Analysis of the Distribution Characteristics of Journal Disciplines

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Abstract. This paper analyzes the interdisciplinary characteristics of academic journals from the perspective of the classification number in the reference, and expands the application of the classification number in the research of academic journals.Taking a variety of journals with strong interdisciplinary as an example, this paper obtains the reference data of journal papers through the Chinese periodical service platform of Pulse by using empirical analysis method.Based on the three dimensions of discipline type, interdisciplinary knowledge fusion and inter-disciplinary knowledge transmission, an index system for the analysis of interdisciplinary characteristics of academic journals is set up to comprehensively analyze the interdisciplinary characteristics of academic journals.Based on the established index system, it can fully display the discipline distribution of academic journals, identify the active disciplines and marginal disciplines of journals, and explore the interdisciplinary knowledge integration degree, knowledge innovation and knowledge dissemination potential of academic journals.Compared with the journal content analysis method, the data of this method is objective and real, and the data acquisition and processing methods are convenient.Compared with the subject classification number analysis method of journals, this method has abundant classification numbers, finer granularity and more reliable effect.

Keywords: academic journals;References;Chinese Library classification number;Interdisciplinary characteristics;

1 Introduction

The layout of sci-tech journals is an important issue in the construction of sci-tech journals. Reasonable layout of sci-tech journals helps to improve the utilization efficiency of academic resources, promote the rapid and orderly development of China's periodical groups to the maximum extent, improve the international influence of China's periodical groups, promote the exchange and progress of scientific research, en-

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hance the national international academic discourse power, and protect the security of national academic resources.[1] Subject distribution is the most critical link in the layout of science and technology journals. The study of subject distribution of journals relies on the subject classification system, and the current relevant research mainly adopts the periodical hierarchical classification system with journals as the classification object [2-4].With the continuous development of scientific research towards intersectionality and specialization, and the constant adjustment and change of the subject matter of scientific journals, the limitation of the hierarchical classification system of journals in the analysis of the subject layout of journals has become increasingly prominent, which limits the analysis of the subject layout of journals, especially in the study of the subject distribution of journals and the analysis of the characteristics of journals [5].

Subject distribution of journals is dynamically evolving, and these hierarchical classification systems based on experts tend to be highly abstract and generalized knowledge of the domain by experts[6], which is a relatively stable knowledge structure. Although they are more acceptable to managers, decision makers and funders, the subject classification system itself is usually updated slowly.The adjustment and updating of the correspondence between journals and disciplines is also slow, which is not applicable to the exploration of the dynamic changes of periodical disciplines[7-8].

The significance of this paper is as follows :(1) By analyzing the diversity of academic journals' knowledge sources, we can fully grasp the main knowledge sources of academic journals and the contribution of different disciplines to academic journals' knowledge, assist journal editors in selecting and reviewing manuscripts, and guide authors in submitting manuscripts;(2) The analysis of interdisciplinary knowledge integration of academic journals can reveal the discipline penetration and knowledge absorption of academic journals, perspective the application value of journals, and assist journal evaluation research;(3) The analysis of knowledge innovation and knowledge dissemination potential of academic journals can predict the actual utilization rate of readers.

2 Research Design

The reference is essentially a process of knowledge input from the reference to the journal paper. The CLCN of the corresponding journal provides the information of knowledge exchange between the subject of the paper and the subject of the reference. By analyzing the interdisciplinary characteristics of the journal references, the interdisciplinary characteristics of academic journals can be seen through.Based on the CLCN of the corresponding journal of the reference, an index system for the interdisciplinary feature analysis of academic journals is established on the basis of the interdisciplinary analysis index given by others.This paper analyzes the interdisciplinary characteristics of academic journals, such as discipline diversity, knowledge integration, knowledge innovation and knowledge dissemination potential, from three dimensions: discipline type, knowledge integration and knowledge dissemination.As a discipline classification and knowledge classification code, CLCN has been applied to

document indexing and literature retrieval, and is also widely used in the research of interdisciplinary distribution of academic achievements and knowledge structure in subject areas. For example, CLCN is used to analyze the correlation of literature, build the membership network between CLCN and keywords, and define the subject affiliation of literature through keywords.[9-10]

3 Data Source and Processing

At present, the State Grid Co., Ltd. is in charge of and sponsored by 33 periodicals, such as "Power grid Technology", "High Voltage Technology", "Power Information and Communication Technology", "Power System Automation".These journals mainly cover the power system, power equipment, power information, power communication, power energy and other subject areas.

