

Based on Statistical Education to Study Innovative Service and Relationship Quality of University Library under Big Data

Ruiyi Gong¹, Kaijun Yu¹, Hongmei Tang^{2*}

¹ Library, Shanghai University of Medicine & Health Sciences, Shanghai, CHINA

² School of Nursing and Health Management, Shanghai University of Medicine & Health Sciences, Shanghai, CHINA

Received 21 November 2017 • Revised 2 February 2018 • Accepted 23 March 2018

ABSTRACT

Along with the evolution of information technology, libraries have become network libraries and virtual libraries, and major technological revolution has changed the management and service of libraries. When providing users with information service, a library should apply statistical education to accurately analyze user needs and habits, enhance the library by designing diverse information service functions, and provide users with an information integration platform. In addition to more convenience for users utilizing library resources, the practice of statistical education would optimize the management process of a library. Aiming at librarians and users of Shanghai university of medicine and health sciences library, the membership database is applied to collect big data. With online questionnaire, total 500 copies of questionnaire are distributed and 387 valid copies are retrieved, with the retrieval rate 77%. The research results show significantly positive effects of 1.statistical education on innovative service, 2.innovative service on relationship quality, and 3.statistical education on relationship quality. Finally, suggestions, according to the results, are proposed, expecting to have libraries constantly create innovative management and service, facilitate users in the utilization of library resources, and integrate systems for optimizing the library management process.

Keywords: statistical education, big data, university library, innovative service of library, relationship quality

INTRODUCTION

The life after 10 years might appear technologies and computers being the major parts of daily life. Nevertheless, people transfer the attention to the human nature and the real effectiveness of technology; technology present perfect balance between virtual and real worlds and people would develop towards "life automation" in the future. Along with the evolution of information technology, the system of a library changes from paper library and automated library to network library and virtual library. Regardless the paper-based era or the digitalized time, the core value lies in "service", which accompanies major technology revolution and changes the management and service of libraries to enhance service quality. Since the establishment of library automation systems, traditional management is changed into reader-need oriented service pattern. The approach of network era has reader needs become diversified. The cooperation of librarians and system staff also creates distinct innovative management and service. However, the real value of a library is not the hardware facilities or the quantity of archives, but is the utilization of archives and the interaction with users. Especially, a university library, in order to integrate academic service, should take reader needs into the service account.

Regarding the information delivery, a library has been considering to effectively provide information for users. For instance, users are not clear of the library resources when new archives are purchased in the library. Moreover, some archives in a library present higher reputation or are arranged being more easily acquired that users cannot easily borrow them because of high use rate. In fact, there are lots of archives with the same categories and of users' interests in the library not being borrowed. A library therefore has to apply statistical education to accurately

Contribution of this paper to the literature

- The application of innovative service should take the existing system structure of a library and the technical resources into account so that the library could more smoothly develop innovative service.
- A library could reinforce the cooperative relationship with users by providing customized services to enhance user trust and establish deeper commitment on the relationship quality.
- A library should reinforce the statistical education, enhance the statistical analytical ability, and understand users' use situations, according to demographic variables, behavioral variables, and geographical variables.

analyze user needs and habits, when providing users with information service, to enhance the library by designing diverse information service functions and provide users with the information integration platform. Based on statistical education, this study intends to discuss the innovative service of university libraries under big data and apply big data in Internet of things to discuss the application of innovative service. In addition to providing users with convenient utilization of library resources, the integration of systems could optimize the management process of a library.

LITERATURE REVIEW

Statistical Education

Cox (2013) stated that statistics was used for dealing with data, which were composed of numbers; however, they were not simply numbers, but the numbers with contents. Statistics therefore was to find out information from data and make conclusions. Heyne, Boettke, and Prychitko (2013) indicated that statistics aimed to find out the implied information in data through analyses and organization for explaining certain phenomena or making predictions. The so-called statistics was to explain the essence of various social or natural phenomena through descriptive data and organize and analyze data for understanding the meaning of phenomena. The process of statistics contained four points of data collection, data organization and analysis, data characterization, and data explanation. Armstrong and Kotler (2014) indicated that a complete statistical teaching should contain dynamic activities allowing students' actual participation and developing necessary insight or enhancing the level of understanding from relevant data collection. The content of statistics course design therefore was a series of processes to deal with an actual problem, including problem formation, data collection, and data organization, calculation, presentation, and explanation. Rosell, Lakemond, and Wasti (2014) mentioned that statistical education contained the understanding of mean and mode being the representatives of population and the abstract meaning of statistical terms, the realization of phenomena with the information expressed in statistical charts or statistical numbers, the ability to extract meaningful information from statistical charts, the understanding of changes in life through the explanation of statistical charts, and the reasonable prediction of uncertain situations (Gomez & Ballard, 2013).

