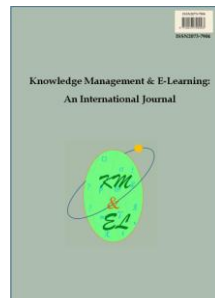# Knowledge Management & E-Learning

Social media for informal science learning in China: A case study

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Social media for informal science learning in China: A case study

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Abstract: This article reports a case study on a popular informal science learning community via social media in China, named GuoKr (meaning "nutshell" in English). Data were collected through a variety of Chinese social media and social networking sites, web-based community portals, and discussion boards. Content analyses and data mining were conducted to investigate how GuoKr successfully attracted and engaged public in informal learning on scientific topics in particular. The study found three key characteristics that contributed to the success of such learning communities: (a) utilizing a variety of social media to empower participants with just-in-time, accidental learning opportunities; (b) daily tweets related to emerging or ongoing social events or hot topics to provide brief but intriguing knowledge "bites", which often leads to extended readings and related resources; and (c) the integration of social media and traditional face-to-face local events to engage the public in science-related learning and knowledge sharing. Practical and research implications are discussed with suggestions for future research as related to ubiquitous learning communities for informal science learning.

Keywords: Social media; Informal science learning; Learning community; China; Microblogging

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1. Introduction

Social media and mobile technology are drastically changing the ways of communication, teaching and learning. They promote and intensify communications and interactions beyond the physical or geographic boundaries of traditional learning settings (Bonk & Zhang, 2008; Warren, Nihalani, Kim, Zhang, Veletsianos, Bonk, Ana-Paula, & Lee, 2012; Zhang, 2008; Zhang & Bonk, 2009). Social media allow users to communicate synchronously or asynchronously, to collaboratively build knowledge base, and to form learning communities virtually (Ebner, Lienhardt, Rohs, & Meyer, 2010; Gao, Luo, & Zhang, 2012; Warren et. al., 2012; Zhang & DeLoose, 2009). They creatively address the needs and characteristics of media-savvy generations of learners known as the neo-millenniums (Dede, 2005; Dieterle, Dede, & Schrier, 2007; Zhang & Bonk, 2008, 2009).

Weibo, a microblogging tool in Chinese is often known as China's Twitter. It has been increasingly popular, with 249,880,000 users in China in 2011 (China Internet Network Information Center, 2012). Numerous communities are forming and evolving on Sina Weibo, since its launch in fall 2009. However, an extensive review of literature indicates that research on Twitter for learning is rather limited, and mainly focuses on microblogging as an extension or supplement of formal classroom learning (Gao, Luo, & Zhang, 2012). Few studies have investigated the impacts of microblog-mediated social networking on communities for informal learning.

2. Adult informal learning & social media

The current knowledge-based society and different generations of learners (Dede, 2005; Zhang & Bonk, 2009) demand different ways of learning (Koper, 2004). Informal learning happens everyday, and is increasingly integrated into work and life contexts, either incidentally or by choice, to improve knowledge, skills, and competence. It may be incidental in the workplace, communities of practice, or during leisure activities. Learners are naturally at the center stage of the process, and responsible for their own learning. Ultimately, they are free to decide what, when, where and how they want to learn (Drachsler, Hummel, & Koper, 2008), and are not limited to curriculum-based or otherwise pre-scheduled traditional modes of learning (Friesen & Anderson, 2004). Informal learning may also be highly contextualized and tailored to everyday life. Social

media and ubiquitous technologies have great potential to realize anytime, anywhere, just-in-time learning (Hung & Zhang, 2012; Zhang, 2008), and thus further promote engaging and effective informal learning.

With emerging and increasingly available mobile technologies, learning may occur literally anywhere, anytime, and go beyond traditional, brick-and-mortar, formal educational settings (Koper, 2004). Social media, such as blogs, wikis and podcasts realize instant content creation and sharing (Bonk, 2009; Bonk & Zhang, 2008; Zhang & Bonk, 2008, 2009; Zhang & DeLoose, 2009). Individuals who have particular learning needs may either post questions online for help or easily find relevant resources created or presented by others. Social networking sites such as Facebook® and Twitter® quickly connect people with similar interests all over world, making it easy to create a virtual learning community with members with diverse expertise in a relatively short period of time. Thus, with the support of social network technologies, it is possible to establish "networks of distributed collaborating learners" (Koper, 2004, p. 676).

So far, research that explored the use of microblogging for learning has mainly been conducted in formal educational settings, many with positive effects (Gao, Luo, & Zhang, 2012). Microblogging, for example, benefits classroom learning by enriching instructors' lecturing and enhancing students' engagement. According to Ebner and Maurer (2009), microblogging allows just-in-time interactions with classmates on course content. In addition, with microblogging, students could participate at a level that they would not normally do. Junco, Heiberger, and Loken (2011) noticed that the use of microblogging encouraged online participation from those who otherwise might not been active participants in class. Similarly, Rankin (2009) noted that the integration of Twitter in the classroom allowed more students to get involved in the class discussion.

Research reveals that microblogging plays an active role in building and sustaining learning communities (Hsu & Ching, 2011). According to Junco, Heiberger, and Loken (2011), the adoption of microblogging in formal learning environments enabled sustained discussions, and thus helped build a strong learning community amongst students. Similarly, Ebner and Maurer (2009) found that a sense of community and network building were boosted by the use of microblogging. Most interestingly, researchers noticed that learning communities supported by microblogging remained active even after the courses had ended, continuing to serve as a platform for students to interact and collaborate (Dunlap & Lowenthal, 2009; Holotescu & Grosseck, 2009).