This paper selects 12 typical State Grid periodicals, namely, Journal of China Electrical Engineering, Power Grid Technology, Power System Automation, High Voltage Technology, Power Grid and Clean Energy, China Electric Power, Power Engineering Technology, Global Energy Internet, Zhejiang Electric Power, Sichuan Electric Power Technology, Shanxi Electric Power and Northeast Electric Power Technology.Among them, there are high-quality journals such as "China Electrical Engineering Journal", "Power Grid Technology" and "Power System Automation", and balanced journals such as "High voltage Technology", "Power Grid and clean Energy", "China Power", "Power Engineering Technology", "Global Energy Internet" and "Zhejiang Electric Power".There are also "Sichuan Electric Power Technology", "Shanxi Electric Power", "Northeast Electric Power Technology" these relatively less influential journals, using these 12 journals to analyze the interdisciplinary characteristics of the State grid journal group.Pulse Chinese Journal service platform can not only provide journal citation information, but also provide the reference CLCN of journal papers, so the Pulse Chinese journal service platform is taken as the data source.References of papers published in the above journals within 10 years were used as data objects.

4 Analysis on the Characteristics of Periodical Subject Distribution

4.1 Index of Interdisciplinary Feature Analysis

At present, there are many mature interdisciplinary measurement indicators, and the typical indicators include discipline diversity index, discipline specialization index, discipline differentiation index, discipline equilibrium index, and network characteristic index (intermediate centrality, network density, average path, cohesive subgroup density, etc.).Based on previous studies, this paper sets up an index system for the analysis of interdisciplinary characteristics of academic journals from three dimensions: discipline type, interdisciplinary knowledge fusion and inter-disciplinary knowledge dissemination.

Subject Richness Index and Subject Concentration Index

Subject richness is measured by the number of subject categories involved in the references of journal articles.The total number of discipline categories k refers to the number of categories of different disciplines involved in the journal, which is used to describe the diversity characteristics of disciplines.The larger the value of k, the greater the subject richness of the journal knowledge source, and its expression is

$$k = \sum_{i \in S} S_i \tag{1}$$

i represents literature belonging to subject S;S_i represents the number of disciplines included in reference i.Represents the literature belonging to the discipline S;S_i represents the number of disciplines included in reference i.

Subject specialization is measured by subject breadth and depth of journal content, subject breadth is measured by k, subject depth is calculated by the occurrence frequency of subjects involved in the journal f_k, and the measurement formula of subject specialization is

$$P = \frac{f_1^2 + f_2^2 + \cdots + f_k^2}{(f_1 + f_2 + \cdots + f_k)^2} \tag{2}$$

$P \in [0,1]$, the larger the P value, the higher the degree of discipline specialization, the fewer subjects involved, and the more professional the journal content;The smaller the P value, the lower the degree of discipline specialization, the larger the discipline span, and the relatively broad content of the journal.

Subject distribution equilibrium refers to the uniformity of subject distribution of journals, calculated by information entropy H(x), and its expression is

$$H(x) = -\sum_i p_i(x) \cdot log_2\, p_i(x) \tag{3}$$

Where $p_i(x)$ is the probability distribution of different disciplines.In information theory, information entropy is mainly used to describe the uncertainty of the information source. The greater the entropy, the more balanced the information distribution.The larger the value of $H(x)$, the more balanced the distribution of journals.The smaller the value of $H(x)$, the more unbalanced the distribution of subjects.

Subject Similarity Index and Subject Difference Index

Subject similarity refers to the distance of the relation between disciplines, which can be measured by the co-occurrence relation of CLCN.CLCN co-occurrence is a phenomenon of CLCN in different disciplines simultaneously.The interdisciplinary similarity of journals is calculated by using the former formula of cross degree

$$J_0 = \frac{\sum_m \sum_n F_m F_n \cos(m,n)}{\sum_m \sum_n F_m F_n} \tag{4}$$

Where, F_m and F_n represent the proportion of references belonging to class m and class n disciplines in journals respectively, and cos(m, n) represents the cosine similarity of the two disciplines quantified by the co-occurrence model of class m and

class n disciplines.$J_0 \in [0,1]$. The larger the value of J_0, the higher the similarity between disciplines, and the stronger the ability of cross-disciplinary knowledge integration of journals.

Subject difference degree can also reflect the distance between the source disciplines of periodical knowledge. Therefore, the knowledge innovation ability of periodicals can be measured by subject difference degree, and its expression is

$$J_C = 1 - \frac{\sum_m \sum_n F_m F_n \cos(m,n)}{\sum_m \sum_n F_m F_n} \tag{5}$$

$J_C \in [0,1]$. The larger the J_C value, the less the number of CLCN co-occurrence, the farther the disciplinary distance, and the higher the knowledge difference, then the journal absorbs more new interdisciplinary knowledge and has higher knowledge innovation.