Referring to Kang and Kang (2014), statistical education in this study includes the following dimensions.

- (1) Process approach: A complete teaching activity should start from forming problems and transforming into statistical problems, collecting data aiming at the problems (including the decision of sample size and the way of sampling), establishing representative data, classifying and organizing data with diagrams or tables for analyses, and describing and explaining the data content, i.e. interpreting the implications of diagrams and tables.
- (2) Basic concept: Concept learned from the designed materials, covering knowledge concepts in the statistics process, according to data organization, data presentation, data explanation, production and report, and statistical chart interpretation.
- (3) Analytical ability: Referring to data organization, data presentation, and data explanation to further understand phenomena, extract meaningful information, analyze, explain, and criticize the information, and reasonably predict or infer uncertain situations according to organized information.

Innovative Service

Javkhuu (2014) regarded innovation as the process from fuzzy to specific. From the aspect of knowledge creation, Salunke, Weerawardena, and McColl-Kennedy (2013) defined innovation as the process creating related knowledge and information of new affairs. Accordingly, the broad definitions of innovation focused on concepts and regarded innovation as a concept or process with value (Jeong, Jang, Day, & Ha, 2014). Aziz and Omar (2013) pointed out innovative service as the process of a company adding value to business philosophy, culture, and operation process to enhance the profit of served objects from products or services. Wei, Miao, and Huang (2013)

mentioned Kelly and Storey's definition of new products of a service enterprise in 2000 that the products were new for a company or first created in the world and the products could improve existing products and present value-added service (de Farias, Aguiar, & Melo, 2014). Innovative service could be the product, process change, or the outcome of the production process of products with high intangibility, simultaneity, and heterogeneity (Tang, 2013). Gremyr et al. (2014) considered that innovative service showed the characteristics of intangible essence and high customization that closeness was the key of the innovative development of new service. Successful service innovation would constantly create, design, and provide package service, within the bearable risks, to match customers' urgent and general needs (Kindström, Kowalkowski, & Sandberg, 2013).

Referring to Ho and Ganesan (2013), innovative service in this study is divided into the following dimensions.

- (1) Novelty: The difference between new service processes and existing service processes.
- (2) Know-how: The difference in required skills and knowledge between new services or new systems and existing services or systems
- (3) Facility & environment: The changes of service environment with new services or systems, such as place decoration and smooth traffic flow and personnel.

Relationship Quality

Solomon (2014) pointed out intangibility, complexity, lack of service familiarity, and long time horizon of delivery as the factors in service that the high uncertainties would affect service, while good relationship quality could reduce uncertainties. Batnasan (2014) regarded relationship quality as the quality of interaction between a company and customers which could have customers experience the meaning of quality and enhance the development of long-term relationship. Josiam and Henry (2014) referred relationship quality as the reduction of consumers' perceived anxiety, doubt, and uncertainty after contacting with businesses. Domenico et al. (2014) defined relationship quality as the high-order construct containing various positive relations, reflecting the total intensity of relationship and the satisfaction of interested parties' needs and expectations. Relationship quality referred to the overall evaluation of relationship intensity (Yan, Wang, & Chau, 2013), i.e. customers' attitudes towards services provided by a company; the measurement of the overall evaluation was relationship quality. Nevertheless, relationship quality would determine the continuous interaction in the future. Grönroos and Voima (2013) considered that relationship quality, similar to product quality, could be regarded as the appropriateness to satisfy customer needs for relationship.

