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Comparing digital libraries with virtual communities from the perspective of e-quality

Perspective of
e-quality

173

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Abstract

Purpose – In this study, the authors use the term “e-quality” to refer to information quality, system quality and service quality. This study aims to focus on e-quality, exploring and comparing users’ perceptions of digital libraries and virtual communities in the hope that the results of this study can help lead to better understanding of the exact nature of e-quality as perceived by users.

Design/methodology/approach – A large-scale survey was conducted for data collection. Data collected from 334 users of digital libraries and virtual communities were used for data analysis.

Findings – The study finds that users are likely to perceive a higher level of information quality, system quality and service quality of digital libraries than of virtual communities.

Practical implications – The authors suggest that librarians do not need to have concerns over the challenge brought by virtual communities, which indeed have an increasing impact on the way a lot of people seek and gather information. Instead, they should encourage their users to use both digital libraries and virtual communities. The authors believe that the usage of these two types of information sources by users can efficiently inform each other, thus facilitating the e-quality of both digital libraries and virtual communities to reach excellence.

Originality/value – Building on the information systems (IS) success model, this study explores and compares users’ perceptions of digital libraries and virtual communities in terms of e-quality, which the authors think presents a new view for digital library research and practice alike.

Keywords Information quality, Service quality, China, System quality, Digital libraries, Virtual communities

Paper type Research paper



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1. Introduction

Digital libraries utilize various information and communication technologies (ICT) to deliver information collection and associated services to user communities, playing the role as the extension of traditional physical libraries in a modern information society (Heradio *et al.*, 2012). Digital libraries in universities have gone “from a curiosity to mainstream” over the last three decades (Arms, 2012, p. 579) given more than 50 percent of the budget was used to purchase electronic resources in many academic libraries (Noh, 2012). In China, digital libraries in universities have achieved substantial development since the Ministry of Education (MOE) initiated the China Academic Library and Information System (CALIS) in 1998. There are four national information centers whose ultimate support is provided and maintained by CALIS:

- (1) the Science, Social Science and Humanities Information Center;
- (2) the Medical Information Center;
- (3) the Engineering and Technology Information Center; and
- (4) the Agricultural Information Center.

Introducing and creating varied databases are important aims of CALIS, with the result that both Chinese and English databases covering various subjects and disciplines have largely been introduced (Zhu, 2003; Yan *et al.*, 2013). Member institutions of CALIS such as academic libraries can benefit from all the services provided by CALIS, such as online cataloguing, dissertation database building, consortia acquisition of imported resources, interlibrary loan (ILL) and document delivery (DD) (Luo *et al.*, 2010). The CALIS ILL/DD services network was created in June 2004. With this network, users of small member libraries could request remote and networked ILL/DD services, which are provided by about 60 large academic libraries (Yao, 2012; Yao and Zeng, 2012). The substantial development of digital libraries offers library users the opportunity to conveniently and quickly access more electronic resources than ever before (West and Miller, 2011).

Meanwhile, the rapid growth of online virtual communities has made it easier and faster for users to produce and disseminate mass information than ever before (Lu and Yuan, 2011). Virtual communities are important applications of Web 2.0 technologies, referring to online social networks where information and knowledge are shared among people who have common favorites, interests, or experience (Chiu *et al.*, 2006). Web 2.0 virtual communities encourage people to participate in the shared generation of content, with the result that members' collaborative work is accumulated to become the assets of the communities (Liao and Chou, 2012). Consequently, many increasingly popular content creation systems that are open, collaborative and evolving, such as Wikipedia, have emerged (Stvilia *et al.*, 2008) and virtual communities are providing informal yet useful platforms for knowledge sharing activities (Yan and Davison, 2013). Indeed, for members of a virtual technological community, information seeking is their important activity (Bouty, 2000); as regards the academic value of social networking sites, students have a more positive attitude (Jahan and Ahmed, 2012); the aim of individuals participating in virtual communities is just to seek information and knowledge so that problems at work can be resolved (Chiu *et al.*, 2006). In China, some virtual communities such as Baidu Know, ScienceNet Blog, Chinese Wikipedia, Baidu Document and Sina Microblog have become popular, attracting millions of active

users. For example, hundreds of topics and categories of information and knowledge can be seen in Baidu Know, typically including:

- computers/networks;
- education/science;
- resource sharing;
- electronic digital;
- enjoyment and leisure;
- medical health;
- business;
- culture/arts; and
- society.