Subject Co-occurrence Network Index

Knowledge transmission power is the ability to realize effective knowledge transmission, which depends on the scope and effect of knowledge transmission.The ability to effectively spread knowledge among multiple disciplines can be reflected by the number of disciplines involved in the source knowledge of a journal and the number of co-occurrences between disciplines.By constructing CLCN co-occurrence network, the knowledge dissemination effect of periodicals is analyzed according to the parameters of CLCN co-occurrence network, such as network average degree D and average path length L.Network average D is the quotient of network degree and the number of nodes.Network degree is the number of all the edges connected by each node, which can represent the degree of direct correlation between nodes in a network to a certain extent.The higher the D, the better the connectivity and the stronger the knowledge dissemination ability of the journal.Network average path length L refers to the average distance between any two nodes, is the average shortest distance between all pairs of nodes in the network, and the distance between two nodes in the network is equal to the number of sides of the shortest path needed to connect these two nodes.Therefore, L reflects the degree of separation between nodes in the network and the transmission efficiency of knowledge in the network.The shorter it is, the higher the efficiency of knowledge dissemination.

4.2 Empirical Analysis

In order to accurately analyze the discipline balance and professionalism of journals, H(x), P, J0 and Jc of 12 journals were calculated using equations (2), (3), (4) and (5) according to the discipline data. The results are shown in Table 1.

Table 1. Interdisciplinary indices and impact indicators of 12 journals

periodical	*H(x)*	*P*	J_0	J_c
Proceedings of the CSEE	2.68	0.22	0.544	0.456

periodical	*H(x)*	*P*	J_0	J_c
Power grid technology	1.37	0.63	0.298	0.702
Power system automation	1.73	0.53	0.312	0.688
High voltage technology	2.79	0.171	0.632	0.368
Power grids and clean energy	1.92	0.44	0.365	0.635
China Power	2.24	0.35	0.403	0.597
Electric power engineering technology	1.75	0.49	0.345	0.655
Global energy Internet	2.03	0.38	0.401	0.599
Zhejiang Electric Power	2.43	0.30	0.423	0.577
Sichuan electric power technology	2.35	0.31	0.419	0.581
Shanxi Electric Power	2.48	0.28	0.454	0.546
Northeast electric power technology	2.46	0.28	0.446	0.554

The H(x) value of Grid Technology is the smallest, and the P value is the largest, which indicates that the subject distribution of source knowledge in this journal is the most unbalanced and the subject concentration is the highest.The reference disciplines of "Power Grid Technology" are mainly concentrated in the discipline of electrical engineering - power system and automation (occurrence frequency is 10,920 times), and the occurrence frequency accounts for 78.9% of the occurrence frequency of all source disciplines, which shows that the journal attaches importance to the use of power system and automation disciplines to carry out scientific research and discover potential knowledge research results, which is consistent with the purpose of the journal.Moreover, in "Power Grid Technology", there is a large gap in the occurrence frequency of disciplines. The occurrence frequency of the top 5 disciplines differs by 10,168, 207, 24 and 277 times, indicating that the distribution of disciplines is extremely unbalanced.The H(x) value of CSEE is large and the P value is small, which indicates that the content of CSEE involves more subjects and the distribution is relatively balanced.In the Journal of Electrical Engineering of China, the three disciplines with the highest frequency are electrical engineering-power systems and automation (occurrence frequency is 6765 times), electrical engineering-electrical appliances (occurrence frequency is 2547 times), and electrical engineer-motor (occurrence frequency is 2542 times).The largest frequency difference is 4218 (between electrical engineering - power systems and automation and electrical engineering - appliances), as shown in Table 1.There is little difference in the frequency of the disciplines with low frequency. Electrical engineering - high voltage and insulation technology, power engineering and engineering thermal physics - power machinery and engineering appear 1111 times and 1100 times respectively.Electrical engineering - Power electronics and power transmission, automation and computer technology - Control sci-

ence and Engineering and Environmental science and engineering - Environmental engineering appeared 516 times, 420 times and 416 times, respectively.Therefore, the discipline distribution of CSEE is more balanced.Relatively speaking, the H(x) and P values of Power System Automation are between the first two journals, but they are closer to the values of power grid technology, which indicates that the subject distribution and knowledge structure of power grid technology and power system automation are more similar than that of the CSEE.