Researchers also find that microblogging benefits informal learning beyond the classroom. The study of Junco, Heiberger, and Loken (2011) showed that completing microblogging-based assignments promoted active learning because students were able to link the course materials to their own experiences both in and outside the classroom. In Dunlap and Lowenthal's (2010) study, students used Twitter to support informal learning activities, discover relevant resources, and research out for help with coursework. As a result, researchers believe that microblogging allowed learners to stay connected and share information in an informal e-learning community (Ebner & Maurer, 2009).

Although researchers recognize the potential values of social media, such as microblogging, in fostering learning communities and promoting informal learning, most studies examined the usage of a particular type of online tool in isolation (Matthews, Whittaker, Badenes, & Smith, 2014). Limited research has thoroughly examined a more open-ended informal learning community involving the general public via a combination of multiple social media tools as opposed to learning communities created or mandated by instructors.

Kraut and colleagues (2012) identified five critical design challenges when creating a successful online community. The first challenge is starting a new community. When a community is newly created, it needs to have a rich profile of content to attract the users. The second challenge is attracting and socializing new members. It is critical to identify and encourage potential members who have the skills and motivation to contribute to the emerging community. The third challenge is encouraging commitment. Creating commitment is especially challenging in online communities, because people can, and often do, easily leave one community. The fourth challenge is encouraging contribution. Online communities need to encourage participants to contribute resources. Under-contribution may cause problems. The last challenge is regulating behavior, which is necessary to resolving competing interests. A few studies have led to specific suggestions on how to overcome some of these challenges. For example, Kraut and Fiore (2014) suggested that founders who have more resources and opportunities for acquiring relevant skills, as well as those who are more actively engaged may create more successful communities. Ren and Kraut (2014) suggested that a broad range of topics and high volumes of message can lead to high member of commitment. However, such studies have been scarce, and the majority of current research on online communities has focused on understanding how these online communities function or how or why people participate.

This study explored a popular, ubiquitous science learning community in China named GuoKr. The study investigated GuoKr's successful community-building efforts through analyses of its social media activities, and further probed on how to successfully attract and engage the public in informal learning via social media and traditional media tools.

3. Research design

Case study research was conducted to investigate how GuoKr communities were established and promoted via social media. According to Yin (2009), case study as a research method is "an empirical enquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (p.13), and thus it was chosen as the research method for this study.

GuoKr community was identified and selected as the focus of our research for the following reasons: (1) it was the 11th most influential website Weibo as per Sina Weibo Impact Ranking; (2) it was the only one devoted to adult informal learning and public science education in particular; (3) it had a large and increasing number of followers on Sina Weibo, the most populated and influential social media in China.

Our inquiry was guided by the following research question: How did GuoKr attract and engage the public to informal learning via social media?

As Yin specified, case study research "includes both single- and multiple-case studies"(Yin, 2009, p. 14). Compared to single-case design, multiple-case design is more robust, and is likely to have higher explanation power and generalizability (Santos & Eisenhardt, 2004; Yin, 2009). Thus, in this study, two cases were analyzed to build a deep understanding of the roles of social media in these informal learning communities. One case was built to capture the general operations of GuoKr communities via social media; and a second case was built to illustrate how GuoKr engaged the general public in learning through a series of social-event-triggered social media activities. The two cases

complimented each other through different lenses: the first was more general and broad, and the other was a close-up of social-events-triggered incidental learning.

3.1. Context: GuoKr communities

As an informal learning community, GuoKr has 2,854,998 followers as of August 8, 2014 on Sina Weibo. Housed inside GuoKr are dozens of learning communities designated to various subjects or areas of interests. GuoKr aims to engage the general public in science learning through a wide range of activities, both online and offline. GuoKr means nutshell in English, and here it indicates science in a nutshell. The founder, Ji named it with inspirations from Hawking's (2001) popular science book, *the universe in a nutshell*, and Hamlet's famous quote, "I could be bounded in a nutshell, and count myself a king of infinite space". Through a range of popular ubiquitous learning communities, GuoKr carries a mission to promote informal, science learning and knowledge sharing among the general public.

3.2. Data sources

Multiple datasets from various resources were collected, such as Sina Weibo (e.g., tweets, re-tweets, comments or responses, etc.), Douban, GuoKr web portal, user blogs, and other social media sites as summarized in Table 1.

Table 1
A summary of data sources

Data source	Data	Type of data
Sina Weibo	Tweets, Retweets, Comments, Hashtags, Hot topics	Textual, Date and time, Frequencies
Sina Weibo User Profile	Description, Self-selected WeiQun (micro-communities), Number of followers	Textual, Date and time, Frequencies
GuoKr Web Portal	Communities, Discussion boards, Blogs, Activities, User generated content, Q&A, Number of participants, questions and answers, Hot topics	Textual, Date and time, Frequencies

3.3. Data analyses

All data was recorded, read, analyzed and triangulated with both quantitative and qualitative methods (Creswell, 2003, 2005; Creswell & Clark, 2007). All textual data were read, coded, categorized, recoded and then analyzed. In particular, content analyses were conducted to identify and categorize the following:

- Learning Topics, Triggering Social Events, and discipline/subject area
- Types of Learning Activities (e.g., Q&A, rumor correcting, etc.)
- Types of Media

