DEVELOPING THE MEASUREMENT SCALE OF INFORMATION QUALITY FOR SOCIAL Q&A SITES

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Abstract

Social Q&A sites take advantage of the wisdom of crowds and produce huge number of answers every day. This research-in-progress paper aims to develop a measurement scale of Information Quality (IQ) for social Q&A from the perspective of the user perception. Based on the previous studies with a set of attributes, a conceptual framework of IQ in social Q&A context is developed. Five scholars in the IS field are also interviewed for helping us modify this scale. Baidu Knows, which is the most influential Chinese social Q&A website, is used to conduct the empirical study. This paper employs the Exploratory Factor Analysis (EFA) to test our preliminary measurement scale and make some further revisions. The findings show the IQ of social Q&A includes four dimensions, i.e., Content Quality, Source Quality, Performance Quality, and Emotion Quality with a total of 19 key indicators. This tentative study of IQ evaluation is effective in identifying high-quality answers on social Q&A sites. Moreover, it also has the potential to contribute to the interaction design of social Q&A sites.

Keywords: Social Q&A, Online community, Information quality, User-Generated Content, Scale development.

1   INTRODUCTION

Social Question and Answering (hereinafter Social Q&A), which is also called Community Question and Answering (CQA), is one of the typical applications of User-Generated Content (hereinafter UGC) and User-Rated Content (hereinafter URC) in Web 2.0 era (Gazan 2011). Users can ask or answer questions freely, and rate content submitted by others as well as vote for the best answers in social Q&A sites (Qu, et al. 2012; Jin, et al. 2013; Chua & Banerjee 2013). So far, there are many popular social Q&A services worldwide, such as Yahoo! Answers (answers.yahoo.com), Askville (askville.amazon.com), Naver (www.naver.com), WikiAnswers (wiki.answers.com) and Quora (www.quora.com.), which have accumulated a large amount of users and made a great impact on the every aspects of the society. In China, Baidu Knows (zhidao.baidu.com) is the most influential social Q&A site which was founded in 2005 (Zheng, et al. 2012), and was also a pioneer of UGC in knowledge sharing field. As a widespread Chinese social Q&A site, Baidu Knows provides users with an environment to put forward concrete questions by themselves, and launches an open call to let the crowd solve these questions by awarding mechanism. Later, answers to these questions will be provided to those who with similar concerns or doubts as search results. Among the many responses, participants can also vote for the best answer or select the standard answer.

Generally, social Q&A provides a simple and powerful way to raise questions and get answers from the mass crowd (Surowiecki 2005; Shah, et al. 2009). The promising problem-solving model roots in the assumption that everyone can have the potential to plug in the valuable information, and many of them are also willing to do so at their convenience. In that case, social Q&A collections can be regarded as knowledge repositories which may facilitate the information sharing and knowledge dissemination in a self-organizing way. According to Shah, et al. (2009), social Q&A consists of three basic components, i.e., a mechanism for users to submit questions in natural language, a venue for users to provide answers for questions, and an online community supporting this interaction and exchange. Therefore, the primary affordance of social Q&A is to meet the requirement of social information seeking (Hargittai & Hinnant 2006; Evans, Chi 2008; Xu, et al. 2010) or social reference (Shachaf 2010a; Gazan 2007, 2010, 2011). Compared with traditional library reference service and expert consulting service, social Q&A sites have advantages in the number of respondents and its diverse demographics (e.g., age, education background, and culture etc.). Owing to the diversity of professional degrees and levels of knowledge between all these answerers, social Q&A may to some extent achieve the desired and acceptable results for the users in an efficient way.

