to scientific research activities and the results in question and reaching quantitative conclusions based on a model, in particular with the addition of the external quantitative evaluation of scientific and technological results. Semi-quantitative evaluation methods are used in scientific evaluation, which is a third type of evaluation method for basic scientific research results between quantitative and qualitative evaluation, such as the case study and retrospective study methods.[22] Studies have shown that pure quantitative or qualitative research makes an evaluation susceptible to bias and have thus recommended a combination of qualitative and quantitative evaluation as well as a combination of internal evaluation and external evaluation.[22] At present, the methods most commonly used in the evaluation of scientific research are the peer review method, the Delphi method, bibliometrics, analytic hierarchy process, case study, and retrospective study.[23–25]

In the 1980s, the peer review mechanism was formally introduced in China.[26]

Peer review generally includes several formats, such as peer review through correspondence, expert or committee peer review, on-site peer review, and internal peer review.[22,26] Peer review is the most commonly used method of scientific and technological results evaluation, which fully embodies the wisdom and experience of experts. However, it is also affected by many factors, which makes it difficult to be completely fair. Because it is a qualitative expression of personal opinion, peer review is inevitably impacted by the academic level, academic perspective, and even personal qualities of the expert reviewers to a certain extent in terms of understanding the evaluation criteria, even when a system of guidelines is used. Therefore, the evaluation results exhibit a certain degree of randomness and are susceptible to overestimating the scientific value of the research results. In addition, new disciplines continuously emerge, with increasingly finer classifications, and the evaluation of interdisciplinary research results is increasingly subject to the limitations of the research fields of the expert reviewers. It is thus difficult to perform an objective evaluation of all research results. At present, the evaluation of scientific and technological results still lacks unified, scientific, simple, and applicable evaluation criteria and methods, which makes it difficult for expert reviewers to grasp evaluation standards. The fairness and objectivity of peer review may be threatened due to interpersonal relationships and conflicts of interest, which may even lead to the emergence of the “Matthew effect.”[27] Therefore, peer review experts must be carefully selected, and their own research field must be aligned with the field of the research results to be reviewed. A confidential system should be established, and double-blind review should be adopted to ensure the scientificity, objectivity, and fairness of the review. At the end of the 1950s, Delphi proposed providing experts sufficient time to systematically and anonymously address complex issues using their own knowledge. The core idea was to seek expert advice through multiple rounds of anonymous letter exchanges. Through systematic summary and feedback in each round of collected expert opinions, the expert opinions become consistent, to ultimately reach more consistent and reliable conclusions or plans.[28,29] In the absence of psychological stress, the experts become familiar with the topic before providing a clear answer to predictive proposals. In addition, multiple consultations are required when the review cycle is long, and a wide range of topics are covered. The final results of expert evaluation present a certain degree of instability particularly when they are based on a statistical distribution. The intuitive evaluation opinions of different experts and their coordination cannot be completely identical, and thus, this method has its limitations.[30–33]

In the study of scientific and technological results evaluation, the bibliometric method has been applied to the evaluation of scientific research results, mainly through examining the number of papers, publications as book chapters, type of domestic and international journals in which the results were published, citation in other scientific papers, citation rate, average frequency of citation, and impact factors.[25]