Referring to Tsai and Hsu (2014), relationship quality contains the dimensions of trust, satisfaction, and commitment. Customers' satisfaction with service providers' businesses, trust of service providers, and commitment to the relationship with service enterprises are the key elements of relationship quality (Yu et al., 2013).

- (1) Satisfaction: Homme and Raymond (2013) defined customer satisfaction in relationship quality as customers' cognition of overall services and influential evaluation in the service process, according to personal experiences.
- (2) Trust: Tseng and Lee (2014) defined trust as a party believing that another party would be responsible for satisfying the needs, meaning that customers, when facing service suppliers, believed that the service provided by service suppliers would satisfy the needs.
- (3) Commitment: It is generally regarded as a situation, in which the party with relationship tends to certain behaviors and the successive attitudes also tend to the continuous interaction (Namkung & Jang, 2013).

Research Hypothesis

Zhang and Wu (2013) proposed that innovative service should be developed from new concepts to acquire knowledge for market needs and develop new concepts and creativity through statistical education; with service design and internal/external tests, the new services were invested in the market and improvements were continuously made. Rosell et al. (2014) indicated that, when proceeding service innovation, the conditions of industrial environment should be analyzed with statistical education to filter and select new opportunities conforming to the overall strategies and resources of an enterprise. Armstrong and Kotler (2014) indicated that after confirming the innovation direction, customer needs should be deeply understood at the next stage; statistical education could help an enterprise accurately analyze customer needs, aiming to thoroughly understand customers' problems, pursued experiences, and the reasons for such needs. Kang and Kang (2014) developed innovative service based on customers, which appeared higher probability of success than technology-oriented innovative service to develop multiple effect of customer resources, effectively analyze customers' psychological difficulty and the shortage of market and knowledge with the accurate statistical analysis of statistical education, and allow customers participating in innovation process. In addition to reducing service development costs, it

could ensure the development of innovative service better conforming to the market and customer needs (Gomez & Ballard, 2013). The following hypothesis is therefore proposed in this study.

H1: Statistical education shows significantly positive effects on innovative service.

Gremyr et al. (2014) considered that innovative service could maintain the advantages of an enterprise or an organization and could assist in adjusting the provided service to satisfy customer needs. A company or an organization could conform to customer needs and enhance customer satisfaction by developing better innovative service (de Farias et al., 2014). Ho and Ganesan (2013) regarded relationship quality as the relationship between customers and an enterprise, and such relationship was determined by the degree of the innovative service satisfying customer needs; the higher relationship quality on the relationship between customers and an enterprise could better satisfy customer needs. Aziz and Omar (2013) indicated that the value of innovative service provided for customers would affect customer satisfaction and trust, which would influence relationship quality. Accordingly, the following hypothesis is proposed in this study.

H2: Innovative service reveals remarkably positive effects on relationship quality.

Domenico, Francis, and Daniela (2014) pointed out the intangibility and changeability characteristics of service that customers perceived high uncertainties when facing complicated and unfamiliar services, and those with longer deliver time; such uncertainties would enhance the possibilities of service failure and negative results. Good statistical education could definitely analyze the service required for customers and provide service for customer satisfaction to reduce uncertainties and affect the relationship quality of continuous interaction in the future (Yan et al., 2013). In the survey of five-star hotels in Seoul, South Korea, Batnasan (2014) indicated that high-quality service would result in high relationship quality. Apparently, definitely analyzing customer needs with statistical education to provide high-quality service could enhance relationship quality (Tsai & Hsu, 2014). In this case, the following hypothesis is proposed in this study.

H3: Statistical education presents notably positive effects on relationship quality.

SAMPLE AND MEASURING INDICATOR

Research Sample and Object

Aiming at university libraries in Shanghai, China, the librarians and users of Shanghai University of medicine and health sciences are studied. The membership database is applied to collect big data and 500 copies of online questionnaire are distributed. Total 387 valid copies are retrieved, with the retrieval rate 77%. Shanghai University of medicine and health sciences library has the multi-subject, multi-language, and multi-device archives adapted to university teaching and required for scientific research. Besides, it is gradually forming a literature information resource center with rich resources, seamless connection, school coverage, and Innovational service.