To better understand the successful implementation of social Q&A and its underlying challenges and problems, many researchers have endeavoured to explore the user's motivation and behaviour in social Q&A process (Raban & Harper 2008; Ong, et al. 2009; Kang, et al. 2011; Jin, et al. 2013; Shah, et al. 2014). Those studies from user perspective may focus on the cognitive, social and psychological aspects of social Q&A adoption and diffusion. In addition, as suggested by Zhao, et al. (2014), UGC can be decomposed into three primary components, namely user, content, and process. Such is the same case for social Q&A site. The quantity and quality of content produced by the mass crowd in social Q&A sites play a significant role in the initial and post adoption and diffusion of those social information systems. In this case, Information Quality (hereinafter IQ) of social Q&A site is a dominant factor for its sustainability, and how to evaluate the IQ of social Q&A from various dimensions should be highly explored. Empirically, social Q&A sites often attract controversy in its answer quality (Blooma, et al. 2010; Chua & Banerjee 2013, 2015). Researchers from a variety of disciplines are trying to investigate the assessment or the indicators of social Q&A answer quality in recent years (Fichman 2011). Yet, there is still a lack of comprehensive understanding toward the evaluation of IQ in social Q&A context. The main purpose of this research-in-progress paper is to describe the development of a measurement scale designed to examine the IQ in social Q&A sites. A preliminary survey was conducted to validate our measurement scale by taking the Baidu Knows as an example. The necessity for the development of such a scale relates to the impact IQ is having on the adoption and continuous usage of social Q&A sites in people's everyday life.

2   LITERATURE REVIEW

2.1   Conceptualization of IQ for Social Q&A

Information quality, also known as data quality in the early stage (Wang & Strong 1996; Wang & Wang 1996), is an important measure of the content quality in information systems (Ong, et al. 2009; Zheng, et al. 2009). Delone and McLean (1992) defined it as "the quality of the information that the system produces, primarily in the form of reports", and the construct can be measured in terms of accuracy, timeliness, completeness, relevance, and consistency (Delone & McLean 2002, 2003). Wang and Strong (1996) developed a significant and hierarchical framework with four categories and 15 related dimensions of IQ in IS context, namely intrinsic, contextual, representational, and accessibility.

In the web context, many scholars also treat the IQ as a multi-dimensional concept measured by indicators and attributes. For instance, Alexander and Tate (1999) proposed a concept of "web wisdom" and developed six relevant criteria to examine the web IQ. In particular, some researchers have shown great interest in evaluating the IQ of web information retrieval & search (WIR&S), and put forward different versions of conceptualization or metrics (e.g., Knight 2008; Naumann & Rolker 2000; Rieh 2002; Zhu & Gauch 2000).

Although the traditional conceptualization of IQ in IS or WIR&S context may yield some implications, it cannot be directly transplanted to the Web 2.0 context, especially when UGC is fundamentally altering how users interact with the internet, and how those UGC platforms reach their audience (Zhao, et al. 2014). One of the most significant features of UGC lies in its social characteristics, which means more participation, communication, and collaboration in an open way. Social Q&A is a typical application of UGC, and the content produced by such platforms is usually with less centralized quality control and more heterogeneity or diversity (Stvilia, et al. 2005). Therefore, reconceptualising the IQ for social Q&A will better our understanding on this topic. Lukyanenko, et al. (2014) define the Crowd Information Quality (Crowd IQ) as "the extent to which stored information represents the phenomena of interest to data consumers (and project sponsors), as perceived by information contributors", which is more pertinent to the Web 2.0 era and embedded with the social elements compared with the traditional definition of IQ. Lukyanenko and Parsons (2015) also indicated that users are facing with a variety of problems and challenges for understanding and improving the quality of UGC. Among them, the IQ for social Q&A applications has become a serious concern in IS field due to the huge amount of real-time Q&A production yet poor reliability and credibility (Shachaf 2010b). In this paper, based on the previous work (Chua & Balkunje 2012; Hilligoss & Rieh 2008), we summarize the IQ for social Q&A as: people's subjective judgment of goodness and usefulness of an answer that answerer offer to the asker in a social Q&A site in terms of their own expectations of information.

2.2   Methods employed to measure IQ for Social Q&A

2.2.1   Feature extraction and classification

Researchers in CS field are specialized in identifying, evaluating, forecasting and recommending high-quality answers of social Q&A using the computer technology. For example, Maximum Entropy Model (Jeon, et al. 2006; Zheng, et al. 2012), answer verification and weight boosting method (Oh, et al. 2012), hierarchy-of-classifiers framework (Tobaa, et al. 2014) are often designed to determine and identify IQ. Essentially, these appraisal methods can be regarded as a feature extraction and classification process that based on the machine learning and some kind of classification algorithm. In addition, link analysis, such as PageRank and HITS (Jurczyk & Agichtein 2007), and Bayesian Information Criterion (Bouguessa, et al.) are also employed to analyze the user graphs to discover the authoritative users in social Q&A communities.