Both digital libraries and virtual communities are important online information system applications with the development of the internet, and both are potentially important information sources in the modern information society. We suggest that quality is likely to be a salient characteristic as both digital libraries and virtual communities strive towards success, given that quality represents “a degree of excellence” (Babalhavaeji *et al.*, 2010, p. 594). DeLone and McLean (1992) presented the information systems (IS) success model in 1992. In this model, they proposed six dimensions of success:

- (1) system quality;
- (2) information quality;
- (3) user satisfaction;
- (4) use;
- (5) individual impacts; and
- (6) organizational impacts.

Ten years later, they updated this model by proposing minor refinements, i.e. service quality is added as a component of IS success. At the same time, “net benefits” was used to replace the original terms “individual impacts” and “organizational impacts” (DeLone and McLean, 2003). In this study, we use the term “e-quality” to refer to information quality, system quality and service quality. Compared with the growing number of digital library projects in the past decade, the overall quality evaluation of digital libraries is limited and insufficient (Zhang, 2010), inviting more research.

Given the acknowledgment of usefulness, reliability, quality and knowledge value of ongoing virtual communities, which have an increasing impact on the way a lot of people seek and gather information (Fallis, 2008; Jahan and Ahmed, 2012; Lim and Kwon, 2010; Stvilia *et al.*, 2008), this study explores and compares users’ perceptions of digital libraries and virtual communities in terms of e-quality, which we think presents a new view for digital library research and practice alike. Following this introduction, we describe the research methodology and data collection. Then, we conduct data analysis and present the results. Finally, implications and suggestions are discussed.

2. Method and data collection

2.1 IS success model and measures development

The e-quality this study examines is based on the updated IS success model proposed by DeLone and McLean (2003) as presented in Figure 1. Compared with the original IS success model (DeLone and McLean, 1992), service quality is new to this model. In this updated model, technical success is measured by system quality; semantic success is measured by information quality; and effectiveness success is measured by use (intention to use), user satisfaction and net benefits (DeLone and McLean, 2003). DeLone and McLean did not mention what success can be measured by service quality, and we suggest that application success can potentially be measured by service quality.

Following DeLone and McLean (1992, 2003), some studies have developed and tested portions of this IS success model. The purpose of this study is not to test the causal relationship proposed in this model. Instead, this study focuses on e-quality, exploring and comparing users' perceptions of digital libraries and virtual communities in the hopes that the results of this study can help better understand the exact nature of e-quality as perceived by users. Specifically, six constructs (latent variables) were investigated in this study, namely:

- (1) information quality of virtual communities (IQVC);
- (2) information quality of digital libraries (IQDL);
- (3) system quality of virtual communities (SYSQVC);
- (4) system quality of digital libraries (SYSQDL);
- (5) service quality of virtual communities (SERQVC); and
- (6) service quality of digital libraries (SERQDL).

All the constructs were based on prior literature. All their corresponding measure items were adapted from the prior literature with the consideration of the context of this study. Specifically, the items measuring information quality and system quality

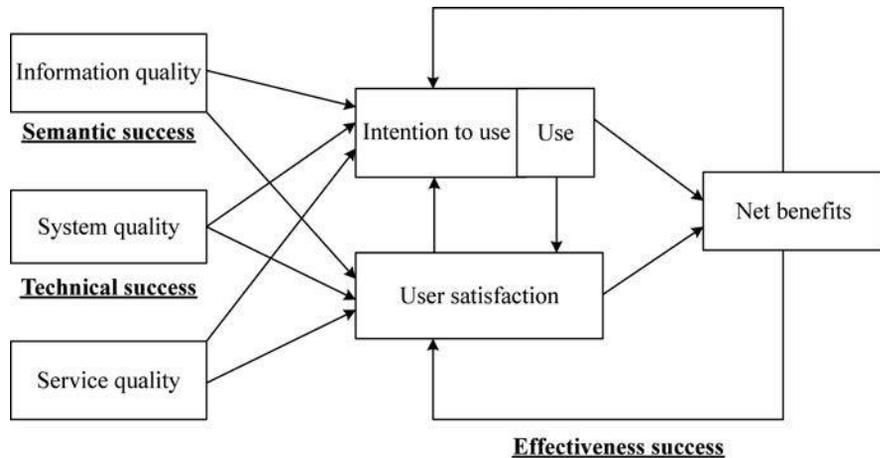


Figure 1.
Updated IS success model

were adapted from Wixom and Todd (2005) and Zhou (2011), while the items measuring service quality were adapted from Zhou (2011) and Zhou (2012).