Reliability and Validity Test

The questions applied in this study are referred to domestic and international researchers, and a pretest is preceded before the distribution of formal questionnaire that the questionnaire presents certain content validity. Statistical education, innovative service, and relationship quality are tested the causal relationship in this study. The analysis with Linear Structural Relations model reveals the overall model fit achieving the reasonable range that it presents good convergent validity and predictive validity. Item-to-total correlation coefficients are used for testing the construct validity of questionnaire content, i.e. reliability analysis. The acquired item-to-total correlations coefficients are used for judging the questionnaire content. The item-to-total correlation coefficients of the dimensions in this study are above 0.7, showing certain degree of construct validity of the dimensions in this study.

Reliability analysis is proceeded to further understand the reliability of questionnaire. The formal questionnaire is developed according to the standards, and the measured Cronbach's α appears in 0.72~0.91, obviously conforming to the reliability range.

ANALYSIS OF EMPIRICAL RESULT

LISREL Indicator

LISREL (linear structural relation) model promises Factor Analysis and Path Analysis in traditional statistics and includes simultaneous equations in econometrics that it is the research tool to calculate multiple factors and multiple causal paths. Regarding the evaluation of model fit, preliminary fit criteria, overall model fit, and fit of internal structure of model are evaluated.

Table 1. Overall analysis of Linear Structural Model

Evaluation item	Parameter/evaluation standard	result	t	
preliminary fit	statistical education	process approach	0.683	9.63**
		basic concept	0.667	8.87**
		analytical ability	0.696	9.92**
	innovative service	novelty	0.702	10.61**
		know-how	0.711	10.89**
		facility & environment	0.723	11.76**
	relationship quality	satisfaction	0.718	11.43**
		trust	0.731	12.38**
		commitment	0.744	12.67**

Note: * stands for $p < 0.05$, ** for $p < 0.01$, and *** for $p < 0.001$

Table 2. Overall analysis of Linear Structural model

Evaluation item	parameter/evaluation standard	result	t
internal fit	statistical education→innovative service	0.825	22.73**
	innovative service→relationship quality	0.851	29.55**
	statistical education→relationship quality	0.837	26.21**

Note: * stands for $p < 0.05$, ** for $p < 0.01$, and *** for $p < 0.001$

Table 3. Overall analysis of Linear Structural Model

overall fit	X2/Df	1.682
	GFI	0.974
	AGFI	0.912
	RMR	0.005

Note: * stands for $p < 0.05$, ** for $p < 0.01$, and *** for $p < 0.001$

The data in this study are organized as below. The preliminary fit, internal fit, and overall fit of the model are explained as followings.

Table 1 shows the complete analysis results of the model. The dimensions of statistical education (process approach, basic concept, analytical ability) achieve significant explanations to statistical education ($t > 1.96$, $p < 0.05$), the dimensions of innovative service (novelty, know-how, and facility & environment) reach the remarkable explanation to innovative service ($t > 1.96$, $p < 0.05$), and the dimensions of relationship quality (satisfaction, trust, commitment) achieve the notable explanation to relationship quality ($t > 1.96$, $p < 0.05$). Accordingly, the model in this study presents good preliminary fit.

From **Table 2**, statistical education shows positive and remarkable correlations with innovative service (0.825, $p < 0.01$), innovative service reveals positive and notable correlations with relationship quality (0.851, $p < 0.01$), and statistical education also appear positive and significant correlations with relationship quality (0.837, $p < 0.01$) that H1, H2, and H3 are supported.

From **Table 3**, the overall model fit standards $\chi^2/DF=1.682$, smaller than the standard 3, and RMR=0.005, revealing the proper results of χ^2/DF and RMR. What is more, chi-square value is sensitive to sample size that it is not suitable for directly judging the fit. Nevertheless, the overall model fit standards GFI=0.974 and AGFI=0.912 are larger than 0.9 (the closer GFI and AGFI to 1 shows the better model fit) that the model presents better fit indicators.