2.2.2   Rating assess and content analysis

Although the evaluation method based on machine learning can analyze huge amount of data in social Q&A sites automatically and efficiently, the processing ability is more limited to text and content characteristics of answers. For some characteristics relying on user's subjective attitude, cognition, and affect, the non-automatic evaluation method, typically including users rating assess (e.g. Harper, et al. 2008; Blooma, et al. 2008, 2010; Shah & Pomerantz 2010; Blooma, et al. 2012; Wong 2013; Hart & Sarma 2014) and content analysis (e.g. Kim, et al. 2007; Kim & Oh 2009; Oh, et al. 2011; Worrall, et al. 2012；Shachaf 2009, 2010b; Fichman 2011, 2014), or a combination of these approaches are often used to identify the IQ of content or text feature for social Q&A by IS and LIS researchers. For example, based on the measurement scale proposed by Zhu, et al. (2009), Shah and Pomerantz (2010) conducted a research to evaluate and predict the quality of answers in Yahoo! Answers and ask Amazon Mechanical Turk workers to rate the quality of each answer. Kim et al. specialized in extracting and rating users' commentary sentences of answer quality from the user-oriented relevance perspective to investigate the best-answer selection criteria in Yahoo! Answers (Kim, et al. 2007; Kim & Oh 2009; Oh, et al. 2011; Worrall, et al. 2012). Chua and Balkunje (2012) performed a comparative evaluation of answer quality consists of content, cognitive, and socio-emotional value of three English and three Chinese social Q&A websites. It is worth noting that some studies find that a social Q&A site, where anybody can answer questions, has an advantage over sites which are depended on specific individuals to answer questions, such as library reference service (Harper, et al. 2008; Shachaf 2009).

3   RESEARCH DESIGN

3.1   Scale Development for Social Q&A

So far, there are some existing scales used to measure IQ in social Q&A context (Blooma, et al. 2008; Chua & Banerjee 2013; Kim et al. 2007; Kim & Oh 2009; Zhu, et al. 2009). We believe that by channelling the separate research efforts into a comprehensive perspective can develop a better understanding of the existing practices and achieve insights that exceed the single perspective. Consequently, the aim of this paper is to lay a conceptual framework on the development of IQ measurement scale in social Q&A context that assist in evaluating the specific answer quality, Building on prior studies, we propose 21 descriptive indicators that closely related to IQ and identify a measurement scale of IQ for social Q&A sites. Thus, the IQ is divided into five dimensions, including Content Quality, Source Quality, Time Quality, Effect Quality and Emotion Quality. The details are shown as below (The appendix of the explanations for the indicators in the conceptual measurement scale can be provided upon request).

- *Content Quality*: Content-oriented dimension is the most common and important criteria for users (Saracevic 2007; Kim & Oh 2009). *Content Quality* of social Q&A refers to the degree that information content consistent with the objective reality. It is comprised of ten indicators in our scale, i.e., *Accuracy* (Alexander & Tate 1999; Rieh 2002; Chua & Banerjee 2013), *Specificity* (Kim, et al. 2007; Kim & Oh 2009), *Objectivity* (Naumann & Rolker 2000; Knight 2008; Zheng, et al. 2009), *Completeness* (Stvilia, et al. 2005; Fichman 2011; Worrall, et al. 2012), *Relevance* (Saracevic 2007; Yaari, et al. 2011; Wong 2013), *Language* (Blooma, et al. 2008), *TextLength* (Zhu, et al. 2009; Blooma, et al. 2010), *Novelty* (Barry & Schamber 1998; Kim & Oh 2009), *Politeness* (Shachaf 2009; Oh, et al. 2011), *Readability* (Knight 2008; Chua & Balkunje 2012).
- *Source Quality*: There are multiple formats and types of information sources, such as books, reports, journals, statistical reviews, and websites, etc. Due to the diversity and heterogeneity of the sources, the information requester may confront distinct kinds of issues and challenges in identifying the credibility of information source in social Q&A settings (Jeon & Rieh 2014). Studies suggest that external sources, such as links and content posted by authoritative organizations or professional experts that cited by answerers are important to the adoption of an answer (Gazan 2006; Kim & Oh 2009). Thus we put forward four preliminary indicators as the

