Research on the Quality of Online Training for Intellectual Property Information Services by University Subject Librarians: Based on Survey Data from the FULink Alliance (Postprint)

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Abstract

[Purpose/Significance] Against the backdrop of normalized pandemic prevention and control and the national strategy for building an intellectual property powerhouse, this study, from a user demand perspective, conducts quantitative analysis and classification of the influencing factors that affect the effectiveness of online training for intellectual property information services for subject librarians in university libraries, with the aim of improving online training quality and promoting the high-quality development of intellectual property information services.

[Method/Process] Seventeen quality elements were extracted across six dimensions: personnel qualifications, course content, training format, learning support services, communication and interaction, and assessment and evaluation. A questionnaire survey was designed and administered, employing the Kano model and Importance-Performance Analysis (IPA) method to identify the categories of these elements and establish their priority for improvement.

[Results/Conclusion] The 17 quality elements were categorized into 2 must-be quality elements, 8 one-dimensional quality elements, 5 attractive quality elements, and 2 indifferent quality elements. Through IPA matrix analysis, it was determined that online training for intellectual property information services for subject librarians in university libraries should prioritize enhancements in three key areas: strengthening courses on patent information analysis and utilization, utilizing diversified curriculum resources, and improving communication and feedback mechanisms.

Full Text

Research on Online Training Quality for Intellectual Property Information Services of University Subject Librarians

Based on Survey Data from FULink Alliance Librarians

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Abstract: [Purpose/Significance] Against the backdrop of normalized epidemic prevention and control and the national strategy for strengthening intellectual property rights, this study quantitatively analyzes and classifies the factors influencing the effectiveness of online training for intellectual property information services for university library subject librarians from a user needs perspective, aiming to improve online training quality and promote high-quality development of intellectual property information services. [Method/Process] Seventeen quality elements were extracted from six dimensions: personnel qualifications, course content, training format, learning support services, communication and interaction, and assessment and evaluation. A questionnaire was designed and distributed, and the Kano model and IPA analysis were employed to identify the categories of elements and their priority for improvement. [Result/Conclusion] The seventeen quality elements were classified into two essential quality elements, eight expected quality elements, five attractive quality elements, and two indifferent quality elements. Combined with IPA matrix analysis, the study identifies three priority areas for improving online training for university library subject librarians: strengthening patent information analysis and utilization courses, leveraging diversified curriculum resources, and improving communication and feedback mechanisms.

Keywords: university intellectual property information services; subject librarians; online training; Kano model; IPA

With the implementation of the national intellectual property strategy, intellectual property information services have gradually become an important component of China's innovation-driven development strategy and intellectual property powerhouse strategy. In recent years, the state has introduced relevant policies encouraging university libraries to develop intellectual property information services. In December 2017, the State Intellectual Property Office and the Ministry of Education jointly issued the "Implementation Measures for the Construction of University Intellectual Property Information Service Centers" [1], supporting university libraries in undertaking intellectual property information service work. In 2019 and 2020, the Ministry of Education and the State Intellectual Property Office selected two batches of 60 university national intellectual property information service centers. In February 2020, the Ministry

of Education, the State Intellectual Property Office, and the Ministry of Science and Technology jointly issued the "Several Opinions on Improving Patent Quality in Higher Education Institutions and Promoting Transformation and Application" [2], establishing intellectual property information services as an important support for promoting scientific and technological innovation and technology transfer in universities.

As a series of policy documents have been implemented and external demands have continuously evolved, university libraries have extended their traditional services into the intellectual property domain by establishing intellectual property information service centers to provide such services. However, research shows that current university library intellectual property information services suffer from deficiencies in deep-level patent information services [3], incomplete service mechanisms [4], and the need to improve professional subject librarians' skills [5-6]. Intellectual property information services are characterized by diversified service targets, variable service demands, and challenging service content, placing higher demands on the professional capabilities of library subject librarians engaged in these services. Shen Jinhua et al. [7] found through investigation that the lack of librarians' patent information service capabilities constitutes an important factor affecting their ability to deliver such services. Therefore, enhancing the professional capabilities of intellectual property information service personnel serves as an important guarantee for university libraries to successfully carry out these services.