After developing the instrument, we selected 20 graduate students for the pilot survey. Based on their feedback and our experience, we adjusted and improved the wording in several items. The Appendix lists the complete instrument. A seven-point disagree-agree Likert scale was applied for all the items. Following this, a large-scale survey was undertaken.

2.2 Data collection

An online survey website on which a questionnaire can be easily designed was used for data collection. The large-scale online survey data collection lasted for five weeks. In the survey questionnaire, we first described digital libraries and listed some Chinese databases such as CSSCI, Wanfang Digital Periodicals and China National Knowledge Infrastructure (CNKI), and some English abstract databases such as SCI (SSCI), as well as some English full-text databases published by Emerald, Elsevier, Wiley, Sage, IEEE and Springer. Meanwhile, we described virtual communities and listed some of them, such as Baidu Know, ScienceNet Blog, Chinese Wikipedia, Baidu Document and Sina Microblog. This study targeted library users of ten universities who are also users of virtual communities. After the questionnaire was published online, users were randomly invited to visit the online questionnaire where the purpose of our study is explained and their participation is solicited and appreciated. Consequently, data collected from 334 users were used for data analysis after the invalid responses were deleted (responses finished within a short time were deleted in terms of the response time the online survey website recorded for each respondent; responses in which “4” was chosen across all the items were deleted). The demographic information of these 334 respondents is documented in Table I.

3. Data analysis

3.1 Measurement model

The measurement model was assessed in terms of content validity, convergent validity and reliability, as well as discriminant validity (Straub *et al.*, 2004). With regard to content validity, we believe these constructs and items each are correctly and clearly expressed given they were adapted from the previous literature, with the wording improved after the pilot survey.

The results of average variance extracted (AVE), composite reliability (CR) and Cronbach’s α are shown in Table II. Convergent validity and reliability can be established with the score of CR and Cronbach’s α greater than 0.7 (Straub *et al.*, 2004). From Table II, we can see that the smallest value of CR is 0.846 and the smallest value of Cronbach’s α is 0.728, which suggests all the constructs have higher convergent validity and reliability.

From Table III, it can be seen that the square root of each construct’s AVE is larger than its correlations with other constructs, suggesting all the constructs have high discriminant validity (Straub *et al.*, 2004).

Given the validity and reliability of the measurement model, we thus believe using these data for further analysis is appropriate. Specifically, the discriminant validity suggests that each of the six constructs in our study is a meaningful variable, making it useful to conduct the comparison of e-quality between virtual communities and

Category	Item	Frequency	Percentage
Gender	Male	159	47.6
	Female	175	52.4
Age	18-25	235	70.4
	26-35	72	21.6
	> 35	27	8.1
Field	Natural sciences	101	30.2
	Social sciences	151	45.2
	Arts and humanities	46	13.8
	Others	36	10.8
Position	Undergraduate	136	40.7
	Master's student	106	31.7
	Doctoral student	41	12.3
Your experience with digital libraries (years)	Faculty	51	15.3
	< 1	57	17.1
	1-2	77	23.1
	2-3	55	16.5
	3-4	40	12.0
	> 4	105	31.4
Your experience with virtual communities (years)	< 1	86	25.8
	1-2	44	13.2
	2-3	49	14.7
	3-4	48	14.4
	> 4	107	32.0
Which information source you used first	Digital libraries	179	53.6
	Virtual communities	155	46.4

Table I.

Demographic information of 334 respondents

Constructs	Items	AVE	CR	Cronbach's α
Information quality of digital libraries (IQDL)	3	0.677	0.863	0.771
Information quality of virtual communities (IQVC)	3	0.646	0.846	0.728
Service quality of digital libraries (SERQDL)	4	0.710	0.907	0.864
Service quality of virtual communities (SERQVC)	4	0.680	0.895	0.843
System quality of digital libraries (SYSQDL)	3	0.770	0.909	0.861
System quality of virtual communities (SYSQVC)	3	0.750	0.900	0.833

Table II.AVE, CR and Cronbach's α of measurement model

	IQDL	IQVC	SERQDL	SERQVC	SYSQDL	SYSQVC
IQDL	<i>0.823</i>					
IQVC	0.146	<i>0.804</i>				
SERQDL	0.607	0.155	<i>0.843</i>			
SERQVC	0.151	0.654	0.208	<i>0.825</i>		
SYSQDL	0.676	0.152	0.633	0.153	<i>0.878</i>	
SYSQVC	0.191	0.739	0.191	0.743	0.166	<i>0.866</i>

Table III.