component of *Source Quality* in this paper, i.e., *External Link* (Kim, et al. 2007; Shachaf 2009), *Available Alternative* (Barry & Schamber 1998; Shachaf 2010b; Wong 2013), *Profession* (Blooma, et al. 2008; Jeon & Rieh 2014), *Originality* (Zhu, et al. 2009).

- *Time Quality:* Chua and Banerjee (2013) investigated the interplay between answer speed and answer quality across five different question types. Thus we identify it as a unique dimension (*Time Quality*) and employ the *Quickness* as an indicator to measure the response time of getting the answers from social Q&A sites (Kim & Oh 2009; Knight 2008).

- *Effect Quality*: The utility of information is closely related to the task of information consumers. Hence, whether an answer is directly useful for making a decision is extremely important to the asker (Kim & Oh 2009). The attribute of *Effect Quality* of social Q&A refers to the extent that the adoption *of* answers can help the asker to solve the current question (Cosijn & Ingwersen 2000). *Effectiveness* (Rieh 2002; Zheng, et al. 2009; Wong 2013) and *Solution Feasibility* (Naumann & Rolker 2000; Zhu & Gauch 2000) are two main indicators of this dimension.

- *Emotion Quality*: Barry and Schamber (1998) indicated that the positive emotional experiences and responses provided by the answerers, such as friendliness, kindness, sympathy, encouragement and praise, may have a desired effect on the adoption and acceptance of answers. Askers would acknowledge those who provide emotional support and effort to write an answer, and show a humorous and agreeable attitude during the interaction (Kim & Oh 2009). Thus, we employ four reflective indicators in *Emotion Quality* dimension to explore the emotional impact on the IQ for social Q&A sites, i.e., *Attitude* (Chua & Balkunje 2012; Jeon & Rieh 2014), *Effort* (Kim, et al. 2007; Oh, et al. 2011), *Agreement* (Naumann & Rolker 2000; Oh, et al. 2011), *Humor* (Kim & Oh 2009).

3.2 Scholar Interview and Scale Modification

In order to improve the measurement scale, scholar interviews were conducted to detect items that were not easily understood or had some cognitive confusion before the formal survey. Five scholars with profound knowledge and rich research experience in the field of IQ evaluation were selected as our interview objects. Our primary purpose of conducting the interview is to focus on the rationality and integrity of the scale, which helps us in evaluating whether the items proposed indeed measured the IQ constructs in social Q&A context we intended.

At the beginning of the interview, we made a brief description of the definition and types of social Q&A service. Then we provided the scholars with a detailed explanation regarding the five dimensions and 21 indicators of the scale. The five scholars gave credit for the scale in general. Meanwhile, they indicated some reflections and questions on several indicators. Finally, according to the feedback of the five scholars, the dimensions and indicators of the scale were revised as follows:

- *Dimension Integration*: We merged the "Time Quality" and "Effect Quality" into one dimension and labeled as "Performance Quality". In this case, the scale was comprised of four dimensions, i.e., Content Quality (CQ), Source Quality (SQ), Performance Quality (PQ) and Emotion Quality (EQ).

- *Indicator Specification*: The "Language", "TextLength" and "Readability" of the CQ were modified as the "Language Expression", "Valuable Words" and "Understandability" respectively. The "Available Alternatives" of the SQ was revised as the "External Certification". And the four indicators of the EQ, namely "Attitude", "Effort", "Agreement" and "Humor", were changed to "Answerer's Attitude", "Answerer's Effort", "Answerer's Agreement" and "Answerer's Humor", to eliminate the understanding ambiguity.