Analysis based on quantitative indicators has strong scientific and rigorous attributes and is independent of individual subjective factors and other non-scientific factors, which facilitates standardization of evaluation behaviors.[27] As a periodical literature search tool developed in the United States, the SCI has assumed the function of scientific research performance evaluation in an increasing number of universities and research institutions.[34] In the 1980s, the British Schools and Universities Foundation adopted the SCI to study and assess research performance in universities and published the results of its assessment in 1986 for the first time. The UK is the first country to conduct scientific evaluation of its universities.[35] In the late 1980s, Nanjing University first introduced the SCI as an evaluation index in China. Subsequently, a number of universities and research institutions in China also started to use SCI evaluation indicators for scientific research evaluation, thus promoting the growth in the number of papers published by Chinese authors in international journals and an improvement in article quality.[30–37] However, as a single scientific research evaluation index, the SCI can only partially explain the relative academic level of the object to be evaluated in the basic research field and cannot fully reflect the academic influence and technological innovation ability of a teacher or discipline.[35] A number of scholars have suggested that it is not realistic to use the SCI as an important evaluation tool due to limitations with regard to the qualification of faculty and the development history of colleges and universities.[38] Moreover, a lack of knowledge of the SCI may have a negative impact on medical education in China, such as a loss of access to academic degrees or professional promotions, which may lead to over emphasis of the SCI and academic fraud.[36] Therefore, a comprehensive analysis of the data obtained is necessary when SCI citation data are used to evaluate scientific research results.[27]

Due to the existence of excessive subjectivity in qualitative evaluation, evaluation results may deviate from fairness. Quantitative evaluation may present inconsequence issues, which may burden the evaluation results with a certain degree of unscientificity.[22] Certain scholars combine qualitative and quantitative evaluation via methods such as the analytic hierarchy process, which can solve multi-objective, multi-level, and multi-criteria decision-making problems through quantifying the thought process of decision-makers. The advantage of this method is to provide a hierarchical framework of thought that facilitates the organization of ideas to ensure a rigorous structure and clear thinking. This method improves the objectivity of judgment through scale comparisons and enhances scientificity and practicability through the combination of qualitative judgment and quantitative inference. Although it fully utilizes human experience and judgment to achieve its core function of selecting optimal programs through ranking, this method also has its drawback because the result is an approximate program ranking, involving significant subjective decision-making elements due to the substantial impact of the subjective human judgments of the analysis results.[23] Many scholars have proposed the use of mathematical statistics, fuzzy mathematics, the analytic hierarchy process, and other modern engineering mathematics and systems engineering methods to establish mathematical models for evaluation.[39–41] Liu et al[42] used the analytic hierarchy process to determine the weight of each parameter and established a model for the evaluation of basic research results. The model ensures objectivity and impartiality in the evaluation of basic scientific research results through weighted calculation and overcomes the interference of human factors in the evaluation process. This model highlights the rigid indicators and weakens the soft indicators to meet the requirements of scientificity and effectively reduce external interference. At present, most of China's ministries and national assessment agencies have directly adopted the concept proposed by the Scientific and Technological Achievements Incentives as the guidelines for evaluation. In 1998, China's Ministry of Science and Technology formulated an evaluation index system for the National Natural Science Award, including three primary indicators (scientific discovery, scientific value, and scientific community recognition)and nine secondary indicators (innovation, difficulty or complexity of the discovery, academic level, impact on the progress of the subject discipline or related disciplines and branch disciplines, impact on economic construction and social development, positive citation by others, impact factor of the journals where the main papers were published, and reception of the subject research results by peers in China and other countries).[7] In 2013, the evaluation indices for the National Natural Science Award were innovativeness of the scientific discovery, recognition of the main academic ideas and views by others, impact of the journals where the main papers were published, publications and impact of published research books, and effect on promoting scientific progress or meeting the needs of national development; the evaluation indices for the National Technology Invention Award were novelty and creativity, technology advancement and its maturity and application in practice, development prospects, and role in promoting scientific and technological progress; the evaluation indices for the technical development projects of the National Science and Technology Progress Award were degree of technological innovation, level of advancement in technical and economic indicators, impact of technological innovation on improvement of market competitiveness, obtained economic benefits, and impact on promotion of scientific and technological progress; the evaluation indices for the social welfare projects of the National Science and Technology Progress Award were degree of technological innovation, level of advancement in technical indicators, status of technology promotion and application, obtained social, ecological, and environmental benefits, and impact on promotion of scientific and technological progress. No unified standards are available for the evaluation of research results in the provinces of China, and thus, further study is needed to establish a unified, comprehensive, and scientific evaluation index system. Systems to index scientific and technological results evaluations specific to various disciplines should be explored based on the nature of these disciplines. Liao et al[43] proposed that the quality of the knowledge in the content of scientific research results is the essential requirement for the evaluation of such results, and scientific research results should be evaluated based on three aspects: degree of innovation, contribution to the subject field, and difficulty of the research. Quantitative indicators play a key role in this method, with qualitative indicators playing a supplemental role, thus minimizing the interference of human factors. Lin[44] proposed principles for the evaluation of educational research results, including the principle of delayed evaluation, the principle of peer review, the principle of combining expert experience and search for novelty, the principle of special attention to objection, and the principle of combining qualitative evaluation and quantitative evaluation.