All textual data were archived in an Excel file, with the textual message, date and time, categorization coding and notes, and cross-checked by both researchers for accuracy and consensus in coding. ROST Content Mining system, version 6.0 (Shen, 2011) was deployed for data mining (Hung & Zhang, 2008; 2012). The ROST Virtual Learning Team at Wuhan University has developed the ROST Content Mining System for text mining of news, mass media and social media content in simplified Chinese. It supported a number of content analysis functions, including (a) word segmentation, (b) word frequency analysis, (c) sentiment analysis, (d) co-occurrence analysis, and (e) social networks analysis. ROST was selected as the text mining system in this study because of its well-recognized capacity for searching, extracting, storing and mining textual data in simplified Chinese, and particularly because of its customized features for analyzing Sina Weibo content (e.g, tweets, re-tweets, etc.). As of Oct. 2010, ROST has been downloaded more than 7,000 times, and has been used by over 100 researchers in several countries (e.g., China, UK, USA, etc.). It has been widely used by researchers for a variety of purposes, including identifying key words on Chinese governmental websites (Shen, Liu, Luo, Fu, & Li, 2009), exploring the hot topics of the developmental psychology research in China (Xu, 2010), and understanding web search results of different search engines on certain topics (Wu, Wang, Zhang, Shi, Zhou, & Wu, 2011).

ROST Content Mining System was used in this study to identify the top 10 majors mentioned in public responses in a Gaokao-related online event initiated by GuoKr. All public responses were collected from the website and saved as one single .txt file. After importing the .txt file into ROST Content Mining System, we first segmented the text into individual words by using the "word segmentation" function. Then, we used the system to (a) calculate the frequencies of these words, and (b) rank them by frequency of occurrence. Finally, we looked through the list generated by the system and identified the top 10 words that represented college majors.

4. Findings

4.1. Social media and mobile technologies

Multiple social media were integrated to build and promote the science learning communities in GuoKr, which included web-based discussion groups, general Weibo (via different Weibo service providers, such as Sina Weibo, Tencen Weibo, Sohu Weibo), themed Weibo, WeChat (a mobile App, Weixin in Chinese), Douban.com, a popular Chinese social networking site. The following briefly describes these media and how they functioned in GuoKr communities for learning.

Web-based discussion groups

As of July 15, 2013, over 200 themed discussion groups were formed on GuoKr's website portal (see http://www.guokr.com/group/all/), including 52 groups on science and technology, 53 on sports and entertainment, 43 on social sciences and studies, 52 on daily life, 14 on learning (such as How to Learn College Physics, Ways of Learning, and the latest addition of MOOC) and 9 more established by GuoKr staff. Most of these groups were created and moderated volunteers from the general public. These groups had members ranging from a few dozens to over 100, 000 each. Users chose or created their own group(s). All discussions and resources were open to the public without requirement for registration to the website or the groups. Members of groups, as well as guest users or visitors participated in online discussions, communications and socializations.

General Weibo

GuoKr Web was the main ID active on Weibo and it was also the most active and popular Weibo in GuoKr communities (see http://weibo.com/guokr42). On July 15, 2013, GuoKr Web Weibo was the No. 11 most influential web-site as per Sina Weibo's Official Top List (see http://data.weibo.com/top/influence/web). On August 8, 2014, GuoKr Web Weibo was ranked as the No. 1 most influential web-site in science and technology category as per Sina Weibo's Official Top List, and two GuoKr themed Weibo were among top 10 as well (see: http://bit.ly/1vf93eW). GuoKr general Weibo covered a wide range of science-related topics, posted updates from theme Weibos, informed GuoKr communities on online or offline events, activities and resource updates, and shared important tweets or retweets across GuoKr communities. This Weibo ID served as the hub of GuoKr communities and played a leading role across communities by posting news and interacting with followers and theme GuoKr Weibos as well.

Theme Weibos

GuoKr had 16 featured GuoKr theme Weibos devoting to a variety of topics. Table 2 summarizes the most popular theme Weibos in GuoKr learning communities.

WeChat

WeChat, known as WeiXin in Chinese, is a popular, free mobile App with billions of users in both China and overseas. It is more private compared to other social media and traditional web-based technologies. GuoKr used it for customized knowledge dissemination and promoted learning-on-demand for its followers. GuoKr created a Weixin AI to collect, analyze and answer questions via this mobile social technology. By Weixin AI, GuoKr actually meant real people working behind the mobile technology, instead of a robotic, auto responding system like artificial intelligence (thus AI) might suggest (GuoKr Sina Weibo, 2012). GuoKr42, the so-called Weixin AI received thousands of text messages everyday, and posted 2 or more short messages to followers daily, packed with knowledge and information by demand (GuoKr.com, 2012).

Douban.com

Douban.com is a popular Chinese social networking site, where users contributed to communities of their choice with knowledge, information, resources and various support. GuoKr had communities on Douban.com, where members shared longer documents, which typically required more serious reading. GuoKr Weibos often provided links to Douban and GuoKr web portals, which took the readers or followers to elaborated and extended readings or multimedia documents.

　　　　GuoKr also built Douban communities for special events, where announcements, nomination, communication, documents, post-event feedback, and more were shared and archived. For example, a community was set up on Douban for a new project, GuoKr "Lightness" Funding Project, which selected and funded ordinary people to learn a special skill of their choice or to pursue a dream they would otherwise not be able to. This event was also well communicated on Sina Weibo, attracting tens of thousands of reads, followers, retweets and comments there.