The reference disciplines of Power Grid and Clean Energy are mainly concentrated in electrical engineering - power system and automation, and the proportion of other disciplines is much lower than that of the other three second-level journals. The H(x) value is the smallest, and the P value is the largest, indicating that the discipline distribution of source knowledge in this journal is the most unbalanced and the discipline concentration is the highest.Throughout the 12 journals, the proportion of disciplines in High Voltage Technology is the most balanced, and the first discipline, electrical engineering - power system and automation, only accounts for 24.4% of the total, its H(x) value is the maximum and P value is the minimum among the 12 journals, indicating that the content of the journal involves more disciplines and the distribution is the most balanced.Among the many journals, "Power Engineering Technology" and "Global Energy Internet" have fewer publications than other journals.In particular, "Global Energy Internet" published the least, among which only 8 articles were published in the literature and history discipline of political law - political science, resulting in relatively poor reference value of discipline distribution.

The discipline distribution of the two journals of Shanxi Electric Power and Northeast Electric Power Technology is very similar. The top three disciplines are electrical engineering - power system and automation, power engineering and engineering thermal physics - power machinery and engineering, and electrical engineering - electrical appliances, and the proportion is similar, indicating that the two journals have strong discipline similarity.

Using equations (4) and (5), J0 and Jc of 12 journals are calculated.Among the 12 journals, "Power Grid Technology" has the smallest J0 and the largest Jc, that is, the interdisciplinary knowledge integration of power grid technology is the lowest, but the interdisciplinary knowledge innovation is the strongest.The J0 of "High Voltage Technology" is 0.632, which indicates that "High Voltage Technology" has the highest degree of interdisciplinary knowledge integration and stronger knowledge integration ability.Although the J0 and Jc of "China Power" and "Global Energy Internet" are the most similar, due to the small number of articles published by "Global Energy Internet", we will not participate in the consideration.The degree of knowledge integration and knowledge innovation of Shanxi Electric Power and Northeast Electric Power Technology are similar.Among the 12 journals, High Voltage Technology has the largest J0 and the smallest Jc, which indicates that High Voltage Technology has a higher degree of interdisciplinary knowledge integration, but it is less innovative than other journals in interdisciplinary knowledge.

The CLCN co-occurrence matrix of references J1, J2 and J3 in the journals of CSEE, Power Grid Technology and Power System Automation was imported into the software to form a co-occurrence relationship network.The node shown in Figure 1, 2,

3 represents the CLCN of a certain discipline, the size of the node represents the number of CLCN with which there is a co-occurrence relationship, the line represents the co-occurrence relationship between the two disciplines, and the thickness of the line represents the number of co-occurrence times.It can be seen that J2 has the highest D and the shortest L, J3 has the lowest D and the longest L, and J1 has the middle D and L values, which are close to J3, indicating that J2 has the best network connectivity, the strongest knowledge transmission potential and the highest knowledge transmission efficiency, while J3 has the worst network connectivity, the weakest knowledge transmission potential and the lowest knowledge transmission efficiency.The downloads and citation frequency of a journal paper can reflect the knowledge dissemination potential of a journal to some extent.The average number of articles downloaded and the average citation frequency of the three journals have a positive correlation with the knowledge dissemination potential of the three journals.It can be seen that the interdisciplinary knowledge dissemination potential of periodicals can be effectively analyzed according to the D and L in the CLCN co-occurrence network.