- *Indicator Adjustment*: We adjusted the indicator of "Politeness" from the CQ to EQ, and changed its name to "Answerer's Politeness" at the same time, to reflecting the answerer's emotional judgment and cognition.

- *Indicator Augment*: We added an indicator named "Interactivity" to describe the PQ, which is the communication and interaction between askers and answerers of the social Q&A site over a period of time. Besides, an indicator called "Answerer's Experience" was added to the EQ, which means that the answerer may utilize his or her experience that is relevant to the asker's concern.

3.3 Questionnaire Design and Preliminary Data Collection

In this research-in-progress paper, we employed Baidu Knows as the research object to conduct a preliminary empirical study, and issued a web questionnaire (*The Answer Quality Survey of Baidu Knows*) on the website of "Sojump" (www.sojump.com) to complete the survey. The questionnaire was mainly composed of two parts. The first part was related to the basic information of interviewees, including their demographic characteristics (gender, age, profession and education level), as well as the average time they used to ask for information and the themes they were concerned about. The second part was the measurement about the IQ level that users perceived from the usage and interaction towards Baidu Knows. In language expression, we tried to use clear and concise statement to express the meaning of each indicator, in order to facilitate the understanding and judgment of interviewees. Meanwhile, we also conducted brief conversations with several interviewees to understand their thoughts when they finished the preliminary questionnaire, so as to learn about the deficiencies that exist in the structure and language expression of the scale, which will be improved in the formal scale.

As a preliminary validation, we sent out 80 questionnaires in total, among which 72 copies are responded. 55 valid questionnaires are acquired eventually after filtering out the non-standard and illogical ones. This research-in-progress paper codes the 23 indicators of four dimensions respectively, as shown in Table 1.

Dimension	Coded Item	Indicator		Dimension	Coded Item	Indicator
Content Quality	CQ1	Accuracy		Performance Quality	PQ1	Quickness
	CQ2	Specificity			PQ2	Interactivity
	CQ3	Objectivity			PQ3	Effectiveness
	CQ4	Completeness			PQ4	Solution Feasibility
	CQ5	Relevance		Emotion Quality	EQ1	Answerer's Attitude
	CQ6	Language Expression			EQ2	Answerer's Politeness
	CQ7	Valuable Words			EQ3	Answerer's Effort
	CQ8	Novelty			EQ4	Answerer's Experience
	CQ9	Understandability			EQ5	Answerer's Agreement
Source Quality	SQ1	External Links			EQ6	Answerer's Humor
	SQ2	External Certification				
	SQ3	Profession				
	SQ4	Originality				

Table 1. Dimensions and Indicators of Preliminary Measurement Scale

4 PRELIMINARY DATA ANALYSIS AND RESULTS

4.1 Reliability and Validity Analysis

Before conducting EFA, reliability and validity of the preliminary data were evaluated. Specifically, reliability of this scale was estimated by Cronbach's α, the value of which should be above the threshold of 0.70 as the minimum requirement for field research (Nunnally 1978; Paul, et al. 1999; Guo & Liu 2010). The total Cronbach's α value of the 23 items is 0.945, which indicates a high level of reliability (McKinney, et al. 2002). As illustrated in Table 2, the reliability analyses show that each of the dimension's Cronbach's α is above 0.80. Nevertheless, CQ9, PQ3 and EQ2 negatively contribute to the reliability since the corresponding Cronbach's α value will increase by deleting these

items, which indicates that they fail to pass the reliability analysis. Therefore, CQ9, PQ3 and EQ2 are removed from this measurement scale.