Table 2
GuoKr's most popular theme Weibos on Sina Weibo

Theme Weibo	Content	Popular Hashtags	No. of followers*	No. of tweets*
GuoKr web	Covers a variety of science-related topics and GuoKr news updates	#GuoKr web# #sciences# #life#	950,615	17,373
GuoKr Rumor Breaker	Clarifications and corrections on popular rumors or misconceptions as related to social and natural sciences	#rumor breaker# # anti-rumor test#	490,497	1,360
GuoKr Q&A	Answers questions raised by the public shares valid and credible answers from the public	#Q&A# #you asked# # true or false#	200,034	4,261
GuoKr Forensics	Forensics, legal cases and related scientific topics and discussions	#murder# #forensics#	175,552	2,539
GuoKr Health 9am-5pm	Particularly focuses on health-related topics for working/middle class	#baby care# #food safety# #tips# #life# #health# #gao kao# (annual national college entrance exams)	55,741	1,347
GuoKr Psych Buster	Particularly focuses on psychology as related to daily life and wellbeing	# Psychology# #worries# #wellbeing#	81,704	1,937
GuoKr DIY	DIY	#engineering# #experiment# #DIY# #scientific design#	76,646	1,120
GuoKr Creative Technology	Focuses on emerging internet technology and its social impacts	#creative tech# #geek# #young scientists# #internet#	46,321	1,395

*: as of 1pm Beijing Time, July 15, 2013

   GuoKr's local events were well documented and archived in forms of videos, presentation files, news reports, participants' blogs, tweets on Weibo, and more. Learning materials, such as videos, presentation files, participants' notes and feedback were made available in GuoKr communities on Douban as well. In addition, the latest new medium GuoKr has utilized was Flipboard, effective August 15, 2012 for better reading experiences for iPad subscribers.

4.2. GuoKr learning activities

Through the above-mentioned social media, GuoKr built active learning communities by attracting the general public and involving leading scientists, professionals, and media partners. Web-based discussions, bulletin board activities, user-initiated and user-generated Q&As, web-community building, documents sharing, and Weibo interactions were common and frequent in GuoKr communities of learning. These media allowed real-time or asynchronous communications, and were meaningful for learning, socializing and community building. Via Sina Weibo, GuoKr has also conducted live interviews on hot topics and current social issues as related to sciences and technology. Two cases were constructed and reported below: (a) *GuoKr in a week on Sina Weibo* and (b) *Social events-triggered learning events*.

Table 3
GuoKr offline learning events

Type of Events	Foci	Guests/participants	Examples of event themes
YouthCon http://www.guokr.com/youthplan/	Showcase of talents, skills, competencies Dissemination of knowledge Funding research, practice and services	Guest speakers were recommended and selected from the public, experts, professionals, scientists, or ordinary people with special talents Partnerships with newspaper, museums, professional organizations General public	7-minute showcase of your talents/skills A class, a moment in science GuoKr open courses on sciences
KidsMuseum	Kids learning in fun	Kids and youth partnership with recognized teachers, field experts, museums	Recycle Fun with paper
KitchenExperiment	Food science, Cooking experiment	Invited guests/specialists and general public	Protein
AllAboutEating	Food safety, nutrition and health	Invited guests/specialists and general public	Packaging Food storage

In addition to frequent online and mobile communications, GuoKr facilitated informal learning through offline events, which in turn, further promoted the ubiquitous learning communities via social media. GuoKr communities organized four types of offline public events, namely YouthCon, KidsMuseum, KitchenExperiment, and AllAboutEating. Among those, YouthCon was conducted more regularly, typically 2-3 times each month. The location was often in the most developed big cities like Beijing, Shanghai, Shenzhen or the like. All events were free to public; and in many cases, guests or specialists were selected via online activities. Due to the popularity and high demands, all events required pre-registration and free tickets were drawn and provided to lucky pre-registered people. It was not rare to have attendants flying from other cities to attend some of these events, as indicated in their Weibo tweets. Table 3 summarizes those offline learning events.

4.3. Case 1: GuoKr in a week via Sina Weibo

To identify the triggering events, we randomly selected a full week of tweets from GuoKr Web, the leading web-site Weibo from August 4th to August 10th, 2012, and analyzed the tweets for types of triggering events. Six types of events were identified as triggers: (a) current social or science news: the latest social or science news around the world; (b) public questions: questions asked by the Weibo users through GuoKr Q&A, either related or unrelated to current news; (c) GuoKr science calendar: comments on historical events that happened on today's date using the hashtag #GuoKr science calendar#; (d) topics initiated by GuoKr: topics raised by GuoKr organizers and staff; and (e) GuoKr events announcements: announcements of GuoKr offline events or new events such as GuoKr online open course.

As indicated in Table 4, the majority of GuoKr tweets were either triggered by current news or events initiated by GuoKr. Throughout the week, GuoKr posted 104 tweets related to current social or science news and events, highlighted with 38 tweets on Olympics and 40 related to Curiosity Rover's landing on Mars. In addition to the tweets on Olympics and Curiosity Rover, GuoKr addressed many hot issues that happened in that week in the other 26 tweets. An example was that GuoKr invited public discussions on the controversial article published on New York Times then titled *Is Algebra necessary?* by Andrew Hacker.

Table 4
Types of triggering events

Triggering Events	Frequency	Percentage
Current social/science news and events	104	48.15%
Topics initiated by GuoKr	54	25.00%
Public Questions	20	9.26%
GuoKr science calendar	10	4.63%
GuoKr events announcements	28	12.96%
Total	216	100.00%

Table 4 reveals that GuoKr initiated 54 tweets on a variety of topics. Those topics touched a number of different areas, including psychology, zoology, computer science,

geology and so on. Interestingly, among these GuoKr-initiated tweets and the tweets on current social/science news and events, some were posted simply for fun. For example, from time to time, GuoKr posted humorous cartoons or cute pictures to entertain its followers; and one tweet on Olympics was a collection of fun things that happened in the past Olympics. GuoKr actively responded to all questions raised by the public. In this particular week, GuoKr published 20 tweets in response to public questions, among which, 4 were related to current news or events, and 16 were unrelated. Finally, among all 216 tweets, 10 tweets were identified using the hashtag #GuoKr science calendar#, and altogether 28 GuoKr learning events were announced.