Correlations between constructs

Note: Italicized values are the square root of each construct's AVE

digital libraries. The convergent validity of the six constructs makes it reasonable to conduct data analysis in terms of data distribution and means at the construct level as described below.

3.2 Comparing information quality of virtual communities and digital libraries

Information quality is defined as the quality of outputs produced by IS which might be in the form of online screens or online reports, concerning completeness, accuracy and currency (Gorla *et al.*, 2010). Completeness refers to users' perceptions of the degree to which all necessary information is provided by IS; accuracy refers to users' perceptions of the degree to which the information is right and correct; and currency refers to the degree as perceived by users to which the information is current and up to date (Wixom and Todd, 2005). Information quality is suggested to be able to measure the semantic success of IS (DeLone and McLean, 1992, 2003).

Information quality has become a concern since more and more sources with mixed and even dubious provenance are available with the user review replacing traditional and specific gate-keeping such as the peer review and editorial review on the information production side (Arazy and Kopak, 2011). Regarding the information quality of virtual communities, there are two types of voices. One type of voice suggests that virtual communities are different from authoritative information sources, whose reliability can be guaranteed by authors with expertise (Lim and Kwon, 2010). Open sources in virtual communities lack quality assurance mechanisms, thus offering information in unfiltered and mixed forms with varying levels of quality (Kim and Sin, 2011). In this situation, it relies heavily on the ability of information users to make information quality judgments given the questionable and suspicious quality of information and the unreliable authority of information sources (Arazy and Kopak, 2011). The evaluation and selection of quality sources have thus become more critical than ever before (Kim and Sin, 2011). Another type of voice suggests that it is likely to result in positive and quite good epistemic effects for people to use virtual communities such as Wikipedia as an information source. The reliability and knowledge value of user-generated Wikipedia compares favorably to the reliability and knowledge value of traditional encyclopedias produced by experts (Fallis, 2008).

With regard to the construct information quality of virtual communities in this study, respondents were asked to rate on a scale of 1-7 the following statements:

- IQVC1. The information in virtual communities is up to date.
- IQVC2. The information in virtual communities is accurate.
- IQVC3. The information in virtual communities is comprehensive.

Following Zha *et al.* (2012, 2013), we conducted data analysis accordingly. For the scale of 1-7, 1 represents strongly disagree while 7 represents strongly agree. First, the number of 1, 2, 3, 4, 5, 6 or 7 for each item was counted based on the choice of the 334 respondents. Then due to this construct's adequate reliability and convergent validity, the corresponding number of these three items was summed to represent the subtotal of 1, 2, 3, 4, 5, 6 or 7, respectively, for this construct, whose total number is thus 1,002 (i.e. 334×3).

Likewise, regarding the construct information quality of digital libraries, respondents were asked to rate on a scale of 1-7 three similar items (see the

Appendix). Given the adequate reliability and convergent validity for all the constructs of this study, data analysis was conducted for this construct and other constructs below in the same way as the construct information quality of virtual communities above. Figure 2 shows a comparison of information quality between virtual communities and digital libraries.

From Figure 2, 31.3 percent (314/1,002) of the respondents think that virtual communities have lower levels of information quality while 41.2 percent (413/1,002) think that virtual communities have higher levels of information quality. At the same time, 27.5 percent (275/1,002) chose 4, which reflects the neutral attitude. As for information quality of digital libraries, 16.3 percent (163/1,002) of the participants think that digital libraries have lower levels of information quality while 63.6 percent (637/1,002) think that digital libraries have higher levels of information quality. Meanwhile, 20.2 percent (202/1002) chose 4, which reflects the neutral attitude.