1 Literature Review

Domestic and international research on university intellectual property information services has primarily focused on service models and positioning [8], service quality improvement [9-10], service marketing [11], and service evaluation systems [12]. Research on intellectual property information service training has concentrated on three aspects: First, investigations focusing on patent training demand content. For example, Wang Xiaohui [13] summarized existing patent training and conducted in-depth research on patent training needs from the perspectives of training faculty, content, format, and cost. Second, design of intellectual property information service training systems. From a user needs perspective, Shen Jinhua et al. [7] analyzed the needs of researchers and research managers to construct a competency framework for university librarians' patent information services, identifying patent-related knowledge, patent retrieval capabilities, patent analysis capabilities, intelligence research capabilities, and basic knowledge of technical fields as essential components of patent information service capacity. Wang Liping et al. [14] constructed a graded and classified intellectual property information service training system for multiple university stakeholders using literature research, expert interviews, and questionnaires. Third, exploration of improvement paths for intellectual property information service training through specific practical cases. Wang Jing et al. [15] and Sun Huijun et al. [16] respectively used Hebei University of Technology and China

Agricultural University as examples to discuss the construction of intellectual property training systems for university intellectual property information service centers from the perspectives of training targets, content, and formats.

In summary, existing research has primarily employed qualitative analyses such as literature research and questionnaire surveys, which have certain value in revealing the quality of intellectual property information service training. However, few studies have conducted in-depth quantitative research, and most service targets have been researchers, students, and enterprise users. Therefore, this paper intends to use the Kano model and IPA analysis to study the quality of intellectual property information service training from the perspective of library subject librarians.

Previously, numerous scholars have widely applied the Kano model to evaluate service quality in university libraries, including mobile reading [17], maker space user needs [18], library digital reference consultation services [19], and WeChat official account services [20]. This demonstrates that the Kano model is suitable for library service quality evaluation, but no existing literature has applied this method to intellectual property information service training quality. The traditional Kano model uses maximum frequency as the classification standard for service quality elements, which is relatively subjective and can lead to inaccurate classification results when the frequency of elements in the most frequent category lacks significant advantage. Therefore, some scholars have attempted to integrate the Kano model with other models such as QFD [21], Better-Worse index [22], and Dematel [23] to improve it and enhance its decision-support function.

To improve online training quality, it is necessary not only to classify quality elements but also to clarify their priority for improvement. The IPA analysis method is widely used for identifying key quality issues. Zhao Naixuan et al. [9] and Shi Guohong et al. [24] combined IPA analysis with the Kano model to identify, classify, and prioritize factors influencing university patent information services and mobile library service quality, proposing paths for service quality improvement. Accordingly, this study draws on the work of Wang Ping et al. [25] and Zhao Wenjun et al. [26] to employ an improved Kano model and IPA analysis method to research strategies for improving the quality of online training for intellectual property information services, hoping to provide references for universities conducting intellectual property information service training.

2 Classification and Identification of Online Training Quality Elements

N. Kano et al. [27] proposed the Kano model from the perspective of user needs and satisfaction to identify user requirements for products or services. By identifying key factors affecting user satisfaction, service quality can be improved in a targeted manner. Based on the different impacts of service quality ele-

ments on user satisfaction, the Kano model classifies service quality elements into five categories: essential quality elements, expected quality elements, attractive quality elements, indifferent quality elements, and reverse quality elements. The classification of elements in the Kano model requires tools such as Kano questionnaires.

2.1 Method for Selecting Online Training Quality Elements

Online training for intellectual property information services is essentially a form of library training service. Therefore, in determining online training quality elements, literature research was conducted focusing on library intellectual property information service training and library information literacy education. Additionally, since online training differs from traditional library training services by being conducted primarily online, corresponding adjustments should be made in the quality element indicator construction. Drawing on the research results of Wang Liping et al. [14] and Wang Xiaohui [13] in intellectual property information service training and library intellectual property information service needs, and incorporating Ren Tan's [28] research on factors affecting online training in teacher remote training effectiveness analysis, this study selected 17 online training quality element indicators from six dimensions: instructor qualifications, course content, training format, learning support services, communication and interaction, and assessment and evaluation (see Table 1).

2.2 Questionnaire Design and Data Collection

(1) Questionnaire Design. The questionnaire consisted of two parts: The first part collected basic user information, including gender, school/region, professional title, and education level. The second part was the main body of the questionnaire, investigating quality elements related to online training, including the 17 options in Table 1. Using a 5-point Likert scale (very satisfied, satisfied, neutral, dissatisfied, very dissatisfied) as response options, the questionnaire investigated both positive and negative questions for each online training quality element. The specific format is shown in Table 2 . Referring to relevant research [29], options were assigned asymmetric values according to Table 3 , and the perceived importance of online training quality elements was rated on a scale from 0.1 to 1.0, with higher values indicating greater importance.