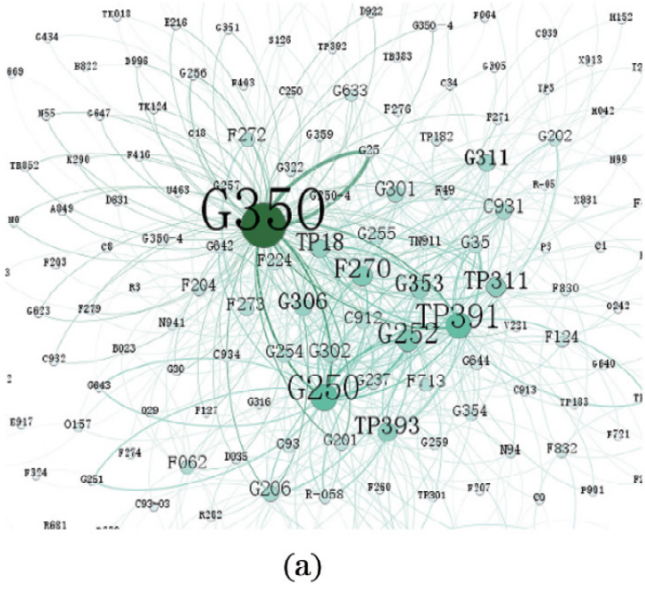
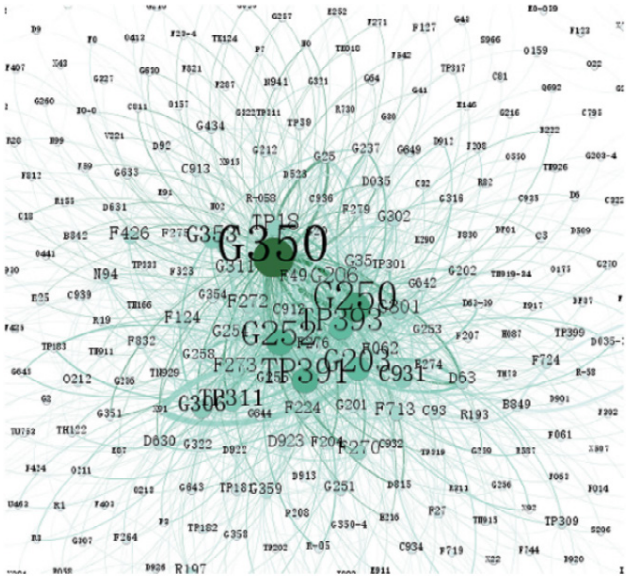
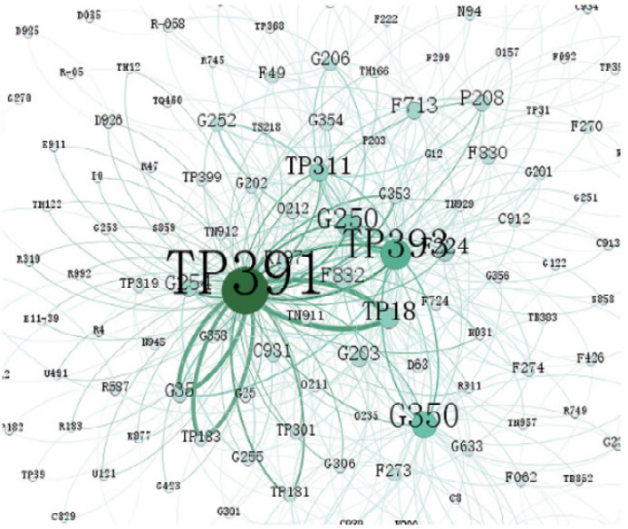


Fig. 1. The CLCN co-occurrence relationship network of journal J_1 references



(b)

Fig. 2. The CLCN co-occurrence relationship network of journal J_2 references



(c)

Fig. 3. The CLCN co-occurrence relationship network of journal J_3 references

As the interdisciplinary characteristics of the 12 typical journals in the State Grid journal group are relatively strong, through the analysis of the interdisciplinary characteristics of the 12 typical journals in the State Grid journal group, it is found that the 12 journals have common interdisciplinary characteristics, and the knowledge source disciplines are wide, including electrical engineering, automation and computer technology and other active disciplines.There are also general industrial technology - materials science and engineering, environmental science and engineering - environmental engineering, economic management - world economy and other non-professional high-frequency disciplines, but mainly concentrated in electrical engineering disciplines.At the same time, through the analysis of the characteristics of various journals in the interdisciplinary aspects, the national network journal group has a strong interdisciplinary and relatively balanced distribution of disciplines.Among all periodicals, "Power Grid Technology" has the lowest degree of interdisciplinary knowledge integration, the highest degree of discipline concentration and the strongest knowledge innovation.The distribution of various disciplines in High Voltage Technology is the most balanced, but it is inferior to other journals in interdisciplinary knowledge innovation.

5 Summary and Outlook

The index system established in this paper reflects the interdisciplinary characteristics of the typical journals of the State Network from different angles: the disciplinary types reflect the disciplinary diversity, balance and professionalism of academic journals, and the inter-disciplinary relations reflect the interdisciplinary knowledge integration and innovation characteristics of academic journals.

In view of the current situation that studies fail to analyze the interdisciplinary characteristics of academic carriers from the perspective of reference CLCN, this paper systematically analyzes the interdisciplinary characteristics of academic journals in interdisciplinary fields from the perspective of knowledge input and based on the measurement indicators of interdisciplinary analysis, providing a new research perspective for the comparative analysis of interdisciplinary characteristics of academic journals.Compared with citation-based and content-based analysis methods, this method can make full use of the subject classification information of journals, avoid the subjectivity of artificial classification of subject content and subject category, and improve the credibility of subject classification.Compared with the CLCN analysis method based on the discipline of the journal paper itself, the CLCN provided in this paper is more abundant, and the analysis results of the interdisciplinary characteristics of the journal are more reliable.

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