3.3 Comparing system quality of virtual communities and digital libraries

System quality is defined as the processing quality of the information system *per se* (Gorla *et al.*, 2010). It can measure the extent to which the information system is robust and sound in terms of software and data components. System quality is characterized by both a system that offers reliable functions and features and software that is easy to learn, user-friendly, and easy to maintain (Gorla *et al.*, 2010). System quality is suggested to be able to measure the technical success of IS (DeLone and McLean, 1992, 2003).

With the quick development of ICT, the speed and the common format of information production, dissemination and delivery, as well as users' expectations and needs have all undergone tremendous changes (Ross and Sennyey, 2008). We suggest that a higher level of system quality is likely to be the premise of all these changes for both digital libraries and virtual communities. Virtual communities offer many functions and features. For example, the openness of Wikipedia provides a highly distributed collaborative work through which both error detection and error correction are given particular attention and substantial focus (Stvilia *et al.*, 2008). For digital libraries, they are also quick to leverage the ICT to enhance easy access to online databases and serials (Ross and Sennyey, 2008). The final aim of the system of digital libraries is to facilitate human knowledge to be fully accessed by people through ICT

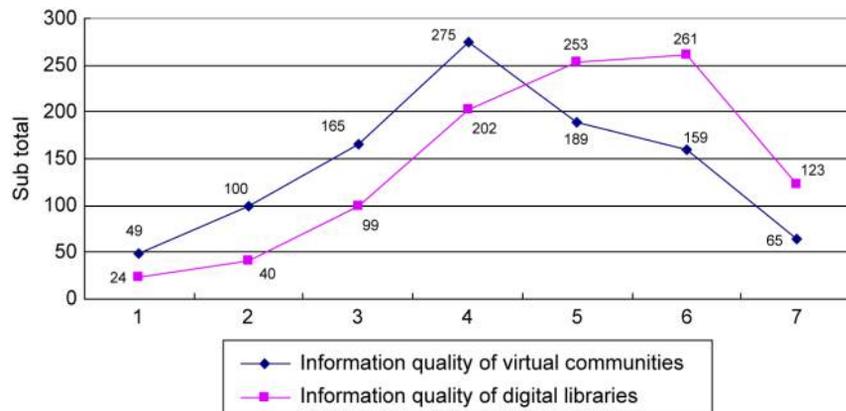


Figure 2. Comparison between information quality of virtual communities and digital libraries

any time and anywhere in a friendly way without distance, time, language and culture barriers (Heradio *et al.*, 2012).

With regard to the construct system quality of virtual communities in this study, respondents were asked to rate on a scale of 1-7 the following statements:

- SYSQVC1. Virtual communities are reliable.
- SYSQVC2. The navigation of virtual communities is effective.
- SYSQVC3. The layout of virtual communities is clear.

In this case, the total number of this construct is 1,002 (334 × 3). Data analysis was applied for this construct in the same way as described above. Likewise, regarding the system quality of digital libraries, respondents were asked to rate on a scale of 1-7 three similar items (see the Appendix). Figure 3 shows a comparison between the system quality of virtual communities and digital libraries.

From Figure 3, 32.7 percent (328/1,002) of the respondents think that virtual communities have lower levels of system quality, while 40.1 percent (402/1,002) think that virtual communities have higher levels of system quality. At the same time, 27.1 percent (272/1,002) chose 4, which reflects the neutral attitude. As for the system quality of digital libraries, 9.6 percent (96/1,002) of the participants think that digital libraries have lower levels of system quality, while 77.5 percent (776/1,002) think that digital libraries have higher levels of system quality. Meanwhile, 13.0 percent (130/1002) chose 4, which reflects the neutral attitude.

3.4 Comparing service quality of virtual communities and digital libraries

Service quality is defined as the service level that IS service providers deliver to users, covering four aspects, namely:

- (1) reliability;
- (2) responsiveness;
- (3) assurance; and
- (4) empathy (Gorla *et al.*, 2010).