(2) Questionnaire Distribution and Recovery. The questionnaire was distributed through the Intellectual Property Information Service Center of Fuzhou University on December 17, 2020, using both online and offline methods to subject librarians engaged in intellectual property information services at university libraries in the FULink Alliance (Fujian University Digital Library). By December 23, 2020, a total of 80 questionnaires were distributed, and 64 valid questionnaires were recovered, yielding an effective response rate of 80%. The basic information of respondents is shown in Table 4 .

(3) Questionnaire Reliability and Validity Testing. SPSS was used to

test the reliability and validity of the questionnaire. The results are shown in Table 5 . Cronbach's α coefficient was used to test the reliability of importance, positive questions, and negative questions. The Cronbach's α values for importance, positive questions, and negative questions were 0.762, 0.868, and 0.832, respectively. The KMO value and Bartlett's sphericity test were used for validity testing. The KMO values for importance, positive questions, and negative questions were 0.710, 0.813, and 0.793, respectively, with Bartlett's sphericity test significance probabilities all at 0.000. The cumulative explained total variance reached 61.271%, 64.084%, and 66.105%, respectively, indicating that the questionnaire had good reliability and validity and met the analysis requirements.

2.3 Classification of Training Quality Elements Based on the Kano Model

(1) Kano Indicator Design. This study defined the score value of user S_j's negative question for online training quality element F_i as X_i, representing user S_j's satisfaction evaluation when element F_i is not provided. The score value of user S_j's positive question for quality element F_i was defined as Y_i, representing user S_j's satisfaction evaluation when element F_i is provided. The perceived importance of quality element F_i by user S_j was ω_{ij}. The average satisfaction of user S_j when providing element F_i was assumed to be 珮 Y_i, and the average satisfaction when not providing quality element F_i was assumed to be 珮 X_i. Using 珮 X_i and 珮 Y_i as horizontal and vertical coordinate axes, a two-dimensional coordinate graph was constructed. The calculation formula (1) is as follows:

珮 X_i = $\Sigma\omega\{\{\{ijX\}\}\}\{\{ij\}\}\}$
珮 Y_i = $\Sigma\omega\{\{\{ijY\}\}\}\{\{ij\}\}\}$
Formula (1)

(2) Kano Classification Design. After calculating the vector polar coordinates using 珮 X_i and 珮 Y_i, the vector r_i = $\sqrt{}$(珮 X_i^2 + 珮 Y_i^2) was calculated through Formula (1), representing the importance degree of quality element F_i to users. The satisfaction index α = tan^{-1}(珮 Y_i/珮 X_i) ($0 \leq \alpha \leq \pi/2$) is the angle between the vector and the horizontal coordinate, representing the relative ratio of user satisfaction/dissatisfaction values for quality element F_i.

According to the Kano model classification design, relevant data are shown in Table 6 . Based on previous research [25-26], the Kano importance index r_0 of 0.5 was selected as the dividing line. Therefore, for element F_i, if r_i < 0.5, F_i is considered an indifferent requirement. Using satisfaction index α = $\pi/6$ and $\pi/3$ as boundaries, with the lower limit α_L = $\pi/6$ and upper limit α_H = $\pi/3$, for quality element F_i, if r_i > r_0 and α_i < α_L, the element is considered an essential requirement; if r_i > r_0 and α_i > α_H, it is considered an attractive requirement; and if r_i > r_0 and α_L < α_i <

α_H, it is considered an expected requirement. The final classification results of online training quality elements based on the Kano model are shown in Figure 1 [Figure 1: see original paper].

Attractive Quality Elements. When such quality factors are met, even if not perfectly implemented, users show high satisfaction. Conversely, when these factors are not met, users do not show obvious dissatisfaction. According to the calculation results, attractive requirements include five elements: C1 (intellectual property field experts), C2 (intellectual property examiners), D4 (patent operation), D5 (other intellectual property types), and E2 (classified training). Among them, C1 and C2 belong to the personnel qualifications dimension, while D4 and D5 belong to the course content dimension.