4.4. Case 2: Social-event-triggered informal learning

To understand how GuoKr and its theme Weibos work together to attract and engage the public in science learning, a case study was conducted to examine a series of events and activities sponsored by GuoKr related to China's annual national college entrance exam, Gaokao in Chinese. Gaokao is required for college admission, and offered only once a year in early June and lasts for two days. Gaokao attracts wide attention in China every year because millions of students, parents, schools, and teachers work for years to prepare for the two-day exam and it is considered a life-changing event for all high school seniors and their families.

In 2012, the exam took place on June 7th and 8th. An interesting nationwide phenomenon related to Gaokao triggered a series of learning activities in GuoKr communities. It started with a striking photo posted on Sina Weibo on May 6, 2012, which was rapidly and widely spread in hours. It was later confirmed that as shown in the photo, in Xiaogan, Hubei Province, a senior class were taking intravenous injections of bottles of amino acids by the side of their study desks at school (see Fig. 1).

Fig. 1. High school seniors taking bottles of amino acids in classroom (source from www.163.com)

It was reported that it was a traditional practice there in Gaokao season. And many believed that constant injections of amino acid would result in quickly-improved health and boosted energy level, which would help students prepare better for the fate-determining exam (ChinaSMACK, 2012). GuoKr immediately and proactively responded

to the hot news, and successfully delivered a series of learning events in May and June then. All related GuoKr events and activities were identified and documented as pre-Gaokao events and post Gaokao events.

Table 5
Pre-Gaokao GuoKr events

Time	Weibo ID	Topic	Media	No. of Retweets	No. of Replies	No. of Posts on GuoKr website
May 6, 09:36	GuoKr Q&A	Does taking IV injections of amino acids help boost energy?	weibo & website	981	171	93
May 6, 22:41	Science Squirrels Club	The side effects of having IV injections of amino acid	weibo	433	90	NA
May 7, 09:07	Science Squirrels Club	Eating healthily is more important.	weibo	192	84	NA
May 7, 11:49	GuoKr #Rumor Breaker#	Does taking IV injections of amino acids help boost energy?	weibo & website	1007	241	149
May 8, 20:00-21:00	GuoKr Health 9am-5pm	Nutrition guide for students preparing for Gaokao	realtime Q&A session	164 questions asked and 30 answered		
May 16, 16:18	GuoKr Q&A	How to choose majors?		4117	639	408
May 31, 21:00-22:00	GuoKr Health 9am-5pm	How to eat well during Gaokao?	realtime Q&A session	98 questions asked and 69 answered		
June 6, 11:33	GuoKr	Eat eggs but less sugar	Weibo & website	336	69	28
June 6, 17:10	GuoKr	A summary of the two realtime Q&A sessions	Weibo & website	60	26	5
June 6, 21:49	GuoKr	Can you choose "C" when you are not sure of the answer of a multiple-choice question?	Weibo & website	1501	382	128

Pre-Gaokao events

GuoKr Q&A was the first to respond to the question raised by a Weibo user, "Does taking IV injections of amino acids help boost energy?" A brief response (110 words) and a longer response (448 words) composed by a GuoKr community member with a Master's degree in Medicine were posted on GuoKr Web Weibo and GuoKr website portal as well, both within an hour from the Weibo question. It was then retweeted by 981 users, and received 171 replies on Guokr Weibo and 93 replies on Guokr website instantly (see Table 5). Soon afterwards, a more detailed Weibo (or tweet) was posted on the side effects of having IV injections of amino acid and the importance of healthy eating and digestion. The next day, May 7, GuoKr #Rumor Breaker# posted a more in-depth article about the IV injections of amino acids on the GuoKr website and advertised it on GuoKr Weibo. The article, composed by a nutritionist, Zhongyi Gu, consisted of 1729 words, explaining in detail the circumstances that IV injections of amino acids were necessary and the types of nutrition needed by the students who were to participate in

Gaokao. The tweet attracted wide attention from the Weibo users, was retweeted for over 4,000 times, and received hundreds of comments and feedback. GuoKr seized the opportunity to educate the public about nutrition, and announced two real-time online Q&A sessions, one on May 8 and another on May 31. Both of the one-hour sessions were well attended, with about two hundred questions asked in a short period of time. On June 6, the day before Gaokao, GuoKr posted a summary of the two real-time Q&A sessions, and an article regarding why it does not work to always choose "C" when you are not sure of the answer of a multiple choice question. It is worth mentioning that, on May 17, GuoKr invited the public input on how to choose majors. But the invitation received more responses and attention after Gaokao, so we examined it in detail in the post-Gaokao events section.

During Gaokao events

All of the five events during the period of Gaokao were on Gaokao essay topics (see Table 6). In June 7, GuoKr listed all the Gaokao essay topics from different parts of the nation and called for mini science fictions on these topics. This fun event attracted many people who either responded to or retweeted the event, and 44 Weibo users submitted their fictions. On the same day, GuoKr analyzed the Gaokao essay topics in terms of what these topics meant, how these topics were related to the topics previously posted by GuoKr, and how students could use the knowledge learned from GuoKr to write the essays. On June 8, GuoKr Logics posted three solutions to a math problem that appeared in the Math exam in Shanxi Province -- "State and prove the Law of Cosines".