4.2. Studies on indicators for evaluation of nursing science research results in China

Qualitative evaluation has long been extensively used for the evaluation of nursing research results, similarly to the evaluation of other scientific research results. It is necessary to construct a scientific, objective, and targeted index system for the evaluation of nursing research results according to the latter's characteristics and requirements and determine the weight of each indicator, in order to provide a practicable, more scientific, and reasonable evaluation tool to guide nursing research results to meet clinical needs.[24,45] Using the Delphi method, Ye and Cheng[45] studied the use of pre-evaluation indicators for nursing research results and proposed an evaluation system that consisted of five primary indicators, including the academic level of the results, the value of the results, the benefits from the results, intellectual property rights, and the environment required for the transformation of the results, as well as 14 secondary indicators, including scientificity, innovation, academic value, economic benefit, social benefit, patent transformation, market, needs of hospitals and service objects, and 39 tertiary indicators, including rigorous design, academic novelty, total number of paper citations, application prospects, universality and urgency of promoting its application, and financial support. This evaluation system reflects the features of nursing research results and the characteristic contents of the nursing discipline and plays a positive role in promoting the clinical application of nursing research results.

4.3. Issues in the evaluation of nursing research results

(1) There is a lack of evaluation mechanisms for nursing research results. The study by Liu et al[42] on the evaluation of basic research results showed that current scientific research evaluation indicators are not completely reasonable, with unclear evaluation categorization, and thus cannot objectively, truthfully, and accurately reflect the actual situation of the objects being evaluated. Liao et al[43] found that the previous scientific research evaluation index system is not targeted and has overlapping indicators and too many subjective indicators and that these shortcomings make it difficult to fully reflect the intrinsic value of scientific research results. (2) The expert review system and the credibility of the system are not optimal, which leads to a positive assessment bias due to personal relationships. (3) Innovation research lacks expertise. At

present, most of the personnel assigned to innovation research in institutions are specialized in fields not consistent with the contents subject to innovation research, resulting in biased innovation research content. (4) There is alack of evaluation of the application of nursing research results. Most scientific research results are evaluated immediately after the projects are completed, leading to a lack of evaluation of the actual application process and the corresponding outcome. (5) The evaluation of scientific and technological results usually adopts the peer review method, with an obvious “Matthew effect.” (6) Undue emphasis is placed on the SCI, with little attention to the actual quality of the scientific and technological results. (7) There are no well-defined assessment results for scientific research. The four assessment grades commonly used in current evaluations are leading international level, advanced international level, leading domestic level, and advanced domestic level. What is the definition of “leading domestic level” and “advanced international level”? What is the basis for these comments? What is the current domestic or international status in the subject field? The innovativeness of scientific research results can only be faithfully reflected when reasonable answers are available to these questions.[43] (8) The quality of a journal is deemed equivalent to the quality of the papers published in that journal. The relationship between the quality of an academic journal and the quality of the papers in the journal is the relationship between the whole and the parts. The quality of a journal does not always correspond to the quality of the papers in the journal. Therefore, the use of journal quality instead of article quality in current research results evaluation practice is unscientific because the core journals have their own limitations, similarly to any evaluation method or indicator. Bibliometric indicators, such as core journals, and various databases in the periodical evaluation system are only the core evaluation indicators of the literature and cannot completely replace the evaluation of the quality of academic journals or the assessment criteria for the value of academic papers.[46] The quality of the papers published in the core journals is not always consistent due to the influence of non-academic factors such as individual academic level, personal relationships, and financial interests, which is a significant limitation in the current evaluation method. The quality of an individual academic should not be generally applied to the papers in that journal. (9) The SCI is widely used as an important evaluation tool. At present, the SCI has developed into an internationally accepted scientific and technological evaluation tool. The number of scientific journals and papers in a country or region that are cited in the SCI and the frequency of citation have generally been considered among the important criteria for evaluating the level of basic scientific research and scientific and technological strength and the quality of scientific papers in that country or region. To measure the academic level of a paper, the internationally accepted general practice is to first verify the quality of the journal where the paper is published, and the commonly used objective criterion to measure the level of academic journals is their impact factor. China has only a small number of academic journals that are included in the SCI. Assessing the level of academic journals based on their impact factor can only be performed in the same discipline for direct comparison. The impact factors of journals in different disciplines cannot be directly compared with each other. This indicator should be used in a scientific and rational way.[38]