CONCLUSION

The research results show that a library could enhance the relationship with users by providing services conforming to user needs to further enhance the trust and relationship commitment. The combination of daily necessities with the Internet, particularly the interaction between sensors and tags, could trace users' movement and any data could be mutually connected to expose users' habits and preference. Statistical education therefore could be applied to accurately analyze big data to enhance the relationship quality between a library and users. However, how to effectively prevent information safety is extremely important. The major challenge of new technology lies in persuading the use of users. Libraries are entering digital libraries, in which information technology is integrated with various automated services and big data are utilized for promoting libraries' statistical analytical ability through statistical education to accurately analyze user needs and understand user opinions for promoting innovative service closer to user needs.

RECOMMENDATIONS

From the research results and findings, practical suggestions are proposed as below.

1. The automation system management in each library is different. The entire automation system is purchased from an external manufacturer that a library would not modify the internal frame of the system, but think of developing innovative value-added services. For this reason, the application of innovative service should take the existing system structure of a library and the technical resources into account so that the library could more smoothly develop innovative service.
2. A library could reinforce the cooperative relationship with users by providing customized services to enhance user trust and establish deeper commitment on the relationship quality. In this case, it could achieve the benefit of relationship marketing. Aiming at different user groups, a library should utilize information technology for designing distinct innovative services. Different user group, and even the same user group, might have various needs that a library should provide suitable services for users.
3. A library should reinforce the statistical education, enhance the statistical analytical ability, and understand users' use situations, according to demographic variables, behavioral variables, and geographical variables. Innovative service could help a library effectively understand user groups and needs and create more accurate strategies for innovative service to provide unique services, satisfy user needs, and further enhance users' relationship quality of the library.

REFERENCES

- Armstrong, G., & Kotler, P. (2014). *Marketing: An introduction (GE)* (12th ed.) England: Pearson Education.
- Aziz, N. A., & Omar, N. A. (2013). Exploring the Effect of Internet Marketing Orientation, Learning Orientation and Market Orientation on Innovativeness and Performance: SEM (Exporters) Perspectives. *Journal of Business Economics and Management*, 14(S1), 257-278. <https://doi.org/10.3846/16111699.2011.645865>
- Batnasan, J. (2014). *Exploring relationships among service innovations, customer satisfaction and customer value in airport*. Asia University.
- Cox, R. (2013). *Environmental Communication and the Public Sphere* (3rd ed.). California: Sage.
- deFarias, S. A., Aguiar, E. C., & Melo, F. V. S. (2014). Store atmospherics and experiential marketing: A conceptual framework and research propositions for an extraordinary customer experience. *International Business Research*, 7(2), 87.
- Domenico, D., Francis, E., & Daniela, S. (2014). The Impact of Public R&D on Marketing and Supply Chains on Small Farms' Market Sensing Capability: Evidence from the Australian Seafood Industry. *International Food and Agribusiness Management Review*, 17(1), 37-82.
- Gomez, L. F., & Ballard, D. I. (2013). Communication for the Long Term: Information Allocation and Collective Reflexivity as Dynamic Capabilities. *Journal of Communication*, 50(2), 208-220. <https://doi.org/10.1177/0021943612474992>
- Gremyr, I., Witell, L., Lofberg, N., Edvardsson, B., & Fundin, A. (2014). Understanding New Service Development and Service Innovation through Innovation Modes. *Journal of Business and Industrial Marketing*, 29(2), 123-131. <https://doi.org/10.1108/JBIM-04-2012-0074>
- Grönroos, C., & Voima, P. (2013). Critical service logic: Making sense of value creation and co-creation. *Journal of the Academy of Marketing Science*, 41(2), 133-150. <https://doi.org/10.1007/s11747-012-0308-3>
- Heyne, P., Boettke, P. J., & Prychitko, D. L. (2013). *The economic way of thinking* (13th ed.) New York: Prentice Hall.
- Ho, H. D., & Ganesan, S. (2013). Does Knowledge Base Compatibility Help or Hurt Knowledge Sharing Between Suppliers in Co-competition? The Role of Customer Participation. *Journal of Marketing*, 77(6), 91-107. <https://doi.org/10.1509/jm.11.0570>
- Homme, B. P., & Raymond, L. (2013). Sustainable development practices in the hospitality industry: An empirical study of their impact on customer satisfaction and intentions. *International Journal of Hospitality Management*, 34, 116-126. <https://doi.org/10.1016/j.ijhm.2013.03.003>
- Javkhuu, B. (2014). *Exploring relationships among service innovations, customer satisfaction and customer value in airport*. Asia University, Department of Business Administration, Taiwan.
- Jeong, E. H., Jang, S. C., Day, J., & Ha, S. (2014). The impact of eco-friendly practices on green image and customer attitudes: An investigation in a café setting. *International Journal of Hospitality Management*, 41, 10-20. <https://doi.org/10.1016/j.ijhm.2014.03.002>