Table 6
During Gaokao GuoKr events

Time	Weibo ID	Topic	Media	No. of Retweets	No. of Replies	No. of Posts on GuoKr website
June 7, 14:26	GuoKr	Call for mini science fictions based on Gaokao essay topics	Weibo & website	322	87	83
June 7, 14:58	GuoKr Q&A	Understanding Shanghai Gaokao essay topic	Weibo & website	169	33	20
June 7, 15:18	GuoKr Q&A	Understanding Beijing Gaokao essay topic	Weibo & website	155	24	6
June 7, 21:00	GuoKr & GuoKr Daily Psychology	Understanding 2012 Gaokao essay topics	Weibo & website	439	85	38
June 8, 13:18	GuoKr Logics	How to solve the problem in Shanxi Gaokao exam	Weibo	627	147	NA

Post-Gaokao events

After the Gaokao was over, GuoKr's focus gradually shifted from Gaokao exam questions to a topic that many students and parents cared a lot about -- how to choose majors, a decision needs to be made soon after students receive their Gaokao scores (see Table 7). GuoKr invited those who have been through Gaokao to share (a) the majors they chose, (b) what these majors are about, (c) the core courses involved in the majors, (d) job opportunities, and (d) their own thoughts and experiences. GuoKr received over four hundred responses.

Table 7
Post-Gaokao GuoKr events

Time	Weibo ID	Topic	Media	No. of Retweets	No. of Replies	No. of Posts on GuoKr website
June 9, 11:09	GuoKr Logics	A physical question discussed earlier by GuoKr Logics appeared in Gaokao exam.	Weibo & website	95	34	164 (including previous posts)
June 10, 20:22	GuoKr Q&A	UnderstandingTianjing Gaokao essay topic	Weibo & website	23	10	36
June 11, 10:15	GuoKr	Retweet: How to choose majors?	Weibo & website	376	85	408
June 16, 17:05	GuoKr	Retweet: How to choose majors?	Weibo & website	395	63	408

Table 8
Top 10 majors mentioned in public responses

	Majors	**Frequencies**		**Majors**	**Frequencies**
1	Engineering	365	6	Chemistry	168
2	Management	227	7	Mechanics	131
3	English	218	8	Physics	131
4	Math	196	9	Economics	116
5	Psychology	184	10	Biology	114

Using the ROST content mining system, we identified those terms mentioned in the 408 responses that indicated different majors, and calculated the frequencies of these terms. About 30 majors were mentioned and discussed. Table 8 presents the top 10 majors mentioned in the public responses and their frequencies. The top10 majors were: Engineering, Management, English, Math, Psychology, Chemistry, Mechanics, Physics,

Economics and Biology, and all of them were mentioned over a hundred times. It is worth noting that, among the top 10 list, more than half were science majors. The discussions, which were mostly based on real experiences in majoring in these disciplines, helped the public to develop a more concrete understanding of what these majors were really about in college education as well as for future career and professional track.

5. Discussion

GuoKr communities are highly successful in attracting and engaging the general public in informal learning on scientific topics. Given the challenges of science education and informal learning in general (Friesen & Anderson, 2004; Wedemeyer, 1981), it is critically beneficial to understand how GuoKr has achieved its success. It was evident that social media played a variety of important roles in building and promoting these communities, as they empowered participants through informal learning, anywhere, any time and just-in-time (Motlik, 2008; Zhang, 2008; Zhang & Bonk, 2008, 2009). GuoKr was noticeably and actively present via all popular social media and social networking sites in China (e.g., Sina Weibo, Douban.com, WeChat, and Flipboard, etc.). Consistent with the findings of Matthews, Whittaker, Badenes, and Smith (2014) that different types of communities may use a combination tools to meet different collaboration needs, GuoKr utilized different social media based on new media's characteristics and user choices. For example, Weibo was used for quick, timely, short and quick knowledge bites, information updates, and small talks for socialization. Douban.com was fully utilized for communities outside of GuoKr's official web portal, dominantly with documents sharing and bulletin board style of discussions. GuoKr and GuoKr theme Weibo were short, prompt, and often created linkages and connections among the various social media, which were integrated for ubiquitous learning for diverse generational learners (Dede, 2005; Zhang & Bonk, 2009).

In addition to regular daily tweets on carefully chosen topics, GuoKr tweets on Sina Weibo always promptly and pro-actively responded to current social events and public interests, as illustrated in both cases conducted in this study. With Weibo, GuoKr attracted public attention, directed people to related, or remotely-related scientific topics with just-in-time "knowledge bites". Through a series of tweets, retweets, and sometimes real-time mini interviews and other interactive events online, GuoKr further engaged the public in informal learning on focused, specific subjects. Via Weibo, GuoKr attracted attention from the general public on currently hot topics, took full advantage of these opportunities as "teachable" moments, and provided just-in-time knowledge bites. These short Weibo tweets then often took readers to additional resources with longer, in-depth elaborations of the appropriately fragmented knowledge bites. These strategies are quite effective in attracting new members, encouraging long-term commitment and increasing contribution from the members, which, according to Kraut and the colleagues (2012) are among the major challenges of building a successful online community. GuoKr communities' media choices were both rational, based on sound understanding of their characteristics, and well aligned with popular social choices of target users. The integration of new, emerging social media, together with traditional face-to-face local events engaged the general public in a variety of fun learning activities. The ubiquitous communities thus were formed and facilitated through online or offline events, with mobile and social media technologies. The broad impact of GuoKr on the public has been widely recognized. As highly praised on Xinhua Daily Telegraph on November 21, 2012 (Wang, Yao, & Ji, 2012), "most public media on science learning in China has little impact on the public, but GuoKr is truly an exception."