5. Summary and prospects

In summary, evaluation of scientific research has received great attention in China, and studies have been conducted addressing the characteristics of the researchers' respective disciplines. However, evaluation of scientific research is still in the exploratory stage, and it is necessary to establish a comprehensive expert review system and an evaluation index system for nursing research results. Emphasis should be placed on related domestic and international studies on this topic in order to improve the evaluation index system for nursing research results, such as the use of the h-index in combination with clinical application of the nursing research results. Limitations should be clarified. It has been suggested that the number of a researcher's papers included in the SCI and the frequency of those papers' citations can reflect the research ability and academic level of that researcher.[3] However, due to the various levels of foreign language proficiency among nursing staff, it is difficult for certain nursing staff to have their research results included in the SCI because of their limited foreign language proficiency, although they have rich clinical experience and strong scientific research ability. Therefore, this indicator should be considered from all aspects in the evaluation of nursing research results. Further studies should be conducted with regard to the general infrastructure in China and the characteristics of the nursing discipline. The selection of indicators should arise from a systematic, scientific, reproducible, and operable process in order to ensure objectivity, fairness, and justice of the evaluation system. Simple, practical, objective, and impartial evaluation methods, particularly those specifically targeting the characteristics of the nursing discipline, should be selected in order to improve the efficiency of the evaluation process and to ensure the objectivity, fairness, and justice of the evaluation system. In addition, we should objectively view the impact factors of academic journals. Journal impact factor can indirectly reflect the academic quality of a paper to a certain extent, but it cannot directly prove its academic value.[46] The value of scientific research results is reflected in the breadth and depth of their understanding of the world and role in improving the world. The former can be assessed using the criteria of truth in the results, while the latter can be evaluated using the criteria of benefits of the results. As it takes time to test results in practice, the effects of the results cannot be immediately visible, and a delayed evaluation is more appropriate with regard to the value of the results, that is, the evaluation should be conducted a certain period of time following the publication of the nursing results or after their application in clinical practice.[47] It is necessary to establish an expert echelon for the evaluation of nursing research results, combine qualitative and quantitative evaluation methods to form a comprehensive judgment, and provide accurate evaluation results. Because it is difficult to accurately judge the level of nursing research achievement using a single method and nursing research results evaluation has many standards, the comprehensive evaluation of nursing research results is fuzzy and complex. It is a multilevel, multi-objective, and comprehensive evaluation. Therefore, we can learn from more mature fuzzy evaluation methods to assess the degree of innovation in nursing research results, with consideration of innovation research results. Attention should be paid to scientific research integrity during evaluation to avoid phenomena such as plagiarizing other papers, tampering with experimental data, and using the name of experts to reap benefits. Government departments should actively play a leading role in strengthening the construction of the system and its regulation as well as in macro management.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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