- Josiam, B. M., & Henry, W. (2014). Entertainment: Utilitarian and hedonic motivations for patronizing fun experience restaurants. *Procedia-Social and Behavioral Sciences*, 144, 187-202. <https://doi.org/10.1016/j.sbspro.2014.07.287>
- Kang, K. H., & Kang, J. (2014). Do External Knowledge Sourcing Modes for Service Innovation? Empirical Evidence from South Korean Service Firms. *Journal of Product Innovation Management*, 13(1), 176-191. <https://doi.org/10.1111/jpim.12087>
- Kindström, D., Kowalkowski, C., & Sandberg, E. (2013). Enabling service innovation: a dynamic capabilities approach. *Journal of Business Research*, 66(8), 1063-1073. <https://doi.org/10.1016/j.jbusres.2012.03.003>
- Namkung, Y., & Jang, S. (2013). Effects of restaurant green practices on brand equity formation: Do green practices really matter? *International Journal of Hospitality Management*, 33, 85-95. <https://doi.org/10.1016/j.ijhm.2012.06.006>
- Rosell, D. T., Lakemond, N., & Wasti, S. N. (2014). Integrating Knowledge with Suppliers at the R&D-Manufacturing Interface. *Journal of Manufacturing Technology Management*, 25(2), 240-257. <https://doi.org/10.1108/JMTM-12-2013-0171>
- Salunke, S., Weerawardena, J., & McColl-Kennedy, J. R. (2013). Competing through service innovation: The role of bricolage and entrepreneurship in project-oriented firms. *Journal of Business Research*, 66(8), 1085-1097. <https://doi.org/10.1016/j.jbusres.2012.03.005>
- Solomon, M. R. (2014). *Consumer behavior: Buying, having, and being* (10th ed.). New Jersey, USA: Pearson Education Inc.
- Tang, T.-W. (2013). Competing Through Customer Social Capital: The Proactive Personality of Bed and Breakfast Operators. *Asia Pacific Journal of Tourism Research*, ahead-of-print, 1-19.
- Tsai, K. H., & Hsu, T. T. (2014). Cross-Functional Collaboration, Competitive Intensity, Knowledge Integration Mechanisms, and New Product Performance: A Mediated Moderation Model. *Industrial Marketing Management*, 43, 293-303. <https://doi.org/10.1016/j.indmarman.2013.08.012>
- Tseng S. M., & Lee, P. S. (2014). The Effect of Knowledge Management Capability and Dynamic Capability on Organizational Performance. *Journal of Enterprise Information Management*, 27(2), 158-179. <https://doi.org/10.1108/JEIM-05-2012-0025>
- Wei, W., Miao, L., & Huang, Z. (2013). Customer engagement behaviours and hotel responses. *International Journal of Hospitality Management*, 33, 313-330. <https://doi.org/10.1016/j.ijhm.2012.10.002>
- Yan, X., Wang, J., & Chau, M. (2013). Customer revisit intention to restaurants: Evidence from online reviews. *Information Systems Frontiers*, 1-13.
- Yu, Y., Dong, X. Y., Shen, K. N., Khalifa, M., & Hao, J. X. (2013). Strategies, Technologies, and Organizational Learning for Developing Organizational Innovativeness in Emerging Economies. *Journal of Business Research*, 66, 2507-2514. <https://doi.org/10.1016/j.jbusres.2013.05.042>
- Zhang, J., & Wu, W. P. (2013). Social Capital and New Product Development Outcome: The Mediating Sensing Capability in Chinese High-Tech Firms. *Journal of World Business*, 48, 539-548. <https://doi.org/10.1016/j.jwb.2012.09.009>

<http://www.ejmste.com>