6. Conclusion

Technology is increasingly available and affordable for the general public in China. Currently, China has 420 million mobile Internet users (China Internet Network Information Center, 2013). As of December 2011, there were more than 500,000,000 Internet users (6 years or older) in China, and 365, 000, 000 (69.3%) of them were mobile phone internet users, 26.5% (136, 000, 000) were in the rural regions and areas, and 35.7% with middle school education (Grades 7-9) only (China Internet Network Information Center, 2013). Popular social media, such as Weibo had attracted about 2.5 billion users by December 2011 (China Internet Network Information Center, 2013). Sound applications and integration of multiple social media and mobile technologies made ubiquitous learning not only possible but also fun, engaging, contextualized and personalized (Hung & Zhang, 2012; El-Bishouty, Ogata, & Yano, 2007; Zhang, 2008). Ubiquitous learning communities like GuoKr demonstrate ways to effectively engage the public in informal learning with the help of social media and mobile technologies. A ubiquitous learning society may be developed as more ubiquitous communities emerge and thrive in China, following examples in neighboring countries like Japan (Zhang, 2008; El-Bishouty, Ogata, & Yano, 2007). Reaching people in the rural areas as well as those with lower levels of education, social media and mobile technologies are promising to promote informal learning and public education in China, as scholars suggested (Carr-Chellman & Zhang, 2000; Zhang, 2005).

GuoKr communities vividly illustrated how social media, when well applied and integrated may promote community building, knowledge construction, in addition to information sharing. As evident in GuoKr tweets on Weibo, community members not only actively inquire learning by asking questions, but also actively contributed to the knowledge creation and sharing processes by answering questions, sharing resources, and providing support. Users' participation and contributions in such communities advocate the power of learner-centered new ways of learning (Bonk, 2009; Bonk & Zhang, 2008; Zhang & Bonk, 2008). The creative uses of social media well addressed the characteristics and demands of new generations of learners for quick, timely and just-in-time learning and communications (Dede, 2005; Zhang & Bonk, 2009). To push the frontier of research on ubiquitous communities and social media for learning, future research may investigate these phenomena using methods like data mining and text mining (Hung & Zhang, 2008; 2012) to understand big data generated in social media, and particularly as to how it relates to learning and community building.

References

Bonk, C. J. (2009). *The world is open: How web technology is revolutionizing education*. San Fransisco, CA: Jossey-Bass.

Bonk, C. J., & Zhang, K. (2008). *Empowering online learning: 100+ activities for reading, reflecting, display and doing*. San Fransisco, CA: Jossey-Bass.

Carr-Chellman, A. A., & Zhang, K. (2000). China's future with distance education: Rhetoric & realities. *Information, Communication and Society, 3*(3), 303–312.

China Internet Network Information Center. (2012). The 29th statistical report on internet development in China. Retrieved from http://www.cnnic.cn/research/bgxz/tjbg/201201/P020120116330880247967.pdf

China Internet Network Information Center. (2013). The 30th statistical report on internet development in China. Retrieved from http://www1.cnnic.cn/IDR/ReportDownloads/201310/P020131029430558704972.pdf

ChinaSMACK. (2012, May 7). *Chinese students get IV drips while studying for Gaokao exam*. Retrieved from http://www.chinasmack.com/2012/pictures/chinese-students-get-iv-drips-while-studying-for-gaokao-exam.html

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed method approaches*. Thousand Oaks, CA: Sage Publications.

Creswell, J. W. (2005). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. New Jersey: Prentice Hall.

Creswell, J. W., & Clark, V. L. P. (2007). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage Publications.

Dede, C. (2005). Planning for neomillennial learning styles: Implications for investments in technology and faculty. In D. G. Oblinger & J. L. Oblinger (Eds.), *Educating the Net Generation*.

Dieterle, E., Dede, C., & Schrier, K. (2007). "Neomillennial" learning styles propagated by wireless handheld devices. In M. Lytras & A. Naeve (Eds.), *Ubiquitous and Pervasive Knowledge and Learning Management: Semantics, Social Networking and New Media to Their Full Potential* (pp. 35–66). Hershey, PA: Idea Group, Inc.

Drachsler, H., Hummel, H. G. K., & Koper, R. (2008). Personal recommender systems for learners in informal learning networks: the requirements, techniques and model. *International Journal of Learning Technology, 3*(4), 404–423.

Dunlap, J. C., & Lowenthal, P. R. (2009). Tweeting the night away: Using Twitter to enhance social presence. *Journal of Information Systems Education, 20*(2), 129–135.

Ebner, M., Lienhardt, C., Rohs, M., & Meyer, I. (2010). Microblogs in higher education - A chance to facilitate informal and process-oriented learning? *Computers & Education, 55*(1), 92–100. doi: 10.1016/j.compedu.2009.12.006

Ebner, M., & Maurer, H. (2009). Can weblogs and microblogs change traditional scientific writing? *Future Internet, 1*(1), 47–58. doi: 10.3390/fi1010047

El-Bishouty, M. M., Ogata, H., & Yano, Y. (2007). PERKAM: Personalized knowledge awareness map for computer supported ubiquitous learning. *Educational Technology & Society, 10*(3), 122–134.

Friesen, N., & Anderson, T. (2004). Interaction for lifelong learning. *British Journal of Educational Technology, 35*(6), 679–687. doi: 10.1111/j.1467-8535.2004.00426.x

Gao, F., Luo, T., & Zhang, K. (2012). Tweeting for learning: A critical analysis of research on microblogging in education published in 2008-2011. *British Journal of Educational Technology, 43*(5), 783–801.

GuoKr Sina Weibo. (2012, August 15). *GuoKr WeChat ID*. Retrieved from http://www.weibo.com/1850988623/yxfAs7SwM

GuoKr.com. (2012, August 15). *What did people ask GuoKr ID on WeChat*. Retrieved from http://www.guokr.com/blog/312598/

Hawking, S. (2001). *The universe in a nutshell*. New York: Bantam Press.