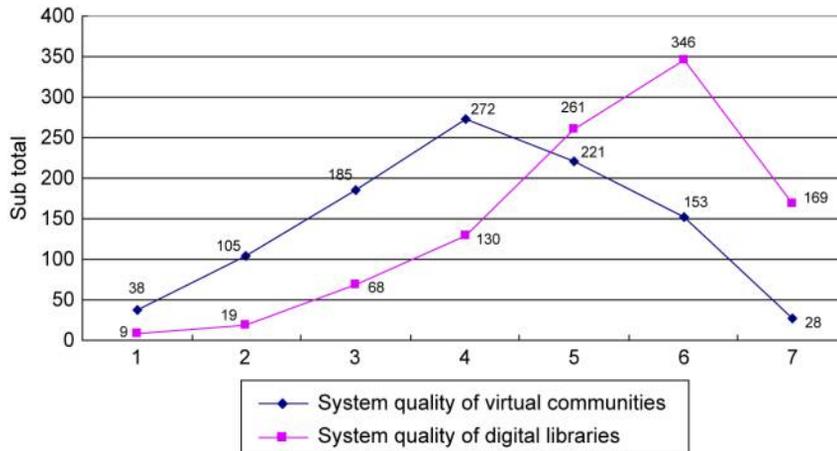


Figure 3. Comparison between system quality of virtual communities and digital libraries

Specifically, reliability refers to the degree to which the service team provides accurate and dependable services (Gorla, 2011), i.e. the success probability of the service during a given period of time (Goncalves *et al.*, 2007). Responsiveness reflects the degree to which the service staff are willing to deliver prompt service. Assurance refers to the degree to which the service staff have the knowledge and ability to instill confidence in users. Empathy reflects the degree to which the service staff pay individual attention to the users (Gorla, 2011). We suggest that service quality is potentially able to measure the application success of IS.

A number of researchers contend that service quality is an important factor that impacts success (Landrum and Prybutok, 2004). Indeed, academic libraries need to deliver prompt, dependable and effective service (Chen and Chou, 2011) given that loyal users may gradually shift from the library to other information sources on the internet as a result of their changing needs and experiences with other online service providers (Kiran and Diljit, 2012). Over the last two decades, library services have shifted from the traditional environment to the online web (Chen and Chou, 2011), with the result that many new types of services have been introduced. These modern library services include not only access to remote and networked electronic resources, but also others such as web portals, online library instruction, personalized services, online document delivery, online reference and helpdesk services, and electronic publishing (Kiran and Diljit, 2012).

Meanwhile, virtual communities have increasingly influenced users' information-seeking behavior (Shah and Kitzie, 2012). Virtual communities provide many services such as social question-answering. With this service, more and more information seekers are posting questions in the form of natural language and they are most likely to receive prompt and personalized answers by information contributors (Shah and Kitzie, 2012). In China, Baidu Know (see <http://zhidao.baidu.com/>) has emerged as the top Chinese social question-answering service platform. Users of Baidu Know can ask any question that might be answered by other users. The answers received would be first judged by the user who asked the question in terms of his/her judgment, and the best answer can be flagged and placed at the top of all the answers. The Baidu Know system records all these processes so that satisfactory answers can be easily located by any other user (Yan and Davison, 2013).

With regard to the construct "service quality of virtual communities" in this study, respondents were asked to rate on a scale of 1-7 the following statements:

- SERQVC1. Virtual communities provide dependable services.
- SERQVC2. Virtual communities provide prompt services.
- SERQVC3. Virtual communities provide personalized services.
- SERQVC4. Virtual communities provide professional services.

In this case, the total number of this construct is 1,336 (334×4). Data analysis was applied for this construct in the same way as described above. Likewise, regarding service quality of digital libraries, respondents were asked to rate on a scale of 1-7 four similar items (see the Appendix). Figure 4 shows a comparison between the service quality of virtual communities and digital libraries.

From Figure 4, 32.0 percent (427/1,336) of the respondents think that virtual communities have lower levels of service quality while 42.5 percent (568/1,336) think

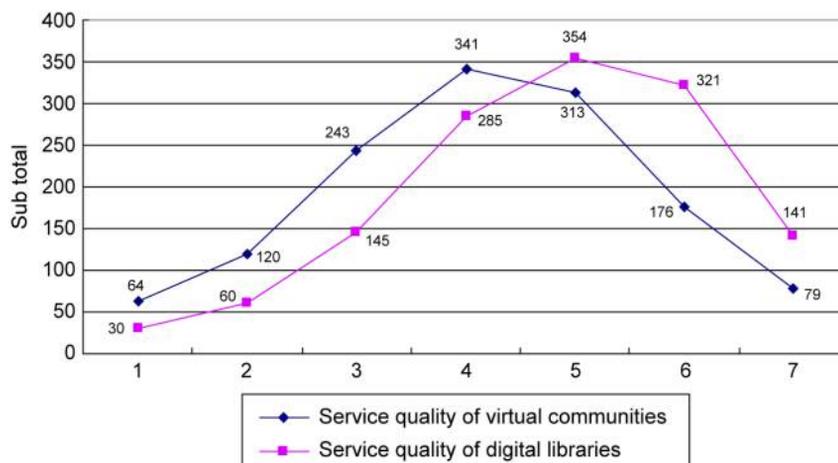


Figure 4.
Comparison between
service quality of virtual
communities and digital
libraries