Expected Quality Elements. There is a positive correlation between the fulfillment of such factors and user satisfaction. When these factors are met or well-implemented, user satisfaction increases positively; conversely, user satisfaction decreases significantly. Expected requirements include eight elements: C3 (patent information analysts), D1 (patent basics), D2 (patent literature retrieval), D3 (patent information analysis and utilization), E1 (training duration), G1 (live communication), G2 (QQ and WeChat groups), and G3 (service feedback).

Essential Quality Elements. These are indispensable factors. When such factors fail to meet user needs, user satisfaction decreases substantially; when they meet user needs, user satisfaction does not improve significantly. Essential requirements include two elements: F1 (platform stability) and F2 (replay function).

Indifferent Quality Elements. Whether these elements are met or not has little impact on user satisfaction. Indifferent requirements include two elements: H1 (online learning time) and H2 (online examination). The survey shows that training participants hope to enhance their intellectual property information service capabilities through training and pay relatively little attention to assessment formats after training.

2.4 Analysis of Training Quality Improvement Strategies Based on IPA

IPA analysis was applied to comprehensively compare and analyze the perceived importance and satisfaction of online training quality elements to further clarify the priority for improving each element. Using the satisfaction index α and importance index r of elements to establish a coordinate system, with their average values as quadrant division points, an IPA analysis matrix was constructed, as shown in Figure 2 [Figure 2: see original paper].

Quadrant I is the "keep up the good work" area, with high satisfaction and high importance. Quadrant IV is the "possible overkill" area, with high satisfaction but low importance. These two areas show high satisfaction, so elements in these

areas should adopt a maintenance strategy. Quadrant II is the "concentrate here" area, characterized by high importance and low satisfaction. Quadrant III is the "low priority" area, with low satisfaction and low importance. These two areas show low satisfaction and should adopt an improvement strategy.

(1) Priority for Improvement Strategy. D3, E1, F1, F2, and G2 are in the concentrate here area, which features high importance and low satisfaction. Among them, F1 and F2 are essential quality elements, which are the most important factors for users. If these factors are not met, they will seriously affect online training quality. D3, E1, and G2 are expected factors that are positively correlated with user satisfaction. While ensuring essential factor services, emphasis should be placed on strengthening course content (patent information analysis and utilization), diversified training formats (training duration), and communication and interaction. H1 and H2 are in the low priority area, with low satisfaction and low importance, and both are indifferent factors. Therefore, they can be disregarded when resources are limited. The priority ranking for training quality element improvement follows the principle: concentrate here area > low priority area, keep up the good work area > possible overkill area, essential factors > expected factors > attractive factors > indifferent factors. Combined with the priority index , the improvement strategy priority is F1 > F2 > G2 > E1 > D3 > H1 > H2.

(2) Priority for Maintenance Strategy. As shown in Figure 2, C1, C2, C3, D1, D2, D4, G1, and G3 are in the keep up the good work area, where user satisfaction is high and should be maintained. Among them, C3, D1, D2, G1, and G3 are expected factors, so training in instructor qualifications (patent information analysts), course content (patent basics, patent retrieval), and service feedback should be maintained to maximize user satisfaction with these quality elements. C1, C2, and D4 are attractive factors, and maintaining the implementation of attractive factors can effectively enhance user satisfaction. D5 and E2 are in the possible overkill area. Although their importance is low, their satisfaction is high, so a maintenance strategy can also be adopted. In summary, the maintenance strategy priority is D1 > D2 > G1 > G3 > C3 > C1 > D4 > C2 > D5 > E2.

The IPA analysis shows that all essential quality elements are in the concentrate here area, most expected and attractive factors are in the possible overkill and keep up the good work areas, and indifferent factors are in the low priority area. For essential and indifferent factors, an improvement strategy should be primarily adopted. For expected and attractive factors, a maintenance strategy should be mainly adopted.