Holotescu, C., & Grosseck, G. (2009). *Using microblogging in education. Case study: Cirip.ro*. Paper presented at the 6th Conference on e-Learning Applications, Cairo, Egypt.

Hsu, Y., & Ching, Y. (2011). Microblogging for strengthening a virtual learning community in an online course. *Knowledge Management & E-Learning, 3*(4), 585–598.

Hung, J., & Zhang, K. (2008). Revealing online learning behaviors and activity patterns and making predictions with data mining techniques in online teaching. *Journal of Online Learning and Teaching, 4*(4), 426–437.

Hung, J., & Zhang, K. (2012). Examining mobile learning trends 2003-2008: A categorical meta-trend analysis using text mining techniques. *Journal of Computing in Higher Education, 24*(1), 1–17. doi: 10.1007/s12528-011-9044-9.

Junco, R., Heiberger, G., & Loken, E. (2011). The effect of Twitter on college student

engagement and grades. *Journal of Computer Assisted Learning, 27*(2), 119–132. doi: 10.1111/j.1365-2729.2010.00387.x

Koper, R. (2004). Editorial: Technology and Informal learning. *British Journal of Educational Technology, 35*(6). 675–678.

Kraut, R. E., & Fiore, A. T. (2014). The role of founders in building online groups. In *Proceedings of the 17th ACM conference on Computer supported cooperative work & social computing*. NY: ACM.

Kraut, R. E., Resnick, P., Kiesler, S., Burke, M., Chen, Y., Kittur, N., Konstan, J., Ren, Y., & Riedl, J. (2012). *Building successful online communities: Evidence-based social design*. Cambridge, MA: MIT Press.

Matthews, T., Whittaker, S., Badenes, H., & Smith, B. A. (2014). *Beyond end user content to collaborative knowledge mapping: Interrelations among community social tools*. Paper presented at the CSCW'14, Baltimore, Maryland, USA.

Motlik, S. (2008) Mobile learning in developing nations. *The International Review of Research in Open and Distance Learning, 9*(2), 1–7.

Rankin, M. (2009). *Some general comments on the "Twitter Experiment"*. Retrieved from http://www.utdallas.edu/~mar046000/usweb/twitterconclusions.htm

Ren, Y., & Kraut, R. E. (2014). Agent-based modeling to inform online community design: Impact of topical breadth, message volume, and discussion moderation on member commitment and contribution. *Human Computer Interaction, 29*(4), 351–389.

Santos, F. M., & Eisenhardt, K. M. (2004). Multiple case study. In M. S. Lewis-Beck, A. Bryman & T. F. Liao (Eds.), *Encyclopedia of Social Science Research Methods* (1st ed.). Thousand Oaks, CA: SAGE Publications, Inc.

Shen, Y. (2011). *Updates on ROST Weibo search tools*. Retrieved from http://blog.sciencenet.cn/home.php?mod=space&uid=239936&do=blog&id=414891

Shen, Y., Liu, Z., Luo, S., Fu, U., & Li, Y. (2009). Empirical research on e-government based on content mining. In *Proceedings of International Conference on Management of e-Commerce and e-Government* (pp. 91–94).

Wang, X., Yao, Y., & Ji. S. (2012, November 21). "Rumor Breaker", GuoKr is 2 years old. *Xinhua Daily Telegraph*. Retrieved from http://news.xinhuanet.com/mrdx/2012-11/21/c_131988558.htm

Warren, S., Nihalani, P., Kim, P., Zhang, K., Veletsianos, G., Bonk, C. J., Ana-Paula, C., & Lee, M. M. (2012). Emerging technologies for informal learning: Transforming traditional education from the inside and the outside. In *Proceedings of the International Conference of the Society of Information Technology and Teacher Education* (pp. 4917–4924). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

Wedemeyer, C. A. (1981). *Learning at the back door: Reflections on non-traditional learning in the lifespan*. Madison, WI: University of Wisconsin Press.

Wu, P., Wang, T., Zhang, L., Shi, Y., Zhou, Q., & Wu, A. (2011). European union education frame in China internet search engine. In *Proceedings of International Conference on Sociality and Economics Development*. Singapore: IACSIT (International Association of Computer Science and Information Technology) Press.

Xu, M. (2010). Hot spots analysis of China's developmental psychology based on co-words analysis method. *Journal of Modern Information, 30* (8), 171–175.

Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). Thousand Oaks, CA: Sage Publications, Inc.

Zhang, K. (2005). China's online education: Rhetoric and realities. In A. A. Carr-Chellman (Ed.), *Global Perspectives on E-learning: Rhetoric and Reality* (pp. 21–34). Thousand Oaks, CA: Sage Publications.

Zhang, K. (2008). Ubiquitous technology for language learning: The U-Japan movement

in higher education. *Journal of Computing in Higher Education, 20*(2), 81–91.

Zhang, K., & Bonk, C. J. (2008). Addressing diverse learner preferences and intelligences with emerging technologies: Matching models to online opportunities. *Canadian Journal of Learning and Technology, 34*(2), 309–332.

Zhang, K., & Bonk, C. J. (2009). Generational learners and e-learning technology. In H. Yang & S. C.-Y. Yuen (eds.), *Handbook of Research on Practices and Outcomes in E-Learning: Issues and Trends* (pp. 76–92). Hershey, PA: IGI Publishing.

Zhang, K., & DeLoose, S. (2009). Wiki. In S. Mishra (ed.), *Handbook on eLearning* (pp. 92–95). India: Gandhi National Open University.