that virtual communities have higher levels of service quality. At the same time, 25.5 percent (341/1,336) chose 4, which reflects a neutral attitude. As for the service quality of digital libraries, 17.6 percent (235/1,336) of participants think that digital libraries have lower levels of service quality while 61.1 percent (816/1,336) think that digital libraries have higher levels of service quality. Meanwhile, 21.3 percent (285/1,336) chose 4, which reflects a neutral attitude.

3.5 Paired samples *t*-test

Figures 2-4 above present the exact nature of users' perceptions of e-quality in terms of data distribution. In order to present the exact mean difference between virtual communities and digital libraries in terms of e-quality, the score of the six constructs this study examines were first each calculated based on their measurement models. Then, we used the statistical method to compare the means. Specifically, we used the paired-samples *t*-test oriented to dependent samples. Table IV shows the results, which suggest that there are significant differences for all e-quality between virtual communities and digital libraries.

From Table IV, the mean difference between system quality of virtual communities and system quality of digital libraries is largest at 1.210, while the mean difference between service quality of virtual communities and service quality of digital libraries is

		Mean	<i>n</i>	SD	Paired differences	<i>t</i>	Significance (two-tailed)
Pair 1	IQDL	4.899	334	1.145	0.747	8.983	0.000***
	IQVC	4.152	334	1.173			
Pair 2	SERQDL	4.802	334	1.160	0.632	7.716	0.000***
	SERQVC	4.169	334	1.218			
Pair 3	SYSQDL	5.319	334	1.125	1.210	14.605	0.000***
	SYSQVC	4.109	334	1.215			

Notes: **p* < 0.05; ***p* < 0.01; ****p* < 0.001

Table IV.
Paired-samples *t*-test

smallest at 0.632. For all e-quality, digital libraries significantly exceed virtual communities.

4. Discussion and implications

According to the updated IS success model (see Figure 1), information quality, system quality and service quality are all important for the success of digital libraries since each quality is linked to user satisfaction and use, which further lead to net benefits (DeLone and McLean, 2003). However, study on the quality evaluation of digital libraries from the perspective of users' perceptions seems to be at an early stage even though its importance is well recognized (Heradio *et al.*, 2012). In this study, we compare users' perceptions of digital libraries and virtual communities in terms of e-quality. Specifically, Figures 2-4 present the exact nature of users' perceptions of e-quality in terms of data distribution. These figures are supplemented by the paired samples *t*-test, which presents the exact mean difference between virtual communities and digital libraries in terms of e-quality. We believe the findings of this study have important implications.

As regards the reliability, usefulness, quality and knowledge value of information created by experts versus information created by the crowd, there is a lot of ongoing discussion (Yaari *et al.*, 2011). Ross and Sennyey (2008) suggest the online collective wisdom is usually correct, even though the tremendous errors and total distortions on the web are pointed out by critics. The result of this study indicates that the quality of the information inside the digital library produced by experts is perceived to be higher than that of the information in virtual communities produced by the crowd. As regards system quality, the result of this study indicates that the system quality of digital libraries is perceived to be higher than that of virtual communities. In China, CALIS facilitates the construction of digital libraries in universities, resulting in the introduction and production of various databases across almost all disciplines and subjects (Yao and Zeng, 2012; Zhu, 2003). These databases typically provide detailed and richer metadata with the effective navigation and clear layout. We suggest these features might lead to ease of use and user friendly and further higher levels of system quality.