3 Quality Improvement Recommendations for Subject Librarians' Intellectual Property Information Service Online Training

Based on the improvement strategies identified above, the following recommendations are proposed for improving training quality elements such as course content, support services, and service feedback mechanisms for libraries developing online training for intellectual property information services in China:

3.1 Strengthen Patent Information Analysis and Utilization to Support Research and Decision-Making

Patent information analysis and utilization (D3) is an expected factor and the only element in the course content dimension located in the concentrate here area, indicating that this factor is currently a weak link in training quality and requires priority improvement. Currently, most universities have carried out basic work such as patent retrieval and patent novelty searches, but few have conducted in-depth services such as patent mining, patent navigation, and intellectual property analysis and evaluation. In terms of training course content, emphasis should be placed on courses related to patent information analysis and utilization. First, data processing and visualization courses. Courses on patent data indexing and processing should be strengthened to enable librarians to identify, process, and combine patent information from massive datasets and transform it into predictive patent intelligence through visualization tools and intelligence analysis methods. Second, patent analysis methodology courses. Training should be conducted from multiple dimensions: data level (data correlation analysis, cluster analysis, citation analysis, etc.), technology level (technology efficacy matrix, technology roadmap analysis, etc.), and industry level (patent technology tracking strategies, R&D cooperation strategy patent analysis, etc.) to familiarize users with patent analysis processes and enhance subject librarians' information analysis capabilities. Third, practical patent information analysis courses. Patent information analysis and utilization work is highly practical, so training content should focus on case studies, providing in-depth analysis of practical operations in patent mining and layout, patent early warning, high-value patent cultivation, patent analysis and evaluation, and patent navigation analysis to enhance users' practical operation abilities. Through targeted development of patent information analysis and utilization courses, librarians' patent analysis proficiency can be improved, promoting the development of in-depth intellectual property information services to support research innovation needs and decision-making requirements of management departments.

3.2 Leverage Diversified Curriculum Resources to Enrich Basic Intellectual Property Training

Patent basics (D1) and patent literature retrieval (D2) are factors in the course content dimension located in the keep up the good work area and are expected

factors. Currently, university intellectual property information services are in their initial stages, with patents being the most involved type of intellectual property and work focusing mainly on basic services such as patent information consultation and retrieval. In setting training course content, it is still necessary to maintain courses on patent basics and patent literature retrieval. On one hand, training organizers should invite relevant experts to screen patent basics and patent retrieval courses, adjusting content according to updates in relevant policies and regulations, and selecting courses that include case analyses and database retrieval skills to avoid outdated or overly theoretical content. On the other hand, abundant online resources can be utilized. Platforms such as Chinese University MOOC, China Intellectual Property Distance Education Platform, free lectures by the Patent Documentation Department of the State Intellectual Property Office, and free intellectual property courses from commercial databases like incoPat and PatSnap all contain high-quality basic intellectual property training and patent retrieval and utilization content. These diversified curriculum resources can be used to enrich online training formats and content.

3.3 Optimize Training Platform Construction and Improve Communication and Feedback Mechanisms

Platform stability (F1) and replay function (F2) are essential quality elements in this study and are located in the concentrate here area. These two quality elements demonstrate that platform usability and usefulness have a direct impact on training quality. Organizers should select stable, compatible, easy-to-operate training platforms with replay functions.

Service feedback (G3) is in the keep up the good work area, is an expected factor, and should be maintained to enhance training effectiveness. First, establish communication platforms. Make full use of social media such as QQ and WeChat to create online communication platforms that facilitate interaction between staff and librarians, paying attention to user feedback on learning issues during training and providing timely answers to relevant questions. Second, conduct regular user needs surveys, such as through questionnaires, to gain insights into user needs and provide decision-making basis for course content setting and training format selection. Optimizing the training platform and further improving the service feedback mechanism can effectively increase training users' satisfaction and loyalty, thereby improving the quality of intellectual property training.

Conclusion

This study employed the Kano model to classify quality elements of online training for intellectual property information services into two essential elements, five expected elements, eight attractive elements, and two indifferent elements. Based on IPA analysis, improvement and maintenance strategies for developing online training for intellectual property information services were proposed

from three aspects: strengthening patent information analysis and utilization, leveraging diversified curriculum resources, and improving communication and feedback mechanisms. These findings provide theoretical reference significance for further improving intellectual property information service capabilities and perfecting the intellectual property information service training system.

This study has several limitations. Respondents came from different universities in the University Intellectual Property Information Service Center Alliance, with significant differences in subject librarians' professional backgrounds, university levels, and service targets, which may cause different types of subject librarians to have distinct classifications of training quality elements and group classification phenomena. Future research should continue to explore demand differences among different user groups to provide more precise decision-making references for university libraries developing intellectual property information service training.

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Note: Figure translations are in progress. See original paper for figures.