Dimension	Cronbach's Alpha	Coded Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Content Quality	0.859	CQ1	.750	.829
		CQ2	.543	.849
		CQ3	.690	.834
		CQ4	.691	.834
		CQ5	.572	.846
		CQ6	.493	.856
		CQ7	.687	.833
		CQ8	.728	.829
		CQ9	.139	.880
Source Quality	0.812	SQ1	.619	.769
		SQ2	.562	.805
		SQ3	.756	.701
		SQ4	.654	.766
Performance Quality	0.823	PQ1	.777	.711
		PQ2	.684	.759
		PQ3	.528	.827
		PQ4	.619	.789
Emotion Quality	0.844	EQ1	.778	.784
		EQ2	.332	.866
		EQ3	.558	.833
		EQ4	.720	.798
		EQ5	.783	.795
		EQ6	.661	.816

Table 2. Initial Reliability and Factor Analysis of the 23 Items

Validity can be assessed by factor loading from the Kaiser-Meyer-Olkin (KMO). The KMO statistic is a Measure of Sampling Adequacy, both overall and for each variable (Kaiser 1970; Dziuban & Shirkey 1974;Cerny & Kaiser 1977). Following the previous empirical recommendations (Adikari & Dutta 2014; Chow 2004), the KMO value greater than 0.50 (and Sig.< 0.05) is considered to be statistically significant and acceptable. As shown in Table 3, the value of the KMO Measure of Sampling Adequacy for this set of variables is 0.637at 0.1% significant level.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.637
Bartlett's Test of Sphericity	Approx. Chi-Square	445.539
	df	190
	Sig.	.000

Table 3. Validity of Preliminary Measurement Scale: KMO and Bartlett's Test

4.2   EFA of Preliminary Data

A principal component analysis using SPSS18.0 was conducted to test the preliminary measurement scale. Four components were extracted, precisely matching each construct respectively (see Table 4). Among the remaining 20 items, the load values of CQ8 are 0.583, 0.439 and 0.428 performed on public factor 1, 2 and 3 successively, which are very close to each other. It indicates that the validity of CQ8 is meaningless, which should be deleted. Hence the rest 19 items were divided into four obvious categories: (i) EQ1, EQ6, EQ5, PQ1, EQ4, and CQ7; (ii) CQ2, PQ2, CQ4, and CQ1; (iii) PQ4, SQ4, SQ3, CQ5, and EQ3; (iv) SQ2, CQ3, CQ6, and SQ1.

Coded Item	Component			
	1	2	3	4
EQ1	.913		.167	.133
EQ6	.873		.107	.147
EQ5	.770		.359	.261
PQ1	.675	.528	.223	
EQ4	.645	.450	.142	.462
CQ8	.583	.439	.428	.275
CQ7	.540	.406	.268	.331
CQ2		.798		.156
PQ2	.171	.746	.410	
CQ4	.589	.707		
CQ1	.119	.604	.522	.312
PQ4	.336	.312	.811	.157
SQ4	.394		.780	.128
SQ3	.273	.146	.756	.342
CQ5	-.121	.531	.697	.101
EQ3	.202	.441	.561	.333
SQ2	.259	.301	.204	.744
CQ3		.617	.177	.672
CQ6	.530		.293	.638
SQ1	.389	-.150	.461	.559

Table 4. Factor Analysis Results: Principle Component Extraction

5   CONCLUSIONS AND FUTURE WORK

Based on the literature reviews, scholars interviewing, and the EFA of the preliminary survey data, we implement the supplement and selection of the indicators of IQ for social Q&A sites, and identify a formal measurement scale with 19 items finally, as shown in Table 5. In the formal study, we will redesign a questionnaire survey based on this modified scale, and synthetically employ the method of structural equation model (including EFA and CFA) to further explore the indicators that affect the IQ of social Q&A sites and the relationships between them depending on the in-depth data analysis.

Dimension	Coded Item	Indicator	Dimension	Coded Item	Indicator
Content Quality	QC1	Accuracy	Performance Quality	QP1	Quickness
	QC2	Specificity		QP2	Interactivity
	QC3	Objectivity		QP3	Solution Feasibility
	QC4	Completeness	Emotion Quality	QE1	Answerer's Attitude
	QC5	Relevance		QE2	Answerer's Effort
	QC6	Language Expression		QE3	Answerer's Experience
	QC7	Valuable Words		QE4	Answerer's Agreement
Source Quality	QS1	External Links		QE5	Answerer's Humor
	QS2	External Certification			
	QS3	Profession			
	QS4	Originality			

Table 5. Dimensions and Indicators of Formal Measurement Scale

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