Our study examines service quality in terms of reliability, responsiveness, assurance, and empathy. For personalized services (empathy) in digital libraries, we already see good applications. At the University of Oklahoma library, users can create their own personalized webpage and see the personalized information each time they log onto the library system (Kim and Abbas, 2010). For professional services, it is suggested that users are less likely to believe that the librarian has the adequate and right knowledge to solve their specific information need. Instead, users are more likely to plan information activities that they would rather take on themselves than delegate to librarians (Pinto *et al.*, 2010). In our study, the result indicates that users are likely to perceive a higher level of service quality of digital libraries than that of virtual communities. We suggest the digital library service is likely to be salient given that libraries and business entities essentially function differently (Kiran and Diljit, 2012). Shah and Kitzie (2012) examine the differences in service models between a one-to-one interaction in a digital library between an asker and an answerer versus a collaborative interaction in a virtual community between multiple askers and multiple answerers. They suggest a core challenge faced by both digital libraries and virtual communities

is providing relevant information with high quality to meet information seekers' needs (Shah and Kitzie, 2012). In this situation, we recommend that managers of digital libraries should think more about how librarians could actually obtain adequate knowledge and abilities to provide professional service for the users in the hopes that the core challenge can be overcome.

As suggested by the updated IS success model, when users perceive a higher level of information quality, system quality and service quality of digital libraries than that of virtual communities, they feel more satisfied with digital libraries and use them more frequently, which further results in more net benefits. We thus suggest that the findings of this study reflect that virtual communities are complementing rather than replacing digital libraries. This might be attributed to the positive effect of CALIS on digital library construction in China. Digital libraries have many challenges in management practice (Skaggs *et al.*, 2006). One question is whether the entire internet needs to be and can be cataloged by librarians in a standard and professional way to satisfy library patrons' information needs in the modern, ever-changing information society (Zha *et al.*, 2012). Furthermore, information quality is likely to be neglected by users who tend to have an overly positive attitude towards virtual communities (Kim and Sin, 2011). Based on the findings of this study, we suggest that librarians need not have concerns over the challenge brought by virtual communities. Instead, they should encourage their users to use virtual communities given the increasing acknowledgment of their usefulness, reliability, quality and knowledge value (Fallis, 2008; Jahan and Ahmed, 2012; Lim and Kwon, 2010; Stvilia *et al.*, 2008) as well as their complementary role. We believe the usage of these two types of information sources by users can efficiently inform each other, thus hopefully improving the overall quality of both.

5. Conclusion

This study examines e-quality from the perspective of users, given that quality is a subjective feeling perceived by users whose point-of-view is crucial (Yaari *et al.*, 2011). Specifically, we compare users' perceptions of digital libraries and virtual communities in terms of information quality, system quality and service quality. We find users perceive a higher level of e-quality of digital libraries than that of virtual communities. We suggest that the findings of this study provide useful insights into the quality issue, which is critical to the success of digital libraries and contributes to digital library research and practice alike. However, since this study targeted library users of ten universities in China, generalizing the results to other settings needs further study. Moreover, quality and information source selection are complex issues given that source quality tends to be simply neglected in favor of convenience by information seekers (Kim and Sin, 2011). We thus suggest that further study concerning other settings or qualitative data would usefully complement the study presented here.

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Appendix. Constructs and items

Information quality of virtual communities (adapted from Wixom and Todd, 2005; Zhou, 2011)

- (1) The information in virtual communities is up to date.
- (2) The information in virtual communities is accurate.
- (3) The information in virtual communities is comprehensive.

Information quality of digital libraries (adapted from Wixom and Todd, 2005; Zhou, 2011)

- (1) The information in the digital library of my university is up to date.
- (2) The information in the digital library of my university is accurate.
- (3) The information in the digital library of my university is comprehensive.

System quality of virtual communities (adapted from Wixom and Todd, 2005; Zhou, 2011)

- (1) Virtual communities are reliable.
- (2) The navigation of virtual communities is effective.
- (3) The layout of virtual communities is clear.

System quality of digital libraries (adapted from Wixom and Todd, 2005; Zhou, 2011)

- (1) The digital library of my university is reliable.
- (2) The navigation of the digital library of my university is effective.
- (3) The layout of the digital library of my university is clear.

Service quality of virtual communities (adapted from Zhou, 2011; Zhou, 2012)

- (1) Virtual communities provide dependable services.
- (2) Virtual communities provide prompt services.
- (3) Virtual communities provide personalized services.
- (4) Virtual communities provide professional services.

Service quality of digital libraries (adapted from Zhou, 2011, 2012)

- (1) The digital library of my university provides dependable services.
- (2) The digital library of my university provides prompt services.
- (3) The digital library of my university provides personalized services.
- (4) The digital library of my university provides